CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

Twenty-fifth meeting of the Plants Committee
Geneva (Switzerland), 17 and 20-23 July 2020

BOSWELLIA TREES (*BOSWELLIA* SPP.)

1. This document has been prepared by the Secretariat and is submitted in relation to document PC25 Doc. 25 on *Boswellia trees (*Boswellia *spp.)*.[1]

2. The Annexes to this information document contain the information that was received by the Secretariat in response to Notification 2020/010 and its Annex on *Questionnaire on Boswellia trees (*Boswellia *spp.)*, as follows:

   a) materials submitted by Parties; and

Annex		**Submitting Party (and non-Parties)**
1		Cameroon: Etat des lieux sur la biologie, l'exploitation, et le commerce des espèces du genre *Boswellia* (*Burseraceae*) au Cameroun (Betti 2020)
2		Eritrea: Questionnaire Notification 2020/010
3		Ethiopia: Questionnaire Notification 2020/010
4	i	Germany: Questionnaire Notification 2020/010
	ii	Germany: Gums and resins for the German market (ProFound, Duerbeck 2015)
	iii	Germany: Species assessment against CITES listing criteria: *B. frereana*
	iv	Germany: Species assessment against CITES listing criteria: *B. papyphera*
	v	Germany: Species assessment against CITES listing criteria: *B. sacra*
	vi	Germany: Species assessment against CITES listing criteria: *B. serrata*
5		New Zealand: Questionnaire Notification 2020/010
6		Slovakia: Questionnaire Notification 2020/010
7		South Sudan: Questionnaire Notification 2020/010
8		Switzerland: Questionnaire Notification 2020/010
9	i	United States of America: Questionnaire Notification 2020/010
	ii	United States of America: Supplementary information compiled by AHPA (2020)

   b) materials submitted by stakeholders.

Annex		**Submitting stakeholder**
10	i	Arbor Oils of Africa (Kenya): Questionnaire Notification 2020/010
	ii	Arbor Oils of Africa (Kenya): Sustainable wild harvesting protocols for gums and resins in Isioro and Samburu counties, Kenya (Muga et al. 2014)
	iii	Arbor Oils of Africa (Kenya): Field appraisal of the state of *Boswellia* species and frankincense commercialization in Kenya (Kagombe, 2002)
	iv	Arbor Oils of Africa: Gum and resin value chain desk study (Mercy Corps, 2020)
11		Centre for Frankincense Environmental and Social Studies (CFESS, Somalia): *Boswellia* in Somaliland, an overview (Kenedid Hassan, 2020)

[1] *The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat (or the United Nations Environment Programme) concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.*

12		Chemiloids Life Sciences Pvt Ltd. (India): Questionnaire Notification 2020/010
13		Dr. Hemadri (India): Questionnaire Notification 2020/010
14		INDFRAG Biosciences Pvt Ltd. (India): Questionnaire Notification 2020/010
15		Dr. Nainala (India): Questionnaire Notification 2020/010
16		Neo Botanika (Somalia): Questionnaire Notification 2020/010
17		Dr. Pullaiah (India): Questionnaire Notification 2020/010
18		Dr. Suthari (India): Questionnaire Notification 2020/010
19	i	Schippmann 2018a: Species data factsheet from MAPROW database on *B. neglecta*
	ii	Schippmann 2018b: Species data factsheet from MAPROW database on *B. papyphera*
	iii	Schippmann 2018c: Species data factsheet from MAPROW database on *B. sacra*
	iv	Schippmann 2018d: Species data factsheet from MAPROW database on *B. frereana*
	v	Schippmann 2018e: Species data factsheet from MAPROW database on *B. rivae*
20		TRAFFIC: Questionnaire Notification 2020/010

3. The following responses to Notification 2020/010 are not listed as an individual Annex, since they do not contain substantial information:

   a) Cambodia, Malta and Monaco communicated that they did not consider themselves range States of *Boswellia* spp. Monaco additionally specified that no imports of the taxon had been requested, and that the taxon was not present in its public gardens.

   b) The Global Frankincense Alliance (GFA) communicated that it had been established in 2018 and that time was too short for collating relevant information.

   c) Additional to the responses listed in document PC25 Doc. 25 on *Boswellia* trees, the Secretariat received, on 29 May, a short communication regarding Notification 2020/010 from the International Fragrance Association (IFRA), stating IFRA's awareness of the situation of wild *Boswellia* populations, and IFRA's willingness to provide detailed information in the future.

ETAT DES LIEUX SUR LA BIOLOGIE, L'EXPLOITATION ET LE COMMERCE DES ESPECES DU GENRE *BOSWELLIA* (BURSERACEAE) AU CAMEROUN

Par

Prof. Dr. Ir. Jean Lagarde BETTI,
Département de Biologie des Organismes Végétaux,
Faculté des Sciences,
Université de Douala, Cameroun.
Tel: +237 6 77 30 32 72/6 90 34 36 02
lagardebetti@yahoo.fr

Mars 2020

Table des matières

Executive summary

Cameroon is located in Central Africa and is often considered as Africa in miniature, given the great diversity of vegetation that it abounds. These various formations, modeled on the major climatic types, contain, according to the latest estimates, more than 8,500 plant species. Among the 3,000 species estimated to be useful, there are many non-timber forest products (NTFPs) that have long contributed to food security, the traditional pharmacopoeia and the pharmaceutical industry. Many others have long been used as building or decorative materials.

The genus *Boswellia* (Burseraceae) is found in Cameroon and provides many products to local communities.. Cameroon became a member of the Convention on International Trade in Endangered Species of Flora and Fauna (CITES) also known as the Washington Convention in 1981. At its 18th session (CoP18, Geneva, 2019), the Conference of the Parties to the Convention adopted Decisions 18.205 to 18.208 on species of the genus *Boswellia*. On 10th February 2020, a notification was published by the Secretary General (SG) of the Convention, notification by which the SG accordance with Decision 18.205 requests the range countries to report on the exploitation and trade of species of the genus *Boswellia.*

This report updates the information on distribution, biology, ecology, management, exploitation; control and trade of products obtained from the genus *Boswellia* in order to allow the Ministry of Forests and Fauna, the CITES management authority of Cameroon, to prepare a full report on this issue before the Plants Committee session scheduled for July 2020. Data were collected on gray (reports, ...) and scientific (publications) literature dealing with various subjects related to species of the genus *Bosswellia* in Cameroon.

The genus B*oswellia* (Burseraceae) has about 25 species from the Sudanese, Sahelian and Zambezian savannahs. In Cameroon 2 species are reported: *B. dalzielii* and *B. Papyrifera*. Numerous works have been carried out with a view to appreciate the size and structure of B*oswellia* populations by different authors. The problem is that most of these works do not stand out the distribution of stem by diameter class to better illustrate the specific structure and propose fair management measures. The very first work to be considered is the one carried out by World Organisation of Food and Agriculture (FAO) in 2004 as part of the national forest inventory. A total of 46 sample units (SU) were inventoried in stratum 2, ie in the Adamawa, North and Far North regions recognized as the distribution area of *Boswellia spp*. The total area sampled in this stratum is 92 ha. A total of 102 *Boswellia* stems were inventoried over the 92

ha, representing an overall density of 1.10 stems/ha. The two species identified during this inventory are *B. dalzielii* (1 stem) and *B. odorata* (101 stems). The presence of *B. odorata* in this inventory could be linked to the identification problem. It could be either *B. dalzielii* or *B. papyrifera*. indeed, the two species had previously been confused and identified in the past as *B. odorata*. Decisions 18.205 to 18.208 of CoP 18 being related to all species of the genus *Boswellia*, it seems important to us at this level to consider the overall density noted and which is 1.10 stems/ha in the northern part of Cameroon.This density is according to the management standards proposed by the integrated pilot management project (API) led in Dimako, well above the critical threshold of 0.05 stems/ha, authorized for exploitation in Cameroon. The other works were carried out to smaller degrees, at regional or local scale.

Bosswellia's current operation and processing does not follow any established management standard in Cameroon. This operation remains confined for use as a medicinal plant. The use as a plant responsible for the production of Frankincense does not yet seem very well known and popularized in Cameroon. *Boswellia spp* species do not appear in the applications for special permits, known as permits allocated to operators and exporters for this type of product. Neither of the two species identified in Cameroon does not even appear in the list of the 487 NTFPs compiled in Cameroon and Central Africa. The bark of *B. dalzielii* (Andakéhi) is applied to arrow wounds and snake bites by people in the far north. The bark alone constitutes the biological material used. The medicinal forms are decoctions, infusions and powders which are administered by washing, rectally, steam bath, balm and orally: - a decoction of the stem bark is used in rectal voice against all forms of poisoning; - this same decoction is used in a steam bath to relieve patients suffering from malaria and the flu; - the infusion of the powdered bark is used in baths against certain diseases of the skin (shingles, scabies, ringworm); - the bark, transformed into powder, is used for its healing power and against poison (food, night poison). It is also applied to wounds left by snake and scorpion bites to suck the venom. According to information obtained from the main people contacted, the plant has the property of fixing toxic particles in the human body. The stem bark of *B. dalzielii* is sold at 2 FCFA/gram (0.004 USD) in the treatment of hernia or intestinal helminthiasis. for *B. papyrifera*, the uses are more diversified: the resin is sold at 250 FCFA/gram to treat stomach aches and diarrhea and also low back pain; the stem bark is sold at 2 FCFA/gram in the treatment of hernias and intestinal helminthiasis, poor positioning of the child in the belly, fever and malaria. The root bark is used to treat jaundice, stomach aches and diarrhea, and asthma. In addition to his property to produce the Frankincense, recent studies have revealed the anticancer properties and the ability to strengthen the immune system of Frankincense. These examples illustrate the pharmaceutical potential of *Boswellia* which remains to be developed in the very near future. *Boswellia*-based products are not yet widely used and exported from Cameroon, but may be in the years to come due to recent discoveries in pharmaceutical properties. Once used on a large scale for commercial purposes, these species will fall within the framework of non-wood forest products called "special products".

All interviewees believe that artificial regeneration is not necessary because the resource is available. The absence of young individuals is synonymous with poor regeneration. The low density of individuals in classes of diameter less than 20 cm demonstrates this. In general, the bell distribution of individuals of *B. dalzielii* suggests that the regeneration of this Burseraceae specie is not guaranteed, although the resource is not used as firewood in the region. Physiological studies of *B. dalzielii* show that fertile seeds contain an almond and gemmule. The sterile seeds have an intact but empty seed coat. This anomaly, cause of infertility, concerns more than 57% of the seeds. In stands, less than 35% of seed trees show a seminal fertility rate greater than 50%. Field observations show that the resource is of definite interest for local communities in the locality. Within the population studied, 86% of individuals show evidence of sampling. The bark is removed in irregularly shaped plates with varying surfaces. The commonly used collection material is the machete. The harvesting techniques used in the area do not endanger the resource in its biotope because no dead individual has been counted on the site. In addition, the volumes of bark to be removed per individual (from 360 cm^3 to 40,482 cm^3) are not likely to endanger the resource in the environment. However, it should be noted that the minimum harvest height do not meet the standards (1.30 m from the ground) for sustainable management of the resource in Cameroon.

Government forestry policy was adopted in 1993. Its general objective was to "perpetuate and develop the economic, ecological and social functions of Cameroon's forests, within the framework of an integrated management which ensures, in a sustained and sustainable manner, the conservation and use of forest resources and ecosystems". The exploitation of special products, is regulated in Cameroon mainly within the Ministry of Forests and Wildlife (MINFOF) through the Forest Department (DF) and the Promotion and Processing of Forest Products Department (DPT). The Directorate of Forests takes care of the management of the resource, namely knowledge of the resource, grants approvals and titles (permits) and forest control. The Promotion and Processing Department is responsible for the promotion, processing, processing and export of derivative products. The Ministry of Finance (MINFI) through the Forest Revenue Security Program (PSRF) collects taxes, which until now have been limited mainly to the regeneration tax (TR).

The forest policy on "special products" has evolved gradually in Cameroon because the country started from a situation of almost free exploitation towards an exploitation generating tax receipts for the benefit of the state. The recovery rate of the regeneration tax has increased, reflecting an evolution in the contribution of the "special products" sector in widening the tax base. Significant changes have been made in securing revenues, notably with the creation of the PSRF in the 2000s. This positive development should not, however, make us forget certain key problems which still undermine the development of the policy and the NTFP sector in Cameroon. These problems mainly concern the lack of knowledge of the resource, the numerous conflicts between the various actors within the NTFP sector or with other sectors. To alleviate these constraints, a strategic action plan for *Boswellia* is proposed. It is split into three objectives and several activities.

Résumé exécutif

Le Cameroun se trouve en Afrique Centrale et est souvent considéré comme l'Afrique en miniature, eu égard à la grande diversité des formations végétales qu'il regorge. Ces diverses formations végétales, calquées sur les grands types climatiques, renfermeraient selon les dernières estimations, plus de 8 500 espèces végétales. Parmi les 3 000 espèces estimées comme utiles, on compte de nombreux produits forestiers non ligneux (PFNL) qui depuis longtemps ont toujours contribué à la sécurité alimentaire, à la pharmacopée traditionnelle et à l'industrie pharmaceutique. Beaucoup d'autres ont longtemps été utilisés comme matériaux de construction ou de décoration.

Le genre *Boswellia* (Burseraceae) se trouve au Cameroun et fournit divers types de produits forestiers non ligneux aux communautés locales. Le Cameroun est devenu membre de la Convention sur le Commerce Internationale des espèces de faune et de flore menacées d'extinction (CITES) encore désignée « Convention de Washington » en 1981. À sa 18ème session (CoP18, Genève, 2019), la Conférence des Parties de la Convention a adopté les Décisions 18.205 à 18.208 sur les espèces du genre *Boswellia.* En date du 10 Février 2020, une notification a été publiée par le Secrétariat Général de la Convention, notification par laquelle le SG conformément à la Décision 18.205 demande aux pays de l'aire de distribution de faire la situation de l'exploitation et du commerce des espèces du genre *Boswellia*.

Le présent rapport actualise les informations sur la distribution, biologie, écologie, aménagement, exploitation ; contrôle et commerce des produits à base du Genre *Boswellia* en vue de permettre au Ministère des Forêts et Faune, organe de gestion CITES du Cameroun, de fournir des informations complètes sur cette question en prélude à la session du Comité pour les plantes projetée en Juillet 2020. Les données ont été collectées sur la littérature grise (rapports, ...) et scientifique (publications) traitant des divers sujets en rapport avec les espèces du genre *Bosswellia* (Burseraceae) au Cameroun.

Le genre *Boswellia* de la famille des Burseraceae compte environ 25 espèces des savanes soudaniennes, sahéliennes et zambéziennes africaines. Au Cameroun 2 espèces sont signalées: *B. dalzielii* et *B. Papyrifera*

De nombreux travaux ont été réalisés en vue d'apprécier la taille et la structure des populations par différents auteurs. Le problème c'est que la plupart de ces travaux ne ressortent pas de manière claire la distribution des tiges par classe de diamètre pour mieux illustrer la

structure spécifique et projeter des décisions d'aménagement durable. Le tout premier travail à considérer est celui effectué par la FAO en 2004 dans le cadre de l'inventaire national. Un total de 46 unités d'échantillonnage (UE) a été inventorié dans la strate 2, soit dans les régions de l'Adamaoua, Nord et Extrême Nord reconnues comme zones de répartition de *Boswellia spp* au Cameroun La surface totale échantillonnée dans cette strate est de 92 ha. Un total de 102 tiges de *Boswellia* a été inventorié sur les 92 ha, représentant une densité globale de 1,10 tiges/ha. Les deux espèces identifiées lors de cet inventaire sont *B. dalzielii* (1 tige) et *B. odorata* (101 tiges). La présence de *B. odorata* dans cette liste pouraît être liée au problème d'identification. Il pourrait s'agir soit de *B. dalzielii*, soit encore de *B. papyrifera*. En effet, les deux espèces avaient déjà fait l'objet de confusion et identifiées par le passé comme *B. odorata*. Les Décisions 18.205 à 18.208 de la CoP 18 portant sur toutes les espèces du genre *Boswellia*, il nous paraît important à ce niveau de considérer la densité globale relevée et qui est de 1,10 tiges/ha. Cette densité est selon les normes d'aménagement proposées par le projet d'Aménagement pilote intégré (API) conduit à Dimako, largement supérieur au seuil critique de 0,05 tiges/ha, autorisé pour l'exploitation au Cameroun. Les autres travaux ont été réalisés à des degrés plus petits, échelle régionale ou locale.

L'exploitation et transformation actuelle de *Bosswellia* ne suit aucune norme établie de gestion au Cameroun. Cette exploitation reste confinée pour l'usage comme plante médicinale. L'usage comme plante responsable de la production du Frankincense ne semble pas encore très connue et vulgarisée au Cameroun. Les espèces *Boswellia spp* n'apparaissent pas dans les demandes des permis spéciaux, c'est-à-dire les permis attribués aux exploitants et exportateurs pour ce type de produits. Aucune des deux espèces identifiées au Cameroun n'apparaît même pas dans la liste des 487 PFNL compilée au Cameroun et en Afrique Centrale. L'écorce de *B. dalzielii* (Andakéhi) est appliquée sur les blessures par flèches et sur les morsures de serpents par les populations du grand Nord. L'écorce à elle seule constitue le matériel biologique utilisé. Les formes médicamenteuses sont les décoctions, les infusions et les poudres qui sont administrées en lavage, voie rectale, bain de vapeur, baume et par voie orale: – la décoction de l'écorce de tige est utilisée en voie rectale contre toutes les formes d'empoisonnement ; – cette même décoction est utilisée en bain de vapeur pour soulager les patients souffrant du paludisme et de la grippe ; – l'infusion de l'écorce réduite en poudre est utilisee en bain contre certaines maladies de la peau (zona, gale, teigne) ; – l'écorce, transformée en poudre, est utilisée pour son pouvoir cicatrisant et contre le poison (alimentaire, poison de nuit). Elle est également appliquée sur les blessures laissées par les morsures de serpent et scorpion pour aspirer le venin.

Selon les informations obtenues auprès des principales personnes contactées, la plante aurait la propriété de fixer les particules toxiques dans l'organisme humain. L'écorce de tige de *B. dalzielii* est vendue à 2 FCFA/gramme 0,004 USD) (ans le traitement de la hernie ou des helminthiases intestinales. Pour *B. papyrifera*, les usages sont plus diversifiés: la résine est vendue à 250 FCFA/gramme pour soigner les maux de ventre et diarrhées et aussi les lumbalgies; lécorce de tige est vendue en moyenne à 2 FCFA/gramme dans le traitement des hernies, des helminthiases intestinales, le mal positionnement de l'enfant dans le ventre, la fièvre et le paludisme. L'écorce des racines est utilisée pour soigner la jaunisse, les mal de ventre et diarrhées, et l'asthme. Les produits à base de *Boswellia* ne sont pas encore largement exploités et exportés à partir du Cameroun, mais ils pourraîent l'être dans les années à venir du fait des découvertes récentes faites sur les propriétées pharmaceutiques. Une fois utilisées à grande échelle pour le but commercial, ces espèces rentreront dans le cadre des produits forestiers non ligneux (PFNL) dits "produits spéciaux".

Toutes les personnes interrogées pensent qu'une régénération artificielle n'est pas nécessaire parce que la ressource est disponible. L'absence de jeunes individus est cependant synonyme d'une mauvaise régénération. La faible densité des individus des classes de diamètre inférieure à 20 cm le démontre. D'une manière générale, la distribution en cloche des individus de *B. dalzielii* suggère que la régénération de cette espèce n'est pas assurée, bien que la ressource ne soit pas utilisée comme bois de chauffe dans la région de l'Adamaoua. Les études sur la physiologie de *B. dalzielii* montrent que les graines fertiles contiennent une amande et la gemmule. Les graines stériles présentent une enveloppe tégumentaire intacte mais vide. Cette anomalie, cause d'infertilité, concerne plus de 57 % des graines. Dans les peuplements, moins de 35 % des arbres semenciers montrent un taux de fertilité séminale supérieur à 50 %. Les observations de terrain montrent que la ressource présente un intérêt certain pour les communautés locales. Au sein de la population étudiée, 86 % d'individus présentent des traces de prélèvement. L'écorce est prélevée en plaques de formes irrégulières et de surfaces variables. Le matériel de collecte couramment utilisé est la machette. Les techniques de récolte utilisées dans la zone ne mettent pas en danger la ressource dans son biotope car aucun individu mort sur pied n'a été dénombré sur le site. De plus, les volumes d'écorces à prélever par individu (de 360 cm^3 à 40 482 cm^3) ne sont pas susceptibles de mettre en danger la ressource dans le milieu. Toutefois, il faut remarquer que les hauteurs minimales de récolte ne respectent pas les normes (1,30 m du sol) pour une gestion durable de la ressource.

La politique gouvernementale en matière forestière a été adoptée en 1993. Son objectif général était de « pérenniser et développer les fonctions économiques, écologiques et sociales des forêts du Cameroun, dans le cadre d'une gestion intégrée qui assure, de façon soutenue et durable, la conservation et l'utilisation des ressources et des écosystèmes forestiers ». L'exploitation des produits spéciaux, est réglementée au Cameroun principalement au sein du Ministère des forêts et de la faune (MINFOF) à travers la Direction des forêts (DF) et la Direction de la promotion et transformation des produits forestiers (DPT). La Direction des forêts s'occupe de la gestion de la ressource, à savoir la connaissance de la ressource, l'octroie des agréments et des titres (permis) et le contrôle forestier. La Direction de la promotion et transformation, elle, s'occupe de la promotion, du traitement, de la transformation et de l'exportation des produits dérivés. Le Ministère des Finances (MINFI) à travers le Programme de Sécurisation des Recettes Forestières (PSRF) assure le recouvrement des taxes, qui jusqu'ici se limitent essentiellement à la taxe de régénération (TR). Les éléments requis pour obtenir un titre d'exploitation des produits spéciaux sont précisés dans la loi forestière.

La politique forestière sur les « produits spéciaux », a évolué progressivement au Cameroun car le pays est parti d'une situation d'exploitation quasi-gratuite vers une exploitation génératrice des recettes fiscales pour le bénéfice de l'Etat. Le taux de recouvrement de la taxe de régénération a augmenté traduisant une évolution de la contribution du secteur « produits spéciaux » dans l'élargissement de l'assiette fiscale. Les changements importants ont été apportés au niveau de la sécurisation des recettes avec notamment la création du PSRF dans les années 2000. Cette évolution positive ne doit tout de même pas nous faire oublier certains problèmes clés qui minent encore le développement de la politique et du secteur PFNL au Cameroun. Ces problèmes concernent essentiellement la méconnaissance de la ressource, les nombreux conflits entre les différents acteurs au sein de la filière PFNL ou encore avec d'autres filières. Pour atténuer ces contraintes, un plan d'action stratégique pour *Boswellia* a été proposer. Il est décliné en trois objectifs et plusieurs activités.

1. Introduction

Situé entre l'équateur et le tropique, le Cameroun se présente comme un grand triangle s'inscrivant entre l'océan Atlantique, le lac Tchad et le bassin du Congo. Au creux du golfe de Guinée, le Cameroun fait la jonction entre l'Afrique Centrale et l'Afrique Occidentale. D'une superficie de 475 000 km^2, il a des frontières avec le Nigeria, le Tchad, la République Centrafricaine, le Congo, le Gabon et la Guinée Equatoriale. Sa situation géographique explique la variété de ses paysages, climats et populations qui lui valent l'appellation d'"Afrique en miniature". Les grandes formations végétales vont de la forêt dense au Sud à la savane sèche voire la steppe au Nord et l'extrême Nord en passant par les savanes humides dans les hautes terres de l'Ouest, du Nord-Ouest et de l'Adamaoua, ainsi que les forêts d'altitude çà et là sur les montagnes.

Ces diverses formations végétales, calquées sur les grands types climatiques, renferment une extraordinaire richesse biologique en général et végétale en particulier. Les résultats des recherches sur la phytodiversité des plantes supérieures varient selon les auteurs. En 1982, Satabié, alors Directeur de l'Herbier National estimait entre 8 000 et 10 000, le nombre de plantes supérieures trouvées dans le territoire camerounais. Le pourcentage de ces espèces, représenté dans la collection de l'Herbier national qui rassemblait déjà près de 50 000 échantillons du patrimoine floristique national, avoisinait 90 pour cent avec 1 284 espèces de plantes camerounaises qui ont été étudiées, décrites et répertoriées en détail dans 23 volumes de la « Flore du Cameroun » (Satabié 1982). En 1995, le Programme d'action forestier du Cameroun faisait mention de 7 000 espèces de ce groupe de plantes qui sont présentes dans le triangle national (MINEF 1995). Parmi ces espèces, plus de 300 produisent du bois d'œuvre (MINEF 1995, Vivien et Faure 1985). En 2002, on estimait à plus de 8 250 le nombre d'espèces végétales supérieures que pouvait compter le Cameroun (Tchatat *et al.* 2002). En 2007, on estimait à 235 familles, 1 779 genres et au moins 8 500 espèces la richese de la flore du Cameroun et parmi lesquelles 3 000 espèces ont au moins un usage connu (Onana 2007). Déjà, 2 269 (26 pour cent) espèces, 622 (35 pour cent) genres et 110 (47 pour cent) familles étaient décrits dans les 37 volumes de la série Flore du Cameroun (Onana opcit.).

La forêt représente l'une des principales ressources du Cameroun, caractérisée par une faune et une flore particulièrement variées et couvre plus de 60 % du territoire national (MINEF, 1998). Elle offre à la multitude des peuples qui y vivent de nombreux produits et services. Les services qu'offre la forêt sont divers : loisirs, tourisme, régulation du climat,…Les produits forestiers sont distingués en deux grands groupes à savoir les produits forestiers ligneux constitués essentiellement du bois lorsqu'il est utilisé comme bois d'œuvre (bois d'œuvre industriel, bois de pâte et sciage artisanal), et les produits forestiers non ligneux (PFNL) qui sont selon la FAO (1995) des produits biologiques autres que le bois d'œuvre fournit par les forêts et par des arbres hors forêt. Ces PFNL peuvent être aussi bien d'origine animale que d'origine végétale et destinés à l'alimentation, à l'usage médicinal et au service.

Le genre *Boswellia* de la famille des Burseraceae, se trouve au Cameroun et fournit divers PFNL ux communutés locles des régions de l'Adamouua, Nord et Extrême Nord. Son usage comme"Frankincense" semble ne pas encore être bien connu par ces populations. Le Cameroun est devenu membre de la Convention sur le Commerce Internationale des espèces de faune et de flore sauvages menacées d'extinction (CITES), encore appelée Convention de Washington en 1981. À sa 18ème session (CoP18, Genève, 2019), la Conférence des Parties de la Convention a adopté les Décisions 18.205 à 18.208 sur les espèces du genre *Boswellia*. En date du 10 Février 2020, une notification a été publiée par le Secrétariat Général de la Convention, notification par laquelle le SG conformément à la Décision 18.205 demande aux pays de l'aire de distribution de faire la situation de l'exploitation et du commerce des espèces du genre *Boswellia*. Le Cameroun faisant partie des pays qui regorgent les populations de *Boswellia*, s'est donné pour mission de répondre à cette demande par des informations scientifiques et techniques sur différents aspects.

Le présent rapport se propose d'actualiser les informations sur la distribution, biologie, écologie, aménagement, exploitation ; contrôle et commerce des produits à base du Genre *Boswellia* en vue de permettre au Ministère des Forêts et Faune, organe de gestion CITES du Cameroun, de disposer des données complètes sur cette question en prélude à la session du Comité pour les plantes projetée en Juillet 2020. Les données ont été collectées sur la littérature grise (rapports, ...) et scientifique (publications) traitant des divers sujets en rapport avec les espèces du genre *Bosswellia* au Cameroun.

Le rapport est structuré en six parties: (1) état des lieux sur l'identification, la biologie et l'écologie des espèces du genre *Boswellia* au Cameroun, (2) état des lieux sur l'exploitation, de *Bosswelia spp,* (3) état des lieux sur la régénération et les menaces sur ces espèces ainsi que sur les causes de ces menaces, (4) état des lieux sur les initiatives de domestication, (5) état des lieux sur l'arsenal juridico-administrative en rapport avec la gestion des espèces du genre *Bosswellia spp,* et (6) un plan d'action susceptible de garantir que le commerce des produits à base de *Boswellia* n'est pas préjudiciable à la conservtion des ces espèces dans le grand Nord du Cameroun..

2. Etat des lieux sur l'identification, la biologie, l'écologie, la taille et structure des populations des espèces du genre *Boswellia* au Cameroun

2.1. Identification, biologie et écologie

2.1.0. Le genre *Boswellia* Roxb. ex Colebr.

Le genre *Boswellia* de la famille des Burseraceae, compte environ 25 espèces des savanes soudaniennes, sahéliennes et zambéziennes africaines. Au Cameroun 2 espèces sont signalées: *B. dalzielii* et *B. Papyrifera* (Onana 2017).

Arbres petits à moyens; bases cylindriques plus ou moins coniques; fûts cylindriques, courts; *rhytidomes* s'exfoliant en lambeaux de feuilles jaunes; *écorces* jeunes à tranche d'aspect fibreux, exsudant une *résine* blanche et poisseuse qui devient jaune en durcissant. *Feuilles* alternes groupées au sommet des rameaux, formant des pseudofascicules d'une dizaine à une vingtaine de feuilles. *Folioles* 2-22 paires opposées, subopposées ou rarement alternes, sessiles, subsessiles ou courtement pétiolulées chez les folioles terminales; *limbes* à consistance papyracée, glabres, glabrescents ou densément pubescents à poils simples hyalins, bords dentés ou crénelés, sommets obtus, effilés ou arrondis; nervation secondaire de type brochidodrome festonnée ou craspédodrome et festonnée.

Espèces *hermaphrodites*. *Inflorescences* en grappes simples ou doubles, axillaires de feuilles caduques sur les rameaux ou au bout de ceux-ci, groupés en fascicules par dizaines. *Fleurs* 5 (-6) mères, pédicellées, calices cupuliformes, corolles tubuleuses ou étalées, *disques* intrastaminaux, *pistil* à *ovaire* glabre ou rarement pubescent, triloculaire, loges biovulées, *ovules* collatéraux. Fruits capsulaires à déhiscence septifrage. Graines ailées.

2.1.1. Clé des espèces camerounaises

Limbes des folioles glabres, bords dentés; inflorescences en grappes simples capsules marquées de trois arêtes, valves minces ....……1. *B. dalzielii* Limbes des folioles tomenteux de poils simples, bords crénelés; inflorescences en grappes doubles; capsules sans arêtes, valves épaisses ....………….................. 2. *B. papyrifera*

2.1.2. *Boswellia dalzielii* Hutch.

Arbuste à petit arbre atteignant 10 m de hauteur; base conique ou cylindrique; fût droit atteignant 50 (- 70) cm de diamètre; *rhytidome* se détachant en lambeaux de feuillets jaunes et en écailles minces de forme irrégulière à la base du tronc sur les arbres ayant subit l'effet des feux; *écorce* jeune verte, lenticellée, tranche tendre, épaisse (jusqu'à 2,5 cm d'épaisseur), rouge, d'aspect fibreux, odorante, exsudant un élémi par gouttelettes blanches poisseuses devenant jaunes en durcissant. *Feuilles* imparipennées, quelques-unes paripennées alternes, insérées au bout des rameaux en fascicules d'une dizaine à une vingtaine; pétioles longs de 3-5 cm, légèrement aplatis dessus, glabrescents à glabres; rachis atteignant environ 15-35 cm de longueur, glabrescent à poils hyalins. *Folioles* 7-11 paires latérales opposées à subopposées, parfois alternes, sessiles ou subsessiles, une foliole terminale généralement avec des *pétiolules* atteignant 1,8 cm de longueur; *limbes* mesurant 1-12 x 0,5-2,6 cm, de consistance papyracée, glabres, lancéolées à étroitement ovales, asymétriques par rapport à la *nervure* principale, bases aiguës, bords dentés, sommets aigus; nervure principale saillante dessous, proéminente dessus; nervures secondaires 5-23 paires alternes, proéminentes sur les deux faces, nervation *tertiaire* de type plagiodrome droite, plagiodrome brisée et parfois réticulée irrégulière.

Inflorescences axillaires de feuilles caduques, formant des faisceaux d'une vingtaine de grappes par rameau; en grappes simples à axe glabre ou glabrescent à poils simples hyalins. *Bractées* cordiformes mesurant environ 2 x 2 mm, pubescentes extérieurement, glabres intérieurement, rapidement caduques. *Fleurs* à pédicelles mesurant 0,8-1,5 cm de longueur, glabres, garni de deux *préfeuilles* rubanées de 3 mm de longueur, velues extérieurement, glabres intérieurement, rapidement caduques; *calices* campanulés, gamosépales surmontés de 5 dents obtuses, glabres; corolles dyalipétales, *pétales* 5 étalés, blancs mesurant environ 6-3 mm, marqués d'un trait rouge médian extérieurement, ovés, glabres; androcée de 10 (12) *étamines* d'environ 5 mm de hauteur insérés sur le bord extérieur bas du disque, *filets* d'environ 2,5 mm de hauteur, glabres, charnus, anthères basifixes, oblongues, pubescentes en une ligne de poils simples hyalins sur les deux faces des loges polliniques, poils caducs, loges à déhiscence latérale longitudinale; *disque* intrastaminal, hypogyne, charnu, annulaire, glabre; *pistil* d'environ 4 mm de hauteur, ovaire supère avec un *gynophore* d'environ 1 mm de hauteur, triloculaire, loges biovulées, *ovules* collatéraux, *styles* d'environ 1 mm de hauteur, trisillonné longitudinalement, stigmate globuleux trilobé.

Capsule verte à maturité, mesurant environ 2,5 x 0,8 cm, pyriforme avec trois arêtes longitudinales au niveau de la suture des valves, sommet apiculé, déhiscence septifrage libérant trois *valves* en forme de cuiller dont chacune abrite une graine fixée à une *columelle* trigone centrale. *Graine* ovoïde de 5-6 x 3,5-4 mm, plan convexe, prolongée par une aile lamellaire spatulée mesurant environ 2,5 x 1 cm; *cotylédons* blancs foliacés, contortupliqués. Fig. 1.

Distribution: Sénégal, Mali, Niger, Côte d’Ivoire, Ghana, Togo, Benin, Nigeria Cameroun, Centrafrique.

Habitat: espèce des savanes soudaniennes et sahélo soudaniennes africaines de basse altitude.

Nom commun: frankincense tree (anglais).

Nom local: andakehi (peulh), biouna (massa).

Note de conservation: LC (IUCN 2012; Onana 2011: 52)

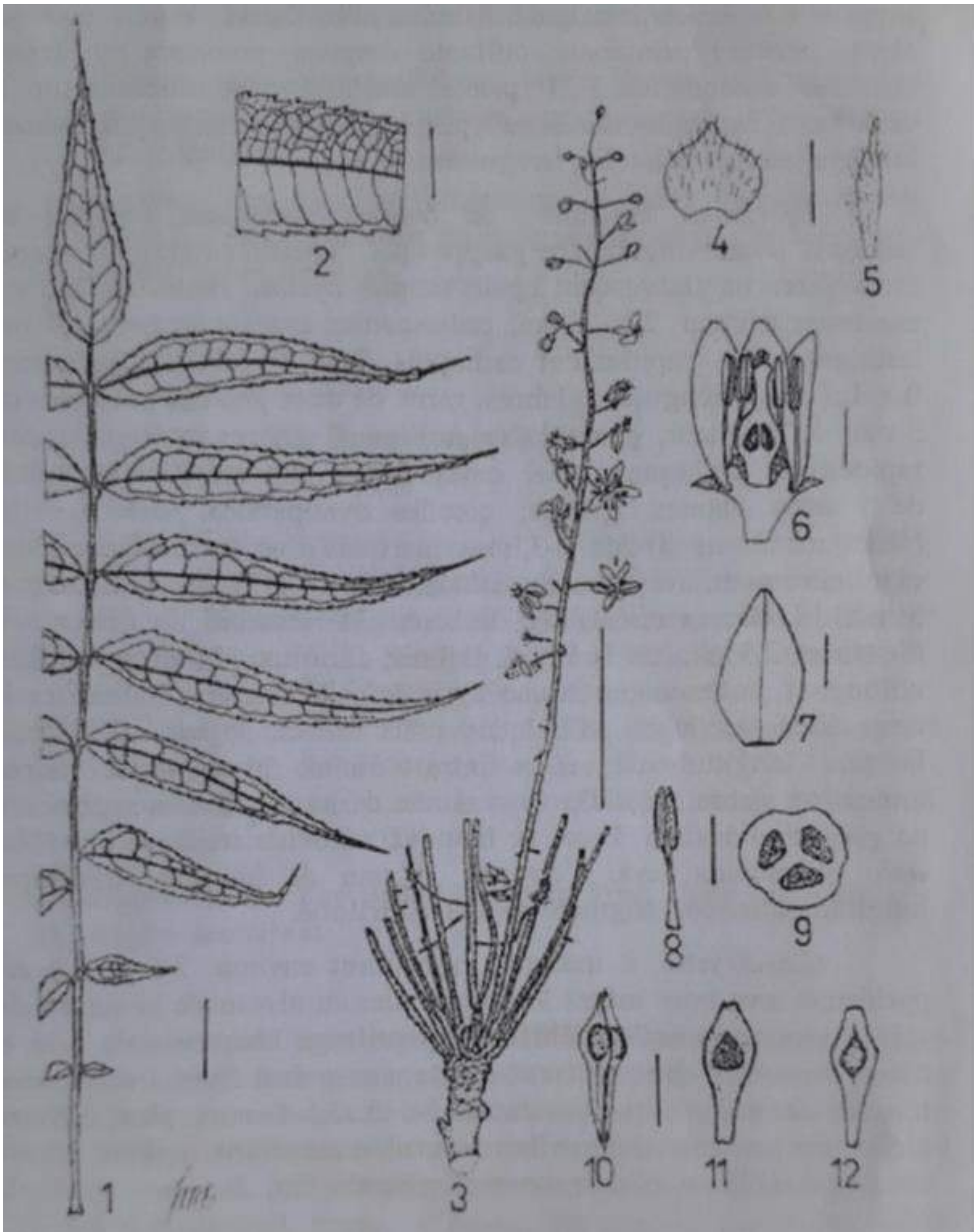


Fig. 2. *Boswellia dalzielii* Hutch. 1, feuille (Ech.: 2 cm); 2, détail de la nervation (Ech.: 2 cm); 3, inflorescence (Ech.: 4 cm); 4, bractée face externe (Ech.: 2 mm); 5, préfeuille face externe (Ech.: 2 mm); 6, C.L. fleur (Ech.: 2 mm); 7, pétale (Ech.: 3 mm); 8, étamine (Ech.: 2 mm); 9, C.T. ovaire (Ech.: 1 mm); 10, fruit (Ech.: 1 cm); 11, valve vue intérieure (Ech.: 1 cm); 12, graine (Ech.: 1 cm). (1, 2: *Onana 421B*; 3, 4, 5, 6, 7, 8, 9: *Malzy 374*; 10, 11, 12: *Onana 316*).

Figure 1. ***Boswellia dalzielii*** **(Onana 2017)**

2.1.3 *Boswellia papyrifera* (Deilile) A.Rich.

Arbuste atteignant 6 m de hauteur; base cylindrique ou légèrement conique; fût droit atteignant 40 cm de diamètre; *rhytidome* se détachant en lambeaux de feuillets gris-cendre ou jaunâtre, parfois en écailles minces de forme irrégulière à la base du tronc sur les arbres ayant subit l'effet des feux; écorce jeune verte, lenticellée, tranche tendre, épaisse (jusqu'à 2,5 cm d'épaisseur), rouge, d'aspect fibreux, peu odorante, exsudant un élémi par gouttelettes blanches poisseuses devenant jaune d'or en durcissant. *Feuilles* imparipennées normalement, quelques-unes paripennées alternes, insérées au bout des rameaux en faisceaux d'une dizaine à une quinzaine; pétioles et rachis tomenteux à poils simples, mesurant 20-30 (-40) cm de longueur. *Folioles* 8-11 paires latérales alternes, subopposées ou parfois opposées, sessiles ou subsessiles, plus une foliole terminale généralement avec des pétiolules mesurant 0,5-2 cm de longueur; limbes mesurant 1-15 x 0,8-5 cm, de consistance papyracée, densément pubescents à poils simples sur les deux faces avec une densité plus forte sur la face inférieure par rapport à la face supérieure, les poils étant fixés sur le réseau de nervures; de forme lancéolé pour les folioles terminales, ovales, falciformes et asymétriques par rapport à la nervure principale chez les folioles terminales, bases arrondies chez les folioles latérales, cunéiformes chez les folioles terminales, bords crénelés, sommets arrondis à obtus; nervures secondaires 3-25 paires alternes à nervation de type craspédodrome et festonné.

Inflorescences axillaires de feuilles caduques, fasciculées par dizaines; en panicules ou rarement en cymes bipares avec des axes primaires mesurant 13-20 cm de longueur, et des axes secondaires alternes ou subopposés tomenteux à poils simples hyalins axillés chacun par une bractée oblongue à sommet aigu, tomenteuse à poils simples hyalins sur les deux faces, mesurant environ 8 x 2,5 mm et rapidement caduques. Bractées des fleurs cordiformes, mesurant environ 2 x 2 mm, velus extérieurement à poils simples, glabres intérieurement, rapidement caduques. Pédicelles de 0,5- 1 cm de longueur, pubescent à poils simples, pourvus de deux préfeuilles rubanées à sommet effilé, velus extérieurement glabres intérieurement, atteignant 3 mm de longueur, rapidement caduques. Fleur hermaphrodite; calice vert campanulé surmonté de 5 (6) dents, pubescent à poils simples hyalins extérieurement; corolle étalée dialypétale, pétales 5 (6) blancs marqués d'un trait rouge médian extérieurement, ovés, glabres, mesurant environ 6,5 x 3,3 mm; androcée de 10 (12) étamines libres atteignant 4 mm de hauteur; filets glabres atteignant 2 mm de hauteur; anthères d'environ de 1,75-2 mm de hauteur, basifixes, oblongues, pubescentes en deux lignes de poils simples sur les deux faces des loges polliniques, loges déhiscentes par une fente latérale longitudinale. Disque intrastaminal, hypogyne, charnu, annulaire, glabre. Pistil central atteignant 4 mm de hauteur; pas de gynophore, ovaire triloculaire, loges à placentation axile, biovulées, ovules collatéraux; style de 2 mm environ, trisillonné longitudinalement, stigmate globuleux trilobé.

Capsule rouge à maturité, mesurant 2-2,5 x 0,9-1 cm; pyriforme, sans arête, sommet apiculé (reste du style), déhiscence septifrage, libérant trois valves épaisses en forme de cuillère et abritant chacune une graine ailée fixée intérieurement à une columelle claviforme. Graine ovoïde, plan convexe, mesurant 5-6 x 3,5-4 mm, prolongée par une aile lamellaire spatulée atteignant 2,5 x 1 cm; cotylédons foliacés blancs condupliqués.

Habitat: espèce des savanes soudaniennes, sahélo soudaniennes et zambéziennes africaines de basse altitude.

Distribution: Nigeria, Cameroun, Tchad, Centrafrique, Soudan, Ethiopie, Ouganda.

Nom commun: frankincence tree (anglais).

Nom local: andakehi, andakédié (peulh).

Croissance: B. papyrifera a une croissance lente. Il atteint 20 cm de diamètre à hauteur de poitrine à l'âge de 73 ans (Tolera *et al.* 2013)..

Note de conservation: LC (IUCN 2012; Onana 2011: 52)

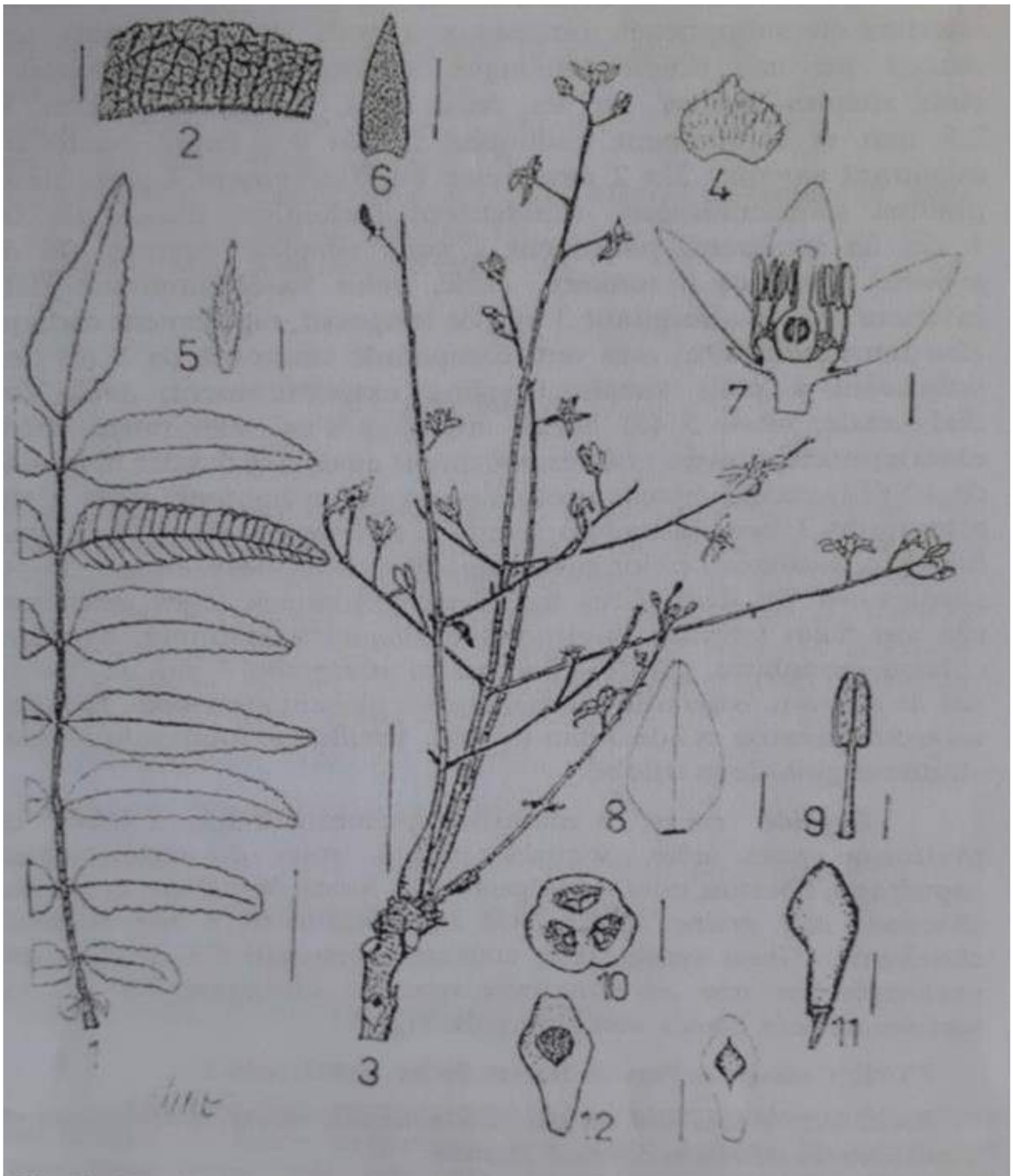


Fig. 3. *Boswellia papyrifera* (Delile) A.Rich. 1, feuille (Ech.: 4 cm); 2, détail de la nervation (Ech.: 1 cm); 3, inflorescence (Ech.: 4 cm); 4, bractée (Ech.: 1 mm); 5, préfeuille, face externe (Ech.: 1 mm); 6, bractée de l'axe secondaire (Ech.: 5 mm); 7, C.L. fleur (Ech.: 2 mm); 8, pétale (Ech.: 2 mm); 9, étamine (Ech.: 1 mm); 10, C.T. ovaire (Ech.: 1 mm); 11, fruit (Ech.: 1 cm); 12, valve vue intérieure (Ech.: 1 cm); 13, graine (Ech.: 1 cm). (1, 2, 3, 4, 5, 6, 7, 8, 9, 10: *Geerling & Tentchou 5560*; 11, 12, 13: *Onana 315*).

Figure 2. *Boswellia papyrifera* (Onana 2017)

2.2. Taille et structure des populations

Des travaux ont été réalisés en vue de l'appréciation de la taille et structure des populations de *Boswellia* par différents auteurs (FAO 2005, Kémeuzé *et al.* 2012, Palou Madi et Balna 2015, Sandjong Sani *et al.* 2013, Todou *et al.* 2016, Haiwa *et al.* 2017). Le problème c'est que la plupart de ces travaux ne ressort pas de manière claire la distribution des tiges par classe de diamètre pour mieux illustrer la structure spécifique. Par ailleurs, il s'agit beaucoup plus des inventaires de biodiversité avec peu d'orientations en vue de l'aménagement de *Boswellia*.

Le tout premier travail à considérer est celui effectué par la FAO en 2004 (FAO 2005) dans le cadre de l'inventaire forestier national. Comme inventaire de reconnaissance, le taux de sondage a été été assez faible, de l'ordre de 1 pour 1000. Le territoire camerounais a été divisé en deux grandes strates : la strate Sud constituée des forêts et la strate Nord constituée en grande partie des savanes. Le maillage (distance entre les unités d'échantillonnage) était différent suivant la strate considérée. Dans la strate Sud, il était de 30' (latitude) X 15' (longitude) alors que dans la strate Nord il était de 30' (latitude) X 30' (longitude). Ce plan de sondage a permis de définir 235 unités d'échantillonnage (UE) qui sont présentées sur la Figure 3. Les informations étaient collectées exclusivement à l'emplacement des unités d'échantillonnage. Les données étaientt relevées à différents niveaux: l'unité d'échantillonnage qui constitue le niveau le plus élevé et des sous-unités de taille plus petite délimitées à l'intérieur de l'unité d'échantillonnage. Les unités d'échantillonnage sont des carrés de 1 Km de côté. Les coordonnées de coin sud-ouest de ces unités correspondent à celles des points du plan systématique initial. Chaque unité d'échantillonnage contient un groupe de 4 placettes d'observation de terrain. Les lignes de base de ce groupe de placettes forment un carré de 500 m de côté dont le centre coïncide avec le centre de l'unité d'échantillonnage. Les placettes sont des rectangles de 20 m de large et 250 m de long. Elles partent de chacun des angles du carré. Les placettes sont numérotées de 1 à 4, dans le sens des aiguilles d'une montre. La surface effectivement échantillonnée par UE est de 4 placettes x 250 m de long x 4 m de large = 20 000 m^2, soit 2 ha. Pour une superficie totale de 475 000 km^2 (47 500 000 ha) et 235 x 2 ha sondées, le taux de sondage serait de l'ordre de 0,0099 pour mille. Ce taux est conforme pour ce type d'inventaire, inventaire de reconnaissance.

Un total de 46 UE a été inventorié dans la strate 2, soit dans les régions de l'Adamaoua, Nord et Extrême Nord reconnues comme zone de répartition de *Boswellia spp*. La surface totale échantillonnée dans cette strate est de 92 ha. Un total de 102 tiges de *Boswellia* a été inventorié sur les 92 ha, représentant une densité globale de 1,10 tige/ha. Les deux espèces identifiées lors de cet inventaire sont *B. dalzielii* (1 tige) et *B. odorata* (101 tiges). La présence de *B. odorata* dans cette liste pouraît être liée au problème d'identification. Il pourrait s'agir soit de *B. dalzielii*, soit encore de *B. papyrifera*. En effet, les deux espèces selon Onana (2017) avaient déjà fait l'objet de confusion et identifiées par le passé comme *B. odorata* (Kew Bull. N° 138 de 1910 et Adansonia n°2:223 de 1984). L'échantillon de Kew Bull. était constitué uniquement des feuilles, tandis que celui de Adansonia avait des inflorescences et fruits. Les Décisions 18.205 à 18.208 de la CoP 18 de la CITES portant sur toutes les espèces du genre *Boswellia*, il nous paraît important à ce niveau de considérer la densité globale relevée et qui est de 1,10 tige/ha. Cette densité est selon les normes d'aménagement proposées par le projet d'Aménagement pilote intégré (API) conduit à Dimako, largement supérieur au seuil critique de 0,05 tige/ha, autorisé pour l'exploitation au Cameroun (Forni 1997). Il n'a pas été possible de ressortir à partir des données obtenues, la structure diamétrique des tiges de *Boswellia* en vue de déceler les éventuels problèmes de régénération forestière et de renouvellement de la ressource.

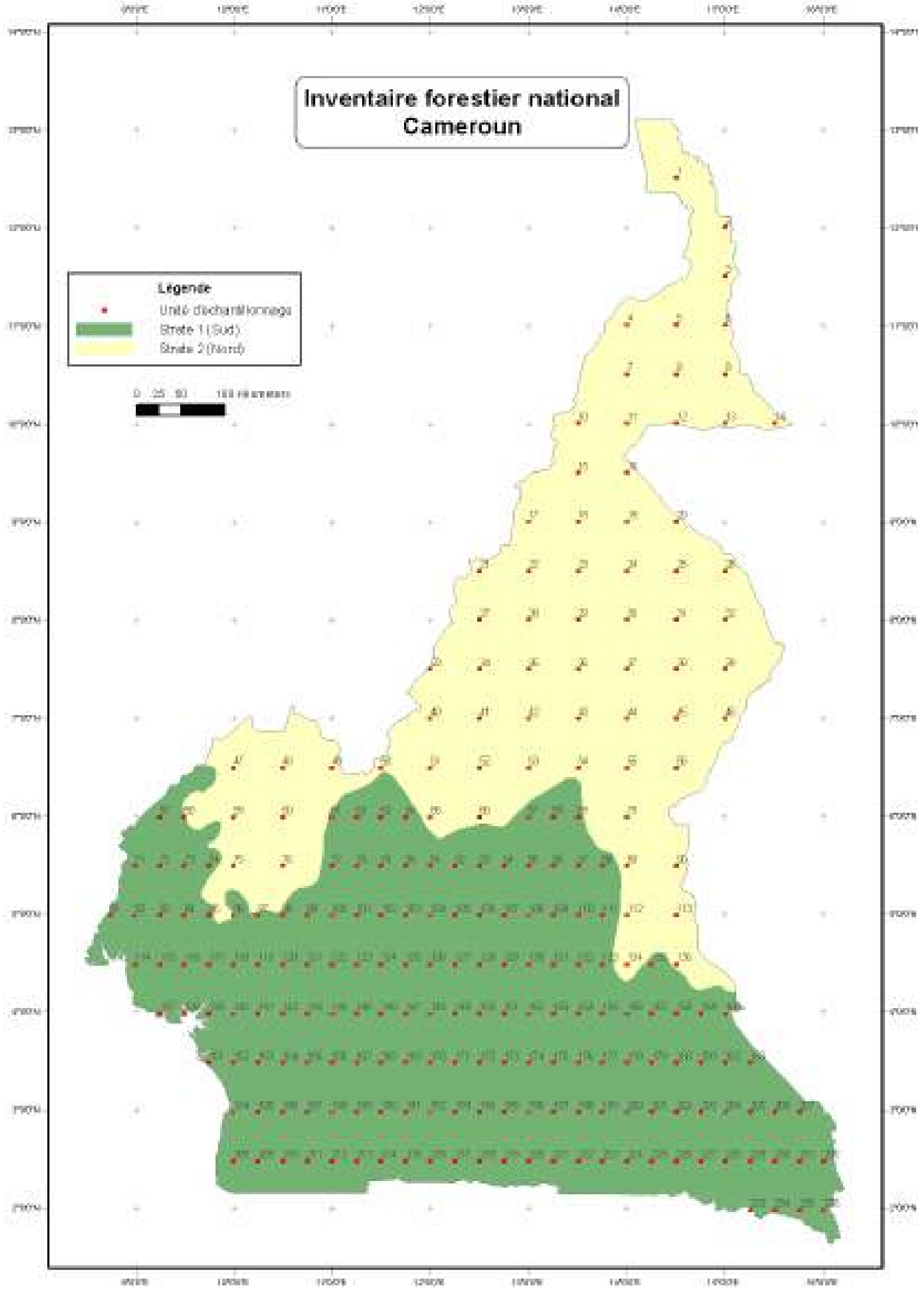


Figure 3. Illustration des unités d'échantillonnage balayées lors de l'inventaire national réalisé en 2004 au Cameroun (FAO 2005).

Les autres travaux ont été réalisés à des degrés plus petits, échelle régionale ou locale. Ainsi par exemple, Kémeuzé *et al* (2012) ont conduit un inventaire en vue de faire un état des lieux des peuplements de *B. dalzielii* dans l'arrondissement de Mbé située à 75 km de Ngaoundéré, sur l'axe lourd Ngaoundéré-Garoua, région de l'Adamaoua au Cameroun. L'analyse des populations ligneuses, selon Kemeuzé *et al.* (2012) peut se réaliser autour des trois éléments que sont : – la répartition des individus en classes de taille ou de diametre, comme indicateur indirect du niveau d'équilibre des classes d'âge et comme témoin des phases vécues par la population en termes de perturbation ou de regénération; – le mauvais état général des peuplements; – l'intensité de la régénération, symbole du renouvellement à terme de la population. A Mbé, les populations de *B. dalzielii* se retrouvent principalement sur les sols rocailleux, les affleurements rocheux, et les collines rocheuses ou elles sont grégaires. Un total de 21 individus a été dénombré sur le transect de 1 km échantilloné, pour une densité globale de 10,5 tiges/ha. La figure 4 illustre la structure diamétrique obtenue. La répartition des individus par classe de diametre presente une allure en cloche avec un pic compris entre 20 et 40 cm. Les jeunes (20 cm) et vieux (60 cm) individus sont rares. Les densités obtenues sont certes fortes, mais ne peuvent pas être généralisées à l'ensemble de l'arrondissement qui est vaste de 3 000 km², du fait du très faible taux de sondage réalisé (moins de 0.0007%).

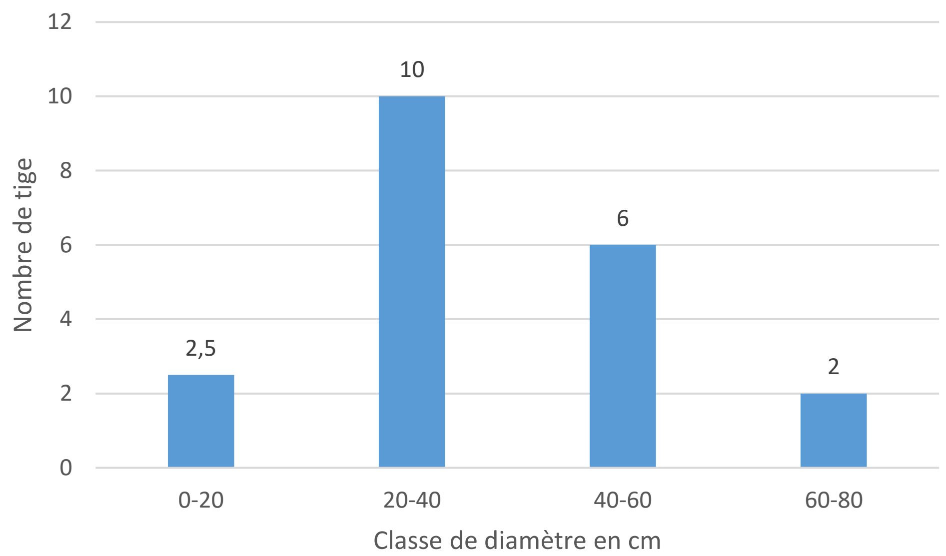


Figure 4. Structure diamétrique de *Boswellia dalzielii* dans le Mbé, Adamaoua (Kémeuzé *et al*. 2012).

Palou Madi et Balna (2015) ont trvaillé dans la cadre du Projet pilote de mise en valeur des sites du Sahel-Vert dans les départements du Mayo-Danay et du Mayo-Kani (Sahel Vert-HIMO), projet conjoint entre l'Institut des Recherches Agricole pour le Développement

(IRAD) et l'Organisation non gouvernementale (ONG) Action pour la Biodiversié et la gestion des terroirs (ABIOGeT). Ils ont dans ce cadre conduit un inventaire d'aménagement, multiressource des ligneux dans deux sites du Sahel vert, à savoir le site de Massinkou-Léra-Bippaing (Commune de Kaélé) vaste de 1 283 ha et le site de Bidéré (Commune de Doukoula), vaste de 325 ha, tous situé dans la région de l'Extrême Nord Cameroun. Le taux de sondage utilisé, soit 1,75% est considéré comme faible (< 2%) pour un inventaire d'aménagement de ce type (superficie inférieure à 5 000 ha). Une seule tige de *Boswellia dalzielii* a été retrouvée sur l'ensemble des deux sites, soit une densité de l'ordre de 0,036 tiges/ha, et non 1 tige/ha proposé par Palou Madi et Balna (2015) dans leur publication. La densité de 0,036 tige/ha reste très faible malgré le fait que les sites prospectés soient restés en défens depuis un certain nombre d'années. Le rapport ne précise pas dans quelle classe de diamètre cet individu a été retrouvé.

Sandjong Sani *et al* (2013) ont conduit des inventaires d'aménagement dans le Parc national de Mozogo-Gokoro, situé en zone sahélo-soudanienne, région de l'Extrême-Nord au Cameroun. L'espèce *B. dalzielii* y a été retrouvée, mais avec des données imprécises sur les effectifs par classe de diamètre.

Haiwa *et al* (2017) ont conduit des inventaires dans quatre départements de la région de l'extrême Nord à savoir: Mayo Danay, Mayo-Kani, Mayo-Sava et Logone-Chari. Bosswellia dalzielii a été dénombré dans ces sites avec des indices de valeur écologique compris entre 0.01 et 0.96, soit de 10 à 100 fois plus faible par rapport à la valeur seuil qui est de 10. Ce fait est lié aux faibles densités de l'espèce, lesquelles sont expliquées par la menace liée aux activités humaines. La superficie totale, la superficie utile, ansi que la distribution des tiges par classe de diamètre n'ont pas été précisées dans ce travail pour autoriser des projections d'aménagement.

Todou *et al* (2016) ont conduit des inventaires dans 5 transects de 1000 m de long x 20 m de large, soit un total de 10 ha dans le Nord et Sud de l'arrondissement de Moutourwa, dans le département de Mayo Kani, région de l'Extrême Nord Cameroun. Un total de 45 tiges de *B. dalzielii* a été dénombré, représentant une densité de 4,5 tiges/ha. Comme pour les travaux précédents, la superficie totale, la superficie utile, ansi que la distribution des tiges par classe de diamètre n'ont pas également été précisées pour autoriser des projections d'aménagement.

3. Etat des lieux sur l'exploitation de *Bosswelia spp*

L'exploitation et transformation actuelle de *Bosswellia* ne suit aucune norme établie de gestion au Cameroun. Cette exploitation reste confinée pour l'usage comme plante médicinale. L'usage comme plante responsable de la production du Frankincense ne semble pas encore très connue et vulgarisée au Cameroun. Les espèces *Boswellia spp* n'apparaissent pas dans les demandes des permis spéciaux, permis attribués aux exploitants et exportateurs pour ce type de produit (MINFOF 2004-2007). Aucune des deux espèces identifiées au Cameroun n'apparaît même pas dans la liste des 487 PFNL compilée par Ingram au Cameroun et en Afrique Centrale (Ingram et Shure 2010). Malzy (1954) signale que l'écorce de *B. dalzielii* (Andakéhi) est appliquée sur les blessures par flèches et sur les morsures de serpents par les populations du grand Nord Cameroun. Saoting *et al.* (2011) ont trouvé que 14%¨des personnes enquêtées dans la ville de Maroua utilisent les écorces de tige de *B. dalzielii* (Andakedje en Fulfulde) pour soigner le paludisme. Kémeuzé *et al.* (2012) ont mené des enuêtes ethnobotniues dans quatre villages couverts par l'ethnie Dii dans l'arrondissement de Mbé, région de l'Adamaoua. *B. dalzielii*, appelé localement « Andakeehi » en Fulfulde, bénéficie d'une très grande considération dans le patrimoine thérapeutique traditionnel de ces peuples. Toutes les 135 personnes interrogées dans cette enquête lui reconnaissent des vertus medicinales. L'écorce à elle seule constitue le matériel biologique utilisé. Les formes médicamenteuses sont les décoctions, les infusions et les poudres qui sont administrées en lavage, voie rectale, bain de vapeur, baume et par voie orale: – la décoction de l' écorce de tige est utilisée en voie rectale contre toutes les formes d'empoisonnement ; – cette même décoction est utilisée en bain de vapeur pour soulager les patients souffrant du paludisme et de la grippe ; – l'infusion de l'écorce réduite en poudre est utilisee en bain contre certaines maladies de la peau (zona, gale, teigne) ; – l'écorce, transformée en poudre, est utilisée pour son pouvoir cicatrisant et contre le poison (alimentaire, poison de nuit). Elle est également appliquée sur les blessures laissées par les morsures de serpent et scorpion pour aspirer le venin. Selon les informations obtenues auprès des principales personnes contactées, la plante aurait la propriété de fixer les particules toxiques dans l'organisme humain ; – *B. dalzielii* figure parmi les espèces qui ne sont pas utilisées comme bois de chauffe dans la région à l'instar de *Combretum molle, Sclerocarya birrea, Sterculia setigera et Commiphora africana.* Selon Onana (2017), une décoction de racines additionnée de feuilles d'*Hibiscus sabdarrifa* est associée à plusieurs remèdes contre la syphilis. Une décoction des racines avec celles de *Daniella oliveri* est réputée comme antidote contre le poison des flèches. La décoction d'écorce de tige de *B. papyrifera* est ingérée en cas de morsure de serpent. Les écorces sont utilisées pour soigner les plaies des chevaux.

L'enquête ethnobotanique conduite dans les marchés de Kousséri (Betti *et al*. 2011) a permi de relever 13 citations de *B. dalzielii* (2 citations) et *B. papyrifera* (11 citations). L'écorce de tige de B. *dalzielii* est vendue à 2 FCFA/gramme dans le traitement de la hernie ou des helminthiases intestinales. Pour *B. papyrifera*, les usages sont plus diversifiés: la résine est vendue à 250 FCFA/gramme (0,45 USD) pour soigner les maux de ventre et diarrhées et aussi les lombalgies; lécorce de tige est vendue en moyenne à 2 FCFA/gramme (0.004 USD) dans le traitement des hernies, des helminthiases intestinales, le mal positionnement de l'enfant dans le ventre, la fièvre et le paludisme. L'écorce des racines est utilisée pour soigner la jaunisse, les maux de ventre et diarrhées, et l'asthme. En sus de sa propriété à produire le Frankincense, *B. papyrifera* est très largement utilisée en Ethiopie en médecine traditionnelle. Les feuilles, les racines, les écorces de tige ainsi que la résine elle-même (Frankincense) sont utilisées dans le traitement de diverses maladies telles la lèpre, la bronchiolite, l'asthme, la fièvre typhoïde et l'héptite virale (Lemenih and Teketay, 2003). Des études récentes ont révélé les propriétés anticancérigènes (Evans 2013) et la capacité à renforcer le système immunitaire (Khajuria *et al*., 2008) de Frankincense. Ces exemples illustrent le potentiel pharmaceutique de Frankincense ui reste à valoriser dans un futur très proche.

Les produits à base de *Boswellia* tout comme bon nombre de PFNL au Cameroun, soufre d'un certain nombre de tares qui peuvent être préjudiciables à sa durabilité : méconnaissance de la ressource, manque des normes d'exploitabilité rationnelle, manque des produits de qualité, une réglementation pas claire et peu efficace. Le Cameroun a cependant fait des efforts notables ces dernières années dans le développement de la filière des PFNL, et notamment par la mise au point des techniques modernes d'exploitation de l'écorce de *Prunus africana*, espèce listée dans l'annexe II de la CITES (Betti et Ambara 2013, Betti et al. 2016).

4. Etat des lieux sur la régénération et les menaces

Dans le site de Mbé dans la région de l'Adamaoua au Cameroun, Kémeuzé *et al.* (2012) ont relevé que tous les individus rencontrés étaient en début de floraison, preuve que la population n'est constituée que d'individus adultes. Par ailleurs, aucune plantule n'a été rencontrée au voisinage de ceux-ci. Toutes les personnes interrogées pensent qu'une régénération artificielle n'est pas nécessaire parce que la ressource est disponible. L'absence de jeunes individus est synonyme d'une mauvaise régénération. La faible densité des individus des classes de diamètre inférieure à 20 cm le démontre. En revanche, au- dessus de cette classe, on a une grande représentativité, ce qui signale une population vieillissante. Plusieurs raisons peuvent l'expliquer. D'une manière générale, la distribution en cloche des individus de *B. dalzielii* suggère que la régénération de cette Burseraceae n'est pas assurée, bien que la ressource ne soit pas utilisée comme bois de chauffe dans la région. Les études sur la physiologie de *B. dalzielii* montrent que les graines fertiles contiennent une amande et la gemmule. Les graines stériles présentent une enveloppe tégumentaire intacte mais vide. Cette anomalie, cause d'infertilité, concerne plus de 57 % des graines. Dans les peuplements, moins de 35 % des arbres semenciers montrent un taux de fertilité séminale supérieur à 50 %. Les graines de *B. dalzielii* ne manifestent pas de dormance. Les taux de germination sont assez faibles, de l'ordre de 33 % à la récolte. Selon la phénologie fructifère de *B. dalzielii*, deux mois séparent la maturité des fruits de la saison pluvieuse. Pendant cette période, la capacité germinative initiale ne baisse pas significativement. A la saison humide sui- vante, soit après 14 mois, les graines ont perdu la moitié de leur pouvoir germinatif. Le temps de latence varie de 8 à 10 jours et la vitesse de germination (temps moyen pour atteindre 50 % du taux final) de 9 à 11 jours. Pratiquement, toutes les graines germent en trois semaines. La croissance initiale en hauteur est faible, en moyenne de 0,2 cm par jour au cours des trois premières semaines au terme desquelles les plants mesurent 5 cm de hauteur. Dés la troisième semaine, le bourgeon apical devient moins actif et on observe un ralentissement de la croissance en hauteur et de la production foliaire (Ouedraogo et al., 2006 cit. Kémeuzé *et al.* 2012). A cela, on peut ajouter : la destruction des plantules soumises en permanence à des feux de brousse ; les paturages (piétinement des plantules par le bétail) ; l'adaptation de l'espèce face aux changements des conditions climatiques du milieu (sahelisation de la région) ; les attaques fongiques des plantules. Les travaux de Kémeuzé *et al*. (2012) ont permis d'évaluer de 4 à 9 % le taux de plantules de *B. dalzielii* mortes suite à des attaques fongiques.

Les observations de terrain montrent que la ressource présente un intérêt certain pour les communautés locales. Au sein de la population de *B. dalzielii* étudiée à Mbé, 86 % d'individus présentent des traces de prélèvement (Kémeuzé *et al.* 2012). L'écorce est prélevée en plaques de formes irrégulières et de surfaces variables. Le matériel de collecte couramment utilisé est la machette. Les techniques de récolte utilisées dans la zone ne mettent pas en danger la ressource dans son biotope car aucun individu mort sur pied n'a été dénombré sur le site. De plus, les volumes d'écorces à prélever par individu (de 360 cm^3 à 40 482 cm^3) ne sont pas susceptibles de mettre en danger la ressource dans le milieu. Toutefois, Kémeuzé *et al.* (2012) indiquent que les hauteurs minimales de récolte ne respectent pas les normes (1,30 m du sol) pour une gestion durable de la ressource. Pour près de 65 % des individus rencontrés, les hauteurs minimales de prélèvement de l'écorce sont inférieures à 1 m du sol. Les volumes d'écorce semblent être prélevés en fonction de la circonférence des individus.

5. Etat des lieux sur la domestication

Toutes les personnes interrogées à Mbé pensent qu'une régénération artificielle n'est pas nécessaire parce que la ressource est disponible (Kemeuze et al. 2012). Pour Onana (2017), l'arbre *B. dalzielii* n'est planté que pour procurer de l'ombrage.

6. Etat des lieux sur l'arsenal juridique et institutionnel

La politique gouvernementale en matière forestière a été adoptée en 1993. Son objectif général était de « **pérenniser et développer les fonctions économiques, écologiques et sociales des forêts du Cameroun, dans le cadre d'une gestion intégrée qui assure, de façon soutenue et durable, la conservation et l'utilisation des ressources et des écosystèmes forestiers** ». Fondée sur les réalités nationales ainsi que sur les valeurs partagées avec la communauté internationale en matière environnementale (Sommet de la Terre, Rio 1992), elle est articulée autour de 4 grandes orientations : (1) assurer la protection de patrimoine forestier national et participer à la sauvegarde de l'environnement et à la préservation de la biodiversité ; (2) améliorer l'intégration des ressources forestières et fauniques dans le développement rural, afin de contribuer à élever le niveau de vie des populations et de les faire participer à la conservation des ressources ; (3) mettre en valeur les ressources forestières en vue d'augmenter la part de la production forestière dans le PIB, tout en conservant le potentiel productif ; (4) dynamiser le secteur forestier en mettant en place un système institutionnel efficace et en faisant participer tous les intervenants dans la gestion du secteur (République du Cameroun 1994, 1995).

Le Cameroun s'est donc engagé, suite à l'objectif fixé, avec l'appui de la communauté internationale, dans un programme de réformes visant la promotion et l'amélioration de la gouvernance forestière. Dans les années 2000 ces réformes se sont poursuivies dans le cadre du 3ème crédit d'ajustement structurel (CAS III) focalisé sur 3 objectifs essentiels de la politique forestière à savoir : (1) la gestion durable de la ressource ; (2) la génération de la croissance économique ; (3) la contribution à la lutte contre la pauvreté et le développement d'un secteur privé dynamique et efficace.

6.1. Evolution du cadre institutionnel en charge des produits forestiers au Cameroun

Durant les années 1980, la forêt était placée sous la responsabilité de l'ex-Ministère de l'Agriculture, (MINAGRI) tandis que la faune relevait du Secrétariat au Tourisme. Quant à la recherche forestière, elle incombait à l'Institut de Recherche Agricole pour le Développement (IRAD). En 1993, les autorités politiques ont opté pour le regroupement de ces centres de décision en créant le Ministère de l'Environnement et des Forêts (MINEF). Celui-ci va éclater par la suite en deux Ministères le 8 décembre 2004, à savoir le Ministère des Forêts et de la Faune (MINFOF), d'une part, et le Ministère de l'Environnement et de la Protection de la Nature (MINEP), d'autre part.

Les principaux organismes mis en place pour accompagner l'action de l'Etat ont également connu des mutations, tant au plan structurel qu'au niveau de la compétence. Il s'agit notamment au fil du temps:

- ✓ du Fonds Forestier (sous la tutelle de l'ex-MINAGRI jusqu'en 1974), dont l'activité portait principalement sur les plantations forestières domaniales ;
- ✓ du Fonds National Forestier et Piscicole (sous la tutelle de l'ex-MINAGRI de 1974 à 1982), consacré au développement des plantations forestières domaniales et à la promotion de la pisciculture ;
- ✓ de l'Office National de Régénération des Forêts (sous la tutelle de l'ex-MINAGRI de 1982 à 1990), chargé des plantations forestières domaniales et de la vulgarisation sylvicole ;
- ✓ du Centre National de Développement Forestier (sous la tutelle de l'ex-MINAGRI de 1982 à 1990), dont la mission consistait à réaliser les inventaires et aménagements forestiers, intéresser les nationaux à l'activité forestière et à suivre l'économie forestière ;
- ✓ de l'Office National de Développement des Forêts (sous la tutelle de l'ex-MINAGRI /MINEF de 1990 à la création de l'ANAFOR) dont les missions étaient identiques à celles du Centre National de Développement Forestier ; puis désormais de l'Agence Nationale d'appui au Développement du Secteur Forestier (sous la tutelle de l'ex-MINEF/MINFOF de 2002 à nos jours), ANAFOR, avec pour rôle d'appuyer le développement des plantations forestières, des communautés et des privés.

De ce qui précède, on observe une grande instabilité des institutions en charge de la gestion des ressources forestières avec une attention principalement portée sur les ressources ligneuses. Quoiqu'il en soit, les actions du sous-secteur des forêts et de la faune sont exécutées dans le cadre des missions dévolues au MINFOF par le décret n° 2005/099 du 06 avril 2005. Celui-ci exerce ces missions conformément aux orientations de la politique forestière, dont les activités sont réalisées dans le cadre du Programme Sectoriel Forêt-Environnement, en tenant compte des prescriptions de la loi n°2007/006 du 26 décembre 2007 portant régime financier de l'Etat.

En outre, le sous-secteur forêt-faune assure la liaison entre le Gouvernement et l'Organisation Internationale des Bois Tropicaux (OIBT) et la Commission des Forêts d'Afrique Centrale (COMIFAC) en relation avec le Ministère des Relations Extérieures. Il assure également le suivi des conventions, accords et engagement internationaux concernant les forêts, les zones à écologie fragile, la faune et les espèces en danger. Il exerce la tutelle sur l'Agence Nationale de Développement des Forêts (ANAFOR), sur l'Ecole Nationale des Eaux et Forêts (ENEF) et sur l'Ecole de Faune de Garoua (EFG).

6.2. Des bases légales favorables au développement local à travers les Produits Forestiers Non Ligneux.

Le cadre juridique des ressources forestières est fortement influencé par la logique internationale qui repose sur toute exploitation des ressources forestières sur une gestion écologique propice au bien être socio-économique des communautés qui en sont principalement dépendantes. On retrouve cette logique dans les dispositions légales relatives aux produits forestiers non ligneux, dispersées dans l'ensemble des textes forestiers camerounais.

L'engagement du législateur camerounais en faveur de la promotion durable des produits forestiers non ligneux se justifie par l'adhésion de l'Etat camerounais à un ensemble de textes internationaux relatifs à la gestion de la biodiversité. Au niveau sous régional, des directives relatives à la gestion des produits forestiers non ligneux ont été adoptées par les Etats regroupés au sein de la Commission des forêts d'Afrique centrale (COMIFAC). Dans le droit positif camerounais, les dispositions relatives aux produits forestiers non ligneux se retrouvent dans l'ensemble des textes portant régime des forêts et gestion de l'environnement. Les textes les plus pertinents qui recoupent le cadre juridique des produits forestiers non ligneux sont : la loi n°94-01 du 20 janvier 1994, portant régime des forêts de la faune et de la pêche ;le décret N°95/531/PM du 23 août 1995 fixant les modalités d'application du régime des forêts ;la décision n°0336/D/MINFOF du 06 juillet 2006 fixant les produits forestiers ayant un intérêt particulier au Cameroun ; l'arrêté n°222/A/MINEF du 25 mai 2001 fixant les procédures d'élaboration, d'approbation, de suivi et de contrôle de la mise en œuvre des plans d'aménagement des forêts de production du domaine permanent ; la lettre-circulaire n°0253/LC/MINFOF/SG/DF/SDAFF du 31 mai 2006, relative aux documents exigés dans les check points et postes de contrôle fixes ou mobiles ;la décision n° 0003/D/MINEF/SG/DF du 09 janvier 2004 portant octroi des quotas des produits forestiers spéciaux ; et le décret n°

2005/099/PR du 06 avril 2005 portant organisation du Ministère des Forêts et de la Faune (MINFOF).

L'objectif utilitariste est perceptible dans l'esprit de ces textes juridiques. On y décèle une vision du développement durable du territoire tout entier à travers la ressource exploitée. En même temps, le développement des localités où l'exploitation menée reste un objectif spécifique capital. L'analyse juridique de l'encadrement normatif de l'exploitation des produits forestiers non ligneux au Cameroun, laisse penser que la réglementation nationale reste favorable à un développement socio-économique des localités riveraines des forêts et à une conservation des produits forestiers non ligneux.

6.3. La consécration du droit d'usage des PFNLs aux populations riveraines en vue d'une utilisation personnelle.

Le cadre normatif des produits forestiers non ligneux consacre des droits particuliers aux populations riveraines. Il s'agit du droit d'accéder et d'user de la ressource forestière. De plus, il reconnaît à tout camerounais le droit de commercialiser les produits forestiers non ligneux à condition de respecter les exigences légales en la matière.

L'expression du droit d'usage permet aux communautés d'assurer leurs besoins domestiques quotidiens, tout en préservant leur culture, permettant ainsi la transmission des savoirs aux générations futures. De même, les revenus issus de la commercialisation des produits forestiers non ligneux par les entités locales impactent sur l'amélioration des moyens de subsistances locaux, influençant ainsi l'investissement local. Par la loi, les populations riveraines des massifs forestiers préservent le droit d'accéder aux ressources de ces forêts. Le droit d'accès constitue la cheville ouvrière du droit d'usage qui en est la continuité. En effet, la loi portant régime de la faune et de la flore reconnaît aux communautés riveraines le droit d'accès aux produits forestiers par le truchement du droit d'usage. Les populations riveraines peuvent exploiter tous les produits forestiers fauniques et halieutiques à l'exception des espèces protégées en vue d'une utilisation personnelle. Ainsi, le droit d'usage consacré par le droit forestier camerounais est en quelque sorte un droit d'usufruit et d'autoconsommation destiné à la satisfaction des besoins domestiques des riverains. C'est donc un droit de jouissance reconnu à une catégorie de personne d'user de certaines ressources forestières.

Toutefois, la principale difficulté de cette définition réside dans le vocable « Populations riveraines des forêts ». Celui-ci pourrait intégrer autant les non ressortissants de la localité, que les autochtones, ces derniers pouvant être tous dépendant des ressources forestières non ligneuses. S'il faut interpréter de façon restrictive la définition juridique du droit d'usage des ressources forestières ; on dira que tout Camerounais qui vit prés de la forêt, qu'il y réside de façon temporaire, pour un besoin de service, ou qu'il appartienne à une composante sociologique autochtone a le droit d'user d'un produit forestier non ligneux. Mais dans la pratique, le droit d'usage est généralement reconnu au riverain traditionnel, c'est-à-dire celui qui a un lien particulier avec la terre où se trouve le produit sollicité. Il ne suffit donc pas de vivre à l'intérieur ou à proximité d'une forêt pour être habilité à y exercer le droit d'usage. Par contre, toute personne à laquelle la coutume reconnaît des droits sur une forêt donnée, qu'elle vive ou non dans les limites géographique du territoire concerné, pourrait valablement y exercer son droit d'usage. Il lui suffira de se conformer aux modalités d'exercice de ce droit.

L'exercice du droit d'usage par les populations riveraines connaît certaines particularités liées à la zone de collecte, à la catégorisation de la ressource concernée, au lieu de jouissance et la destination des produits tirés de la forêt. Déjà, la lettre circulaire n°0131/LC/MINFOF/SG/DF/SDAF/SN du 26 mars 2006 relative aux procédures de délivrance et de suivi d'exécution des petits titres d'exploitation forestières, précise que tous les produits tirés de la forêt dans le cadre du droit d'usage doivent être utilisés dans le village concerné. Cela suppose, par exemple, que les populations riveraines peuvent accéder et collecter les produits forestiers non ligneux, pour leur consommation personnelle, mais ne peuvent pas les transporter hors de leurs localités de résidence. De même, les bénéficiaires du droit d'usage ont le droit de prélever de la forêt tous les produits forestiers non ligneux, à l'exception des essences protégées et de celles dont l'usage est interdit par un arrêté du ministre en charge des forêts. La jouissance du droit d'usage peut être restreinte en fonction de la catégorie de l'espace forestier où il est exercé. C'est le cas lorsqu'une zone est mise en défens, où lorsqu'elle devient une zone de conservation particulière. Néanmoins, les titulaires de titres d'exploitation forestière ne peuvent interdire aux populations riveraines l'accès aux produits forestiers non ligneux des espaces concédés (UFA, Forêt communale, Foret communautaire, etc.).

A l'analyse, on peut dire que le législateur, en reconnaissant un droit d'usage particulier aux communautés riveraines des forêts, avait pour souci de rétablir l'équité sociale en procédant à une justice distributive (FAO 2009). En empruntant l'esprit des règles traditionnelles de gestion des biens communs, la réglementation forestière camerounaise a reconnu à une catégorie de citoyens (le riverain) un droit particulier (le droit d'usage) sur une ressource nationale (les produits forestiers non ligneux). L'expression de ce droit pourrait permettre à ces communautés de valoriser leurs savoirs traditionnels et tout en assurant leur bien-être social à travers des activités de valorisation de ces ressources forestières.

La commercialisation des produits forestiers non ligneux est également un moyen utile pour enclencher le développement durable d'une localité. L'on admet communément que l'exploitation d'une ressource naturelle, lorsqu'elle est durable, engendre des bénéfices qui à terme influencent le revenu des populations. La commercialisation des ressources forestières en générale se présente comme une source potentielle de devises susceptibles de soutenir la relance économique. Par conséquent, l'exploitation commerciale des produits forestiers non ligneux, lorsqu'elle est bien régulée, pourrait permettre un essor de l'amélioration des revenus des ménages vivants à proximité des espaces forestiers où ces produits sont collectés. Au Cameroun, les dispositions relatives à la commercialisation des produits forestiers non ligneux prévoient que seuls les détenteurs d'une autorisation légale peuvent exercer une activité commerciale ayant pour objet des produits forestiers non ligneux.

6.4. Fiscalisation de l'exploitation commerciale des produits forestiers non ligneux au Cameroun

La législation camerounaise utilise le vocable « produits spéciaux » pour désigner les Produits forestiers non ligneux de nature végétale. La politique forestière du Cameroun sur les PFNL de nature végétale a connu plusieurs phases dans son processus d'évolution (Betti 2007 a,b).

Avant 1997, il n'existait pas à proprement parler des taxes pour les produits spéciaux. Ces produits étaient presque totalement ignorés des administrations forestières et fiscales, comparés au bois d'œuvre et aux produits de la chasse (gibier, trophées). L'attribution du Permis d'exploitation des produits spéciaux était conditionnée par le paiement d'une modeste Somme d'argent, arrêtée de manière arbitraire ; il s'agissait en fait d'une contribution aux Recettes de l'Etat, peu importe les quantités prélevées. Dés 1997, il y a eu suspension des permis d'exploitation. Ces permis ont été remplacés par les autorisations spéciales de récolte des produits spéciaux. Cette situation caractérisée, par une exploitation peu contrôlée a duré jusqu'en 2001.

En 1999, est crée le Programme de Sécurisation des Recettes Forestières (PSRF). Trois objectifs spécifiques étaient assignés au PSRF lors de sa création : maîtrise de la production forestière, suivi du contrôle forestier, et lutte contre les fraudes fiscales. A partir de 2001, le Ministère en charge des forêts a levé la suspension de l'attribution des permis d'exploitation.

Le problème relevé dans les nouveaux permis est que, c'est l'opérateur qui est maître de lui même, puisque la taxe de régénération est payée par rapport au volume de produits exploités et déclarés par ce dernier. Ainsi par exemple, l'opérateur ne pouvait déclarer que 2 tonnes de produits exploités sur les 10 réellement récoltés. Ces permis devaient normalement expirer en 2002. Mais, faute de session d'une nouvelle commission d'attribution en cette année, de nouveaux permis n'ont pas été attribués. C'est alors qu'une note ministérielle de prorogation spéciale permettra aux opérateurs économiques de continuer d'exploiter avec leurs titres de 2001. Cette situation a perduré jusqu'en novembre 2003.

Au mois de novembre 2003, la nouvelle Commission d'attribution des permis a siégé pour le compte de la nouvelle année 2004. Le changement est marqué par le paiement de la taxe de régénération par rapport aux quotas (volume) des produits attribués et non plus par rapport au volume déclaré. Ce permis est valable pour une année. Les frais de dossier (quittance) s'élèvent à 150 milles FCFA. Cette nouvelle façon de procéder permet, selon les agents du MINFOF/DF rencontrés, d'éliminer les aventuriers dans la profession d'exploitation des produits spéciaux, tout en encourageant par l'échelonnement des paiements, les nationaux à s'investir dans cette activité et d'amortir progressivement le matériel investi.

Mais la signature des permis de 2004 a été conditionnée, par le paiement des arriérés des années précédentes. Cette clause, instituée dans l'optique de sécurisation des recettes forestières, a entraîné de nombreux blocages dans toute la chaîne des PFNL. Des vives tensions ont été observées entre les opérateurs économiques d'un côté et l'administration forestière de l'autre. Pour les contrôleurs du Programme de Sécurisation des Recettes Forestières rencontrés, beaucoup d'opérateurs économiques ont fait de fausses déclarations pour le paiement des taxes de régénération au regard des statistiques trouvées au niveau du port de Douala. Les différences de déclarations retracées devaient d'abord être payées par chaque opérateur économique, avant de se voir attribuer un nouveau titre d'exploitation. De leur côté, les exploitants des produits spéciaux expliquent le non paiement de ces taxes dans les délais, pour cause de non activité (contradiction avec les données du port ?). Ainsi, les expressions telles que « nous ne pouvons pas payer ce que nous n'avons pas exploité » étaient régulièrement avancées par ce groupe d'opérateurs économiques. Les exploitants des produits spéciaux renvoient la principale cause de leur non activité à l'administration forestière pour ses lenteurs administratives dans le traitement des dossiers de délivrance des titres d'exploitation. Ces lenteurs sont à l'origine de l'arrêt de nombreux contrats entre les exploitants et leurs partenaires.

En 2005, le ministère en charge des forêts a levé les sanctions et reconsidéré la décision d'attribution des quotas de l'an 2001. Les exploitants dont les noms figuraient dans cette décision et qui n'avaient pas obtenu de titres d'exploitation par accumulation des arriérés de paiement, ont été reconsidérés et se sont vus attribués de nouveaux permis en 2005. Le paiement de la taxe de régénération est échelonné exceptionnellement en deux tranches en cette année: 50 pour cent au plus tard le 30 avril 2005 et 50 pour cent au plus tard le 30 septembre 2005.

En 2006, la décision portant octroie des quotas, précise que, la taxe de régénération est payée en trois phases telle initiée en 2004.

En 2007, le Ministère des Forêts et de la Faune a fait une avancée assez importante dans le secteur des produits spéciaux, et notamment dans le renforcement du contrôle et suivi des stocks devant être exploités. L'innovation ici tient essentiellement de la mise en place de deux outils clés à savoir le carnet de lettres de voitures de transport des produits spéciaux et le carnet de suivi des produits spéciaux (encore en élaboration).

6.5. Evolution observée dans les procédures actuelles d'exploitation, de transformation et d'aménagement des espèces du genre *Bosswellia spp*.

Les produits à base de *Boswellia* ne sont pas encore largement exploités et exportés à partir du Cameroun, mais ils pourraîent l'être dans les années à venir du fait des découvertes récentes faites sur les propriétées pharmaceutiques. Une fois utilisées à grande échelle pour le but commercial, ces espèces rentreront dans le cadre des produits forestiers non ligneux (PFNL) dits "produits spéciaux".

Les produits spéciaux sont les PFNL dont l'administration en charge des forêts a ciblé pour réglementer l'exploitation à but commercial. L'alinéa 2 de l'article 9 de la loi N° 94/01 du 20 janvier 1994 portant régime des forêts, de la faune et la pêche précise que « certains produits forestiers, tels que l'ébène, l'ivoire, espèces animales ou végétales, médicinales ou présentant un intérêt particulier, sont dits produits spéciaux ». La liste desdits produits spéciaux est fixée, selon le cas, par l'administration compétente. Les modalités d'exploitation des produits spéciaux sont fixées par décret. L'article 2 de la décision n° 0336/D/MINFOF du 06 juillet 2006 portant sur l'établissement des produits forestiers spéciaux présentant un « intérêt particulier » précise, que « ce sont des produits relativement peu abondants ou pour lesquels des mesures de contingentement sont indispensables à cause des menaces présentées par les méthodes utilisées pour les récolter, par rapport à la pérennité de la ressource ».

L'exploitation des produits spéciaux, est réglementée au Cameroun principalement au sein du Ministère des forêts et de la faune (MINFOF) à travers la Direction des forêts (DF) et la Direction de la promotion et transformation des produits forestiers (DPT). La Direction des forêts s'occupe de la gestion de la ressource, à savoir la connaissance de la ressource, l'octroie des agréments et des titres (permis) et le contrôle forestier. La Direction de la promotion et transformation, elle, s'occupe de la promotion, du traitement, de la transformation et de l'exportation des produits dérivés. Le Ministère des Finances (MINFI) à travers le Programme de Sécurisation des Recettes Forestières (PSRF) assure le recouvrement des taxes, qui jusqu'ici se limitent essentiellement à la taxe de régénération (TR). Les éléments requis pour obtenir un titre d'exploitation des produits spéciaux sont précisés dans la loi forestière (MINEF 1996).

La politique forestière sur les produits « produits spéciaux », a évolué progressivement au Cameroun car le pays est parti d'une situation d'exploitation quasi-gratuite vers une exploitation génératrice des recettes fiscales pour le bénéfice de l'Etat. Le taux de recouvrement de la taxe de régénération a augmenté traduisant une évolution de la contribution du secteur « produits spéciaux » dans l'élargissement de l'assiette fiscale. Les changements importants ont été apportés au niveau de la sécurisation des recettes avec notamment la création du PSRF dans les années 2000. Dés lors, les bénéficiaires des titres d'exploitation se soumettent depuis 2008 au respect des quotas attribués avec notamment l'instauration de deux outils à savoir le carnet de suivi des prélèvements et le carnet de lettres de voitures. Le système des carnets de lettres de voiture et de suivi des produits spéciaux proposé en 2007 (Betti 2007a) est intéressant en ce sens qu'il permet non seulement de mieux renforcer le contrôle et le suivi de l'exploitation des produits spéciaux, mais aussi et surtout il met les exploitants, transporteurs, commerçants, industriels ou exportateurs à l'abri de l'arnaque et des tracasseries routières (police). A terme, le système est conçu pour mettre fin à la contrainte de péage à priori (avant récolte) de la taxe de régénération. La traçabilité documentaire, faite au travers des informations enregistrées dans ces outils permet de mieux sécuriser les recettes fiscales et donc de ne plus soumettre les opérateurs économiques au péage à priori des taxes sur les quantités de produits qu'ils n'arrivent parfois pas à récolter et écouler. Ceci constitue une avancée importante dans la politique sur les produits spéciaux au Cameroun ; et positionne ce pays parmi les plus avancés en matière de développement des outils de gestion durable des PFNL dans le bassin du Congo. Cette évolution positive ne doit tout de même pas nous faire oublier certains problèmes clés qui minent encore le développement de la politique et du secteur PFNL au Cameroun. Ces problèmes concernent essentiellement la méconnaissance de la ressource, les nombreux conflits entre les différents acteurs au sein de la filière PFNL ou encore avec d'autres filières

7. Contrainte dans la gestion des PFNL

Les PFNL sont importants pour l'amélioration de la santé, du bien-être et santé des populations locales et aussi pour l'économie nationale. Le Cameroun a fait des efforts certains pour améliorer la gestion des PFNL. Cependant, de nombreuses difficultés entravent encore l'exploitation écologiquement et économiquement rentable des produits spéciaux (Betti, 2007a,b).

7.1 Méconnaissance de la ressource

Le premier problème et le plus important réside tout d'abord au niveau de la méconnaissance quasi-totale de la ressource, tant sur le plan qualitatif que quantitatif. Les quotas ou potentiel même à titre indicatif de ces produits ne sont pas connus. Faute de données d'inventaires, on ne saurait projeter la durabilité de l'exploitation de ces ressources à l'heure actuelle au Cameroun. Les quotas attribués présentement le sont essentiellement sur base des données informelles (Betti, 2007b). Des attributions faites de cette manière ne sont pas indiquées.

Elles peuvent avoir des conséquences énormes sur le plan écologique (épuisement de la ressource) ou alors sur le plan économique (perte de la clientèle qui parfois veut s'assurer de la régularité de la production, exploitation en dessous de sa capacité en raison des faibles tonnages octroyés, avec risque du mauvais amortissement des investissements consentis par l'opérateur).

La liste des produits forestiers spéciaux présentant un intérêt particulier n'est pas souvent définie sur des bases claires. Ainsi par exemple, classer les poteaux d'Eucalyptus parmi les produits vulnérables, alors que la sylviculture de cette espèce a déjà été maîtrisée par les paysans de l'Ouest et Nord-Ouest, paraît quelque peu paradoxal. L'article 2 de la décision n° 0336/D/MINFOF du 06 juillet 2006 portant sur l'établissement des produits forestiers spéciaux présentant un intérêt particulier précise, que « ce sont des produits relativement peu abondants ou pour lesquels des mesures de contingentement sont indispensables à cause des menaces présentées par les méthodes utilisées pour les récolter, par rapport à la pérennité de la ressource ». Une espèce comme *Eucalyptus* n'a donc pas sa place dans cette liste. Il faut des arguments solides, dénudés de toute passion pour retenir un produit spécial comme présentant un intérêt particulier, d’autant plus que la délivrance des titres sur ces produits requière l’avis de la Commission interministérielle, et donc plus de lourdeurs administratives.

7.2 Généralisation de la taxe de régénération à tous les produits

Le second problème, et qui est toujours lié au premier, réside dans la généralisation tout azimut de la taxe de régénération de 10 FCFA le kilogramme à tous les produits. En réalité, tous les produits spéciaux ne sont pas semblables tant sur le plan économique que écologique. Sur le plan économique, certains produits ont une valeur plus élevée que d’autres ; ainsi par exemple, 1 kilogramme d’ébène ne saurait valoir 1 kg de *R. heudelotii* Sur le plan écologique, tous les produits spéciaux n’ont pas à vrai dire le même statut de vulnérabilité (Betti, 2002a ; 2001). Une espèce largement sollicitée telle que l’Ebène, du fait qu’elle soit un ligneux (croissance lente), typique des forêts primaires (habitat vulnérable au Cameroun du fait de la déforestation à outrance mené actuellement), peu abondante en milieu forestier, et abattu pour son bois, sera beaucoup plus vulnérable qu’une autre espèce comme *Gnetum africanum* pour les paramètres indiqués. La taxe de régénération de l’Ebène devrait par conséquent être plus élevée que celle de *Gnetum*. La taxe imputée à chaque produit doit tenir compte non seulement de la valeur mercuriale du produit, mais aussi de sa vulnérabilité. Ainsi par exemple, les espèces très vulnérables et à haute valeur mercuriale devraient avoir leur taxe élevée par rapport aux espèces non vulnérables et qui sont moins précieuses.

7.3 Confusions entre produits spontanés et domestiques

Le quatrième problème se trouve au niveau de la grande variabilité des PFNL, dont certains débordent le cadre forestier (sauvage) pour intégrer l’espace agricole. Ce fait pose encore beaucoup de problème pour leur taxation. Le cas des produits tels que la cola *(Cola* sp.*)*, la maniguette *(Aframomum melegueta)*, ou encore *Eucalyptus* constituent des exemples typiques. Le paiement de la taxe de régénération de 10 FCFA/kg de cola agricole ou alors de 3000 FCFA/m^3 sur les poteaux d’*Eucalyptus* soulève le problème de distinction entre les produits sauvages et ceux domestiqués ou agricoles. Les poteaux d’*Eucalyptus*, comme précisé dans les permis, sont produits par les paysans ; ils peuvent de ce fait être considérés comme des produits agricoles. L’acheteur ne devrait uniquement traiter qu’avec les paysans et requérir au besoin, un certificat d’origine qui atteste que ces produits proviennent des plantations paysannes.

7.4 Manque de précisions sur les lieux de récolte

L’autre problème réside au niveau de manque de précisions sur les lieux de récolte des produits. Ces lieux restent encore très grossiers puisqu’ils sont définis à l’échelle provinciale. Il serait intéressant que des précisions soient faites à l’échelle départementale, de l’arrondissement ou encore à l’échelle des communes.

7.5 Conflits entre différents acteurs sur le terrain

L’on a relevé de nombreuses situations conflictuelles entre les exploitants forestiers (bois d’œuvre) et les exploitants des produits spéciaux. En effet, les détenteurs des UFA ne comprennent pas pourquoi les détenteurs des permis de produits spéciaux viennent collecter les produits dans leurs forêts. Le concessionnaire de l’UFA qui est assujetti à payer une redevance à la surface concédée ou exploitée ne verra certainement pas du bon œil que quelqu’un qui ne paie pas comme lui cette redevance, vienne collecter les produits dans sa forêt. Les conflits sont encore souvent beaucoup plus perceptibles en ce qui concerne certains produits dont l’intérêt est relevé tant pour son usage comme bois d’œuvre que pour son usage comme produit spécial. Tel est par exemple le cas de *l’Aniégré* dont le bois d’œuvre est très sollicité pour le tranchage par les exploitants forestiers, mais qui par ailleurs fait de plus en plus l’objet d’exploitation comme produit spécial. En réalité ce genre de conflit n’a pas sa raison d’être, la loi est claire à ce niveau et précise que le bénéficiaire d’une vente de coupe ou d’une concession forestière ne peut faire obstacle à l’exploitation des produits non mentionnés dans son titre d’exploitation (Article 62).

L’on a également relevé des situations conflictuelles entre les différents usagers des PFNL sur le terrain. Les exploitants moyens ou petits des produits forestiers spéciaux (ils préfèrent qu’on les désigne ainsi) se plaignent de la concurrence qui leur est faite d’une part par certains herboristes installés en ville, et d’autre part par les gros industriels.

En effet, on voit habituellement des personnes transporter de grandes quantités d’écorce de plantes médicinales pour leurs magasins ou laboratoires basés en ville. Ces personnes ne disposent pas de permis et ne paient aucune taxe liée à la ressource forestière.

Les exploitants moyens des produits spéciaux rencontrés ont déclaré qu’ils avaient aussi un gros problème avec les gros industriels qui leur font une concurrence déloyale. Les gros industriels ont les mêmes titres que les petits exploitants. Dans un système de limitation des quotas comme c’est le cas actuellement au Cameroun, ceci constitue un problème dans la mesure où de grandes quantités de produits sont attribuées à ces gros industriels au détriment des petits. Le problème ici se trouve à deux niveaux :

- au niveau de l'écoulement des produits, les petits exploitants disent qu'à cause des petits quotas qui leur sont attribués, ils perdent progressivement la confiance de leurs partenaires étrangers ;
- au niveau de la gestion durable de la ressource, les personnes interrogées disent que souvent ces industriels ne vont pas eux-mêmes sur le terrain. La plupart, confient souvent leurs titres à des personnes qui n'ont aucune notion d'exploitation durable des produits spéciaux. Les mauvaises techniques de récolte souvent pratiquées par ces personnes sont le plus souvent à l'origine de la menace de disparition qui pèse sur certaines espèces. C'est pour cette raison que les exploitants sont pour un renforcement du contrôle dans le secteur, car les industriels ne se soucient pas de la régénération de la ressource. Ils sont beaucoup plus préoccupés par le gain économique. Les gros industriels devaient rester sur place, attendre que les exploitants moyens et petits leur vendent le matériel, ce qui participera à la lutte contre la pauvreté. Les gros industriels devraient simplement solliciter les titres de transformation ou d'exportation des produits spéciaux.

A la lecture de ces conflits, la question qui vient tout de suite à l'esprit est de savoir s'il faut ou non catégoriser les titres d'exploitations : droit d'usage, petits permis, permis moyens, gros permis ?

7.6 L'Etat ne gagne rien de l'exploitation des produits spéciaux

La taxe de régénération de 10 FCFA fixée reste très faible par rapport au profit marginal fait par ceux des exploitants qui s'adonnent à la commercialisation des produits spéciaux aussi bien sur les marchés nationaux que sur les marchés internationaux. En 1999, un total de 5114 tonnes de produits spéciaux a été accordé à 9 sociétés ou établissements. La taxe de régénération perçue sur ce tonnage par l'Etat n'a été que de 15 000 000 de FCFA contre les 51 140 000 FCFA attendus. Soit une différence de 36 140 000 FCFA de montant qui est resté impayé. Pendant la même année (1999), les ventes obtenues des exportations du rotin camerounais se chiffraient à 13,5 milliards de FCFA (Defo, 2003).

Il a été relevé des discordances importantes entre les données des permis, les déclarations des quotas utilisés faites par les exploitants au niveau du Programme de Sécurisation des Recettes Forestières et les quantités de produits sorties à partir du port de Douala. Toutes ces données illustrent un certain nombre des faits : la mauvaise foi des opérateurs économiques à s’acquitter de leur taxe qui est déjà pourtant très faible comparé aux bénéfices réalisés , les fausses déclarations des quotas récoltés, par les opérateurs économiques (A l’époque la taxe de régénération se payait après récolte du produit et selon un système déclaratif : c’est chacun qui vient déclarer ce qu’il a récolté ou exploité), la grande différence qui existe entre les taxes à payer et les prix de ventes pratiqués sur les marchés tant intérieurs qu’internationaux, et enfin, la sortie illicite des produits qui empruntent souvent plusieurs voies ou circuits pour parvenir à l’extérieur du pays.

Le profit marginal réalisé par les opérateurs économiques est tellement important sur les produits spéciaux au point où, même certains des opérateurs qui jadis étaient concentrés sur le bois d’œuvre, se sont tournés vers cette catégorie de ressources pour faire tourner leur société. Tel est le cas de la Société EQUATO BOIS qui en 2006, a bénéficié d’un permis spécial pour récolter dans toutes les provinces et dans le domaine national, 6075 tonnes de cinq produits à savoir : Ebène (500 tonnes), Yohimbé (100), Gomme arabique (200), Charbon (4250), Rotin (200), *Funtumia* (775), et *Rauvolfia* (70). Ces produits ne lui auraient coûté que 60 750 000 FCFA comme taxe à débourser à l’Etat. Cette modeste somme reste très négligeable comparée à la taxe d’abattage à payer pour le bois d’œuvre de même volume.

L’Etat ne gagne rien de cette exploitation. Dans la province du Sud, et notamment dans la zone d’Ebolowa par exemple, on assiste à un important commerce de Irvingia en direction du Gabon et du Nigeria. Au niveau local (Ebolowa), les commerçants achètent le sac de 40 seaux de 5 litres (= sac de 250 kg) à 208 000 FCFA (soit 5200 FCFA le seau de 5 litres). Ils paient 4000 FCFA par sac aux agents des forêts comme taxe de régénération. Ils déboursent en outre une somme de 6500 FCFA pour traverser les différentes barrières routières (tracasseries policières) surtout lorsqu’il faut se rendre avec son produit à Limbé (Idenau). A Limbé, le commerçant vend son produit au Nigérian à 240 000 FCFA. Ceci lui donne une certaine marge bénéficière de l’ordre de 32 000 FCFA/sac. Les frais de transport du sac Ebolowa – Limbé sont à la charge du commerçant. Ce fait soulève un certain nombre de problèmes. Les 4000 FCFA prélevés par sac comme taxe de régénération sont de loin supérieurs aux 2500 FCFA (10 FCFA/kg) prévus pour les 250 kg de produit. Après avoir payé cette taxe de régénération, les commerçants sont encore tenus de subir des tracasseries policières, lesquelles sont opérées aussi bien par les agents du MINFOF que par les autres corps (policiers, gendarmes, douaniers). Les tracasseries policières coûtent encore plus chères que la taxe de régénération prélevée. Question : Pourquoi les papiers délivrés par les agents forestiers d’Ebolowa sont contestés par les autres barrières ? Les commerçants pensent qu’obtenir un permis d'exploitation des produits spéciaux n'est pas facile. Le processus est long et coûteux. Ils préfèrent obtenir des papiers spéciaux des agents du MINFOF sous forme de gré à gré (4000 FCFA/sac). Malgré les montants exagérés de la taxe de régénération et les tracasseries routières, les commerçants affirment qu'ils trouvent leur compte dans cette filière. Ce qui illustre encore le caractère de gratuité (ou de non bénéfique pour l'Etat), attribué à l'exploitation des produits spéciaux au Cameroun (Betti, 2007).

7.7 Contraintes liées à la production, transformation et conservation des produits:

Les techniques de productions et transformation sont rudimentaires et ne permettent pas de valoriser au mieux les produits ; régression progressif du potentiel productif des PFNL, attaques parasitaires occasionnant des grandes pertes de production, insuffisance des travaux de domestication, situation foncière non clarifiée, faible capacité technique de stockage, inaccessibilité de certains sites de production en raison du mauvais état des routes, non respect des périodes de récolte de certains produits, la récolte des produits immatures (feuilles de *Gnetum* spp.) ; faible niveau technique des équipements pour la transformation artisanale qui oblige les transformateurs à exercer dans des conditions insalubres,;

7.8 Contraintes liées à la commercialisation :

Ces contraintes englobent entre autres le manque d'un système d'information sur les marchés, un cadre réglementaire inadéquat, un secteur mal connu du secteur bancaire (risque élevé pour beaucoup), la non standardisation des unités de mesure, prééminence du secteur informel, faible prix d'achat aux producteurs, faible capacité organisationnelle des acteurs ;

7.9 Contraintes liées à la gestion :

Il s'agit notamment ici d'une faible capacité technique des acteurs (gestion comptable) …

8. Plan d'action stratégique sur la gestion durable des produits à base de *Boswellia spp.*

8.1. Introduction

Malgré l'importance reconnue aux PFNL pour leur contribution à la lutte contre la pauvreté, les résultats des recherches présentés dans la section précédente (section 7) montrent de nombreuses limites dans la gestion des PFNL camerounais : le potentiel des PFNL reste jusqu'à présent très peu connu tant sur le plan qualitatif que sur le plan quantitatif, les circuits de commercialisation sont inorganisés et sont très peu maîtrisés par l'administration forestière, les données statistiques sur les produits spéciaux ne sont pas collectées de manière systématique dans les différents postes de travail, aucune procédure d'analyse n'est mise sur pied, les normes d'exploitabilité rationnelle ne sont pas développées,. Tout ceci fait que les quotas attribués sur les produits spéciaux ne sont pas arrêtés en fonction du potentiel disponible, de nombreux produits spéciaux commercialisés et exportés échappent au contrôle forestier, aucune stratégie nationale de contrôle des produits spéciaux n'est développée, l'exploitation des produits spéciaux n'est pas planifiée dans l'espace et dans le temps. La demande en Boswellia va de plus en plus grandissante, et nécessite par conséquent une planification de sa gestion en vue d'assurer la durabilité (MINEF 2003).

Des initiatives ont été conduites dans le but de développer des stratégies en vue de la valorisation des PFNL (Tchatat et al. 2002, MINEF 2003) ou encore de la collecte et analyse des données statistiques sur les PFNL (Mbolo 2002) au Cameroun. Parmi les nombreuses activités qui ont été identifiées dans ces stratégies, très peu si non aucune n'a encore été mise en œuvre à cause probablement des limites relevées aussi bien dans la précision que dans la suite logique des missions à mener sur le terrain. Le présent plan d'action stratégique est proposé pour remédier à ces problèmes. Il est conçu de manière à être applicable dans l'ensemble des pays du bassin du Congo.

8.2. Objectifs

L'objectif global de ce plan d'action est de promouvoir la gestion durable et plus rentable des produits à base de Boswellia au Cameroun

Les objectifs spécifiques sont: •

- connaître la ressource et les produits à de *Boswellia* ;
- proposer des schémas de gestion et mettre en oeuvre ces schémas

8.3. Activités

Les activités identifiées et à mener sont listées ci-après pour chaque objectif spécifique.

8.3.1. Objectif spécifique 1 : Connaissance de la ressource

La connaissance de la ressource est une étape primordiale dans l'objectif global de production et valorisation de Boswellia. La connaissance de la ressource va s'opérer en trois étapes principales dans la suite logique suivante : état des lieux, enquêtes ethnobotaniques, inventaires.

8.3.1.1. Etat des lieux sur Boswellia

De nombreuses données ont été collectées sur Boswellia du Cameroun. Mais, ces données existent en formes dispersées dans les différentes institutions. L'état des lieux sera basé essentiellement sur les données disponibles dans la littérature. Les activités concrètes à mener dans cet état des lieux sont : • rassembler la littérature sur *Boswellia* étudiés au Cameroun. Afin de limiter les opérations de confirmation des identifications, il faudra limiter cette littérature essentiellement au niveau des publications scientifiques de qualité établie. Les rapports, mémoires, et thèses non publiées sont à proscrire; • concevoir une base de données simple dans Excel pour l'enregistrement des données trouvées dans la littérature rassemblée; • enregistrer pour chaque plante citée, les données sur : o la source de l'information : nom de l'auteur, nom de la revue scientifique ou de la maison d'édition, date de publication ; o les noms : noms vernaculaires (groupes ethniques), nom commercial, nom latin, synonyme des noms latins ; o types d'usages : alimentaire, construction, objet d'art, médicinal. Si l'usage médicinal est relevé, préciser la maladie, le symptôme ou l'effet physiologique indiqué ; o les caractéristiques des usages : organes végétaux utilisés (amande, arille, aubier, bois, boutons floraux, bulbe, écorce de tige, écorce de racine, feuilles adultes, feuilles âgées, feuilles jeunes, fleurs, fruit mature entier, fruit sans les graines, graines, gomme, latex, plante entière, pollen, racine, rameau, résine, rhizome, sève, tige feuillée, tubercule, …), mode de prélèvement (ramassage ou récolte), technique de prélèvement (coupe à blanc, coupe partielle, écorçage au quart opposé, écorçage au 2/3), mode de préparation (calcination, carbonisation, décoction, dessication, infusion, macération, pulvérisation, …) ou la forme pharmaceutique de base (cendre, décocté, macéré, pulvérisat, …) ou élaborée (baume, cataplasme, lotion, …) utilisée, véhicule utilisé dans la préparation (eau, lait, alcool, jus de citron, huile de palmiste, …), mode d'administration du produit (application locale, scarification, voie orale, voie rectale, …) ; o le marché : marché local, marché étranger, produit spécial ; o les caractéristiques floristiques : localité ou les renseignements ont été recueillis sur la plante, longitude et latitude, numéro du spécimen botanique en herbier, herbier où est déposé l'échantillon de référence, biotope (forêt dense sèche, forêt claire, forêt de montagne, forêt secondaire, forêt marécageuse, forêt ripicole, savane arborée, savane arbustive, savane herbeuse, …), phytochorie ou type phytogéographique (espèces cosmopolites, pantropicales, afro-américaines, paléotropicales, afrotropicales, afromalgaches, plurirégionales africaines, soudanozambézienne, omni ou sub-omniguinéocongolaise, centroguinéencongolaise, occidentales guinéennes, Cameroun-Congo, Cameroun – Gabon, sahélienne, soudanienne,…), types et modes de dissémination des diaspores (diaspores légères anémochores, diaspores charnues lourdes, diaspores hydrochores, diaspores autochores, …) ; o les paramètres structuraux : abondance du taxon, fréquence (absolue ou relative), densité (absolue ou relative), dominance relative, importance relative, structure spécifique, accroissement annuel, phénologie, …

8.3.1.2. Enquêtes ethnobotaniques

La méthode ethnobotanique (botanique des sociétés) est préférée dans cette proposition car, en plus de l'efficacité qui lui est reconnue sur le plan pharmacognosique (Balick, 1990 ; King et Tempesta, 1994 ; Cotton, 1996, Betti 2006), cette approche a l'avantage de créer un cadre de négociation ou de concertation (Sow et Anderson, 1996 ; Cotton, 1996) entre le personnel forestier ou le chercheur et les populations locales. Par ailleurs, l'ethnobiologie (ethnobotanique, études chasses, …) est de plus en plus reconnue comme un outil efficace de développement – conservation (Betti 1998, 2006, Malaisse 1997). Après avoir fait l'état des lieux sur *Boswellia* au Cameroun sur la base de la littérature disponible, l'étape suivante consistera à aller sur le terrain pour collecter des informations sur les usages traditionnels ou la commercialisation de ces produits. Les données collectées dans les différentes publications et enregistrées plus haut ont probablement été collectées avec différentes approches méthodologiques, ce qui a rendu difficile les comparaisons et leur valorisation. Les informations devront être collectées selon une méthodologie standardisée dans l'ensemble du territoire. Les principales activités à conduire dans les enquêtes ethnobotaniques sont : • concevoir les fiches d'enquêtes : ces fiches devront comprendre au moins les 5 principales rubriques suivantes en plus de la date: identification de l'enquêteur, identification de l'informateur, type d'usage, caractéristiques des usages, caractéristiques du matériel végétal, remarques ; • procéder à un quadrillage systématique du grand nord (région de l'Adamaoua, Nord et Extrême Nord) en mailles régulières de 5 ou 10 km x 10 km. Ce maillage est très important dans l'optique de la spatialisation de l'information, car il faudra rapporter toutes les informations collectées à l'échelle de chaque maille ; • développer le dispositif d'échantillonnage ; • former les enquêteurs : cette formation devra être basée sur les techniques d'approches ethnoparticipatives (réunions de sensibilisation,…), le langage ethnopharmacologique (mode de préparation et formes des médicaments), le langage ethnobotanique (type biologique, type de diaspore, …), la confection d'un herbier, … ; • réaliser le sondage (enquêtes) proprement dit : il s'agira ici de mener des enquêtes ethnoparticipatives dans les trois régions du grand Nord du Cameroun, premièrement dans les ménages des localités ciblées sur l'usage populaire de Boswellia. La méthodologie adoptée par le programme ECOFAC dans le bassin du Congo peut être utilisée ici : Lejoly (1993), Betti (2002), Betti (2004), Betti & Lejoly (2000), Betti & al. (1999). Une deuxième enquête concernant la commercialisation des produits à base de Boswellia sera conduite dans les marchés selon les méthodologies utilisées par le programme ECOFAC (Debroux & Dethier 1993, Nlegué 1994 ;

Betti 2002a,b,c, Betti 2003a,b, Betti & al. 1999) et le CIFOR (Ndoye & al. 1997). Ces deux enquêtes permettront d'avoir des informations fiables sur Boswellia dans chaque zone, ses usages, et les premières informations sur les caractéristiques floristiques. Il faudra confirmer les identifications des plantes et monter un herbier de référence sur les PFNL du Cameroun ;

8.3.1.3. Inventaires

L'inventaire permettra de rassembler les données en vue de la caractérisation et de l'analyse structurale de la florule de Boswellia. La méthode proposée est celle ayant fait ses preuves dans le programme ECOFAC (Lejoly 1993, Betti 2002). Les activités à conduire sont : (1) délimiter des grandes zones d'exploitation de Boswellia ou Unité d'Allocation à Boswellia (UAB); (2) concevoir le dispositif d'échantillonnage ; (3) concevoir les fiches d'inventaires ; (4) former les prospecteurs ; (5) délimiter les transects et les quadrats ; (6) procéder au comptage des tiges et à la prise des données sur les paramètres structuraux et phénologiques, eyc…. Sur base des activités sus relevées, il sera possible d'établir pour une espèce ciblée, son statut de vulnérabilité : aspect très important si l'on veut gérer de manière durable ces ressources (Betti 2007, 2002).

8.3.2. Objectif spécifique 2 : Elaboration et mise en oeuvre des mesures de gestion

Il s'agira ici tout d'abord de développer sur base des informations obtenues dans les sections précédentes, un plan simple de gestion pour chaque UAB. Une fois le plan de gestion élaboré, il faudre passer à sa mise en oeuvre avec un accent fort sur l'affinement des paramètres d'aménagement, la définition claire des quotas et la mise sur pied d'un système de traçabilité. Les résultats présentés dans les sections précédentes permettent de constater que l'exploitation de Boswellia comme la plupart des PFNL n'est pas suffisamment réglementée et planifiée. De nombreux produits échappent au contrôle des agents forestiers tant au niveau de l'administration centrale qu'au niveau des postes sur le terrain.

Dans le but de sécuriser à la fois les ressources et les recettes issues de l'exploitation de ces ressources, nous avons identifié dans l'ordre les trois activités suivantes : développer des normes d'exploitabilité rationnelle, élaborer une stratégie nationale de contrôle et organiser des réunions sous-régionales avec les autres pays de l'aire de distribution.

8.3.2.1. Développement des normes d'exploitabilité rationnelle des PFNL

Ll'un des problèmes de fonds présentés par les agents forestiers rencontrés sur le terrain pour le contrôle des produits spéciaux réside sur l'inexistence des standards ou normes de contrôle des produits. Comment reconnaître qu'un opérateur économique, permissionnaire, a mal récolté l'écorce de Boswellia ? L'élaboration des normes d'exploitabilité constitue donc une urgence dans le développement d'une stratégie de contrôle dans le secteur de Boswellia en particulier et des PFNL en général. Pour cela, il faudra : (1) faire tout d'abord un état des lieux sur les normes d'exploitabilité qui ont été développées dans la littérature existante en rapport certains PFNL (*Prunus africana* par exemple) ; (2) réaliser des études en vue d'élaborer de nouvelles normes ; (3) vulgariser les normes auprès des agents forestiers.

8.3.2.2. Elaboration d'une stratégie nationale de contrôle

La fonction de suivi/contrôle forestier est la première fonction régalienne de l'administration forestière ; mais elle est défaillante avec des impacts directs dans la gestion durable de la ressource. Une stratégie de contrôle forestier pour le bois d'œuvre et de lutte anti-braconnage a été élaborée en 1999 avec des résultats plus ou moins mitigés dans un contexte où quasiment tout le monde fait du contrôle (ou plutôt de la recherche d'infractions). Aucune stratégie de contrôle n'a encore été développée dans le secteur des PFNL. Dans l'élaboration de la stratégie de contrôle, il faudra comme relevé dans la composante n° 3 du Programme sectoriel forêt – environnement (PSFE 2003) :

A/ recentrer et clarifier le rôle de chaque niveau/service en fonction de son positionnement : il ne sert à rien de multiplier les acteurs du contrôle, ce qu'il faut faire c'est faciliter la responsabilisation et le suivi de chaque acteur sur une tâche précise, il faut adopter une approche fonctionnelle en groupes cohérents d'activités affectés à l'acteur le mieux placé, l'organisation interne doit être simple et adaptée aux priorités et aux évolutions stratégiques. Sur ces bases, le rôle de chaque niveau/service doit être clarifié et recentré comme suit : (1) recentrer les Postes forestiers de contrôle vers la surveillance et la répression de l'exploitation illégale (au sens d'opérateurs sans titre valide), car ils sont les mieux placés pour assurer un quadrillage permanent du territoire, en s'appuyant sur les remontées d'information des concessionnaires privés ou des villageois ; (2) sortir la fonction « check-point » des postes forestiers de contrôle et développer un réseau spécifique, sur la base de celui déjà en place au Programme de sécurisation des recettes forestières (PSRF), pour assurer un filet de sécurité aux points stratégiques avec l'appui des nouvelles technologies de contrôle ; (3) confirmer le Délégué régional comme ordonnateur principal du contrôle, chargé d'organiser, planifier et suivre (notamment approuver et suyivre les plans de travail des Délégués départementaux) ; (4) recentrer et renforcer sur les services centraux sur : la coordination et le suivi du système. Ces fonctions devraient être centralisées à la Direction des forêts.

B/ Evoluer vers un système planifié qui s'appuie sur un système d'information : si le système actuel est défaillant ou peu efficace, c'est aussi parce que plusieurs fonctions complémentaires aux fonctions ci-avant ne sont pas suffisamment assurées. Cela conduit à des activités de contrôle isolées d'un système global de gestion, à une efficacité réduite et une transparence limitée. Pour y remédier il est nécessaire de mettre en place une chaîne de contrôle, sur la base des tâches clarifiées ci-avant, qui permette d'activer les procédures d'acheminement, traitement, suivi et archivage dés qu'un procès verbal de contrôle est dressé, s'appuyant notamment sur : (1) Un système d'information qui permette de suivre les étapes du procès verbal jusqu'au contentieux ; (2) Une inter-action avec le service de recouvrement du PSRF en termes de transmission des amendes et dommages – intérêts à recouvrir puis retour d'information pour clôture du dossier ou mesures judiciaires en cas de non-paiement ; (3) Le développement, notamment au niveau du Délégué provincial, de mécanismes simples de planification/suivi – évaluation/coordination ; (4) Une amélioration de la banque de données SIGIF dans le sens d'intégrer les informations en rapport avec l'exploitation des produits spéciaux ; (5) Une inter-action entre les banques de données SIGIF (exploitation) et COMCAM (commercialisation) (6) L' « institutionnalisation » et la déconcentration des outils SIGIF ou COMCAM sous forme d'unités centrales et provinciales, compte tenu des liens étroits contrôle/information forestière/géomatique.

8.3.2.3. Réunions sous régionales

Des réunions régulières de partage d'expérience des pays de l'aire de distribution (Cameroun, RCA, Tchad) devraient être organisées en vue s'assurer de la gestion durable et plus rentable de ces espèces.

Conclusion

Le genre *Boswellia* compte environ 25 espèces des savanes soudaniennes, sahéliennes et zambéziennes africaines. Au Cameroun 2 espèces sont signalées: *B. dalzielii* et *B. Papyrifera*. Les deux espèces sont utilisées comme PFNL par les populations des trois régions de l'Adamaoua, Nord et Extrême Nord comme plante médicinale dans le traitement de divers maux tels les helminthiases intestinales, le paludisme, les diarrhées. L'usage comme Frankincense n'est cependant pas encore très largement connu. Quelques travaux ont été conduits dans les inventaires, mais les résultats obtenus ne permettent pas encore de tirer des orientations pour une gestion durable. Pour les populations locales, l'espèce n'a pas de problème, puisqu'elle n'est pas utilisée comme bois de chauffe. Elle est essentiellement plantée pour des besoins d'ombrage. L'espèce semble cependant être menacée dans son milieu naturel du fait notamment des difficulté de régénération, des feux de brousse, et du pâturage. Les récentes découvertes faisant mention de propriétés actives dans le traitement des cancer et dans le renforcement du système immunitaire vont à coup sûr succiter la motivation des populations à se ruer sur ces espèces. La politique forestière en rapport avec la gestion des PFNL comme *Boswellia* a beaucoup évolué au Cameroun, mais de nombreuses contraintes sont encore perceptibles. Le plan d'action proposé vise à s'assurer que le commerce des produits à base de *Boswellia* ne soit pas préjudiciable à la conservation des ressources dans leur milieu naturel.

Références

Balick, M.J. 1990. Ethnobotany and the identification of therapeutic agents from the rainforest. In. Chadwick DJ & Marsh J (eds) Bioactive compounds from plants (Ciba Foundation Symposium No. 154). Wiley, Chichester, pp. 22-32.

Betti, J. L. 2002a. Medicinal plants sold in Yaoundé markets, Cameroon. African Study Monographs, 23 (2): 47 - 64.

Betti, J. L. 2002b. Vulnérabilité des plantes utilisées comme antipaludiques dans l'arrondissement de Mintom au sud de la reserve de biosphere du Dja (Cameroun). Systematics and Geography of Plants 71, 661-678.

Betti, J. L. 2003a. Plantes utilisées pour soigner le paludisme dans la reserve du Dja, Cameroun. Revue de Médecines et Pharmacopées Africaines 17, 121-130. 96

Betti, J. L. 2003b. Plantes utilisées comme aphrodisiaques dans la reserve du Dja, Cameroun. Revue de Médecines et Pharmacopées Africaines 17, 145-152.

Betti, J. L. 2004. An ethnobotanical study of medicinal plants among the Baka pygmies, in the Dja biosphere Reserve, Cameroon. African Study Monographs 25 (1), 1-27.

Betti, J. L. 2005 – 2006. Usages populaires des plantes médicinales chez les Bulu à l'ouest de la Réserve du Dja, Cameroun. Revue de Médecines et Pharmacopées Africaines. 19: 93-106

Betti, J. L. 2006. Ethnobiology as a useful tool for the community based development and the conservation of natural resources in the Dja biosphere reserve, Cameroon. The Tenth International Congress of Ethnobiology. Ethnobiology: Food, Health, and Cultural Landscape/Symposium I: Biodiversity for community development: mediating between cultural preservation and development. Chiang Rai, Thailand, 5-9 November 2006.http://ww.biodiversityinternational.org/Themes/Communities_and_livelihoods/pdf/ice 10.pdf

Betti J.L. 2007 Plan d'action/stratégie pour une meilleur collecte des données statistiques sur les Produits forestiers non ligneux au Cameroun et recommandations pour les pays de la COMIFAC. Projet Renforcement de la sécurité alimentaire en Afrique centrale à travers la gestion et l'utilisation durable des produits forestiers non ligneux, GCP/RAF/398/GER, FAO – COMIFAC - GTZ 180 p.

Betti J.L, Ambara J 2013. Mass of Prunus africana stem barks on Tchabal Mbabo and Tchabal

Gang Daba Mountain Forests, Cameroon. African Journal of Environmental Science and Technology, 7 (5): 204-221. DOI: 10.5897/AJEST11.24, ISSN 1996-0786 ©2013Academic Journals.

.

Betti, J. L. Nlégué, E-Y. et Lejoly, J. 1999. Etude ethnobotanique des plantes utiles dans la réserve de biosphère du Dja (Cameroun) : les fruitiers sauvages. In A. Guerci (eds.), Il Cibo E Il corpo. Dal Cibo alla cultura, dalla cultura al cibo. Erga edizioni, CD-Rom, 129- 144.

Betti J.L., Mebere Yemefa'a S.R., Tarla Ntchembi F. 2011. Contribution to the knowledge of non wood forest products of the far north region of Cameroon: Medicinal plants sold in the Kousséri market, Journal of Ecology and the Natural Environment, 3 (7): 241-254.

Betti J.L, Ngankoue Manga C, Njimbam Njukouyou F.O., Wete E. 2016. Monitoring the implementation of *Prunus africana* (Rosaceae) management plans in Cameroon: respect of norms. African Journal of Plants Sciences 10 (9) : 172-188. DOI: 10.5897/AJPS2016.1444, ISSN 1996-0824

Cotton. 1996. Ethnobotany. Principles and applications. Ed. Wiley, 424p.

Defo L. 2004 Le Cameroun et le marché international du rotin. Actes du premier forum national sur le Rotin – bamboo, Association pour la Protection et la Valorisation des ressources forestières (APVF), 25-26 mai 2004, Yaoundé, Cameroun pp: 19-21.

Doucet, J.L. et A, Koufani. 1997. Etude des produits secondaires végétaux de la Forêt de Kompia (Cameroun) : utilisations, inventaires, régénération, commercialisation et gestion durable. Projet « mise en place de forêts communautaires en périphérie de la Réserve de Faune du Dja (Cameroun) » financé par la Commission Européenne. Faculté universitaire des Sciences agronomiques de Gembloux, Gembloux (Belgique).

Evans M. 2013. The cancer-killing properties of frankincense in ovarian cancer. http://soundcloud.com/university-of-leicester/mark-evans)

FAO. 1995. Non-wood forest products for rural income and sustainable forestry. 118 p. + annexes.

Haiwa G, Tchobsala, Ngakou A 2017. Ecological characterization of the Vegetation in the Sudano-Sahelian Zone of Cameroon

Ingram V, Schure J. 2010. Review of Non-Timber Forest Products (NTFPs) in Central Africa: Cameroon. Yaounde: CIFOR/FORENET Project. P 177.

Khajuria A., Gupta A.,Suden P., Singh S., Malik F., Singh J. 2008. Immunomodulatory activity of biopolymeric fraction BOS 2000 from *Boswellia serrata*. Phytother Res 22 (3), 340-8.

Kémeuzé VA, Mapongmetsem PM, Avana Tientcheu M, Nkongmeneck BA, Jiofack RB 2012 *Boswellia dalzielii* Hutch : Etat du peuplement et utilisation traditionnelle dans la région de Mbé (Adamaoua-Cameroun). Secheresse 2012 ; 23 : 278 –83.

King, SR. et Tempesta, MS. 1994. From shaman to human clinical trials: the role of industry in ethnobotany, conservation and community reciprocity. In Chadwick DJ & Marsh J (eds) Ethnobotany and the Search for New Drugs (Ciba Foundation Symposium No. 185). Wiley, Chichester, pp. 197-206.

Lejoly, J. 1993. Ethnobotanique et méthodologie pour les inventaires biologiques. Projet ECOFAC (Conservation et utilisation rationnelle des écosystèmes forestiers en Afrique centrale). AGRECO-CTFT, Bruxelles, 137 p

Lemenih, M., Teketay, D. 2003. Frankincense and myrrh resources of Ethiopia: medicinal and industrial uses. SINET Ethiopian Journal of Science 26,161-172.

Malaisse, F. 1997. Se nourrir en forêt claire africaine. Approche écologique et nutritionnelle. Les presses agronomiques de Gembloux. Gembloux, Belgique.

Mbolo, M. 2002. La collecte et l'analyse des données statistiques sur les produits forestiers non ligneux : une étude pilote au Cameroun. Programme de partenariat CE – FAO, Projet Collecte et analyse de données pour l'aménagement durable des forêts : joindre les efforts nationaux et internationaux, GCP/INT/679/EC. 136 p.

Malzy P. 1954. Quelques plantes du Nord Cameroun et leurs utilisations. In: Journal d'agriculture tropicale et de botanique appliquée, 1 (5-6): 148-179.

MINEF 1998. Manuel des procédures d'attribution et des normes de gestion des forêts communautaires, Yaoundé, Cameroun, ministère de l'Environnement et des Forêts, 101 p.

MINEF. 2004. Décision portant attribution des quotas des produits spéciaux au Cameroun pour l'année 2004.

MINEF. 2003. Aménagement des forêts de production du domaine permanent et valorisation des produits forestiers. Programme Sectoriel Forêts et Environnement (PSFE), Composante 2, 139 p.

MINEF. 1996. A Compendium of official instruments on forest and wildlife management in Cameroon. Imprimerie nationale, Yaoundé, 185 p.

MINEF. 1995. National Forestry Action Programme of Cameroon. Forestry policy document 378 p.

MINFOF. 2005. Décision portant attribution des quotas des produits spéciaux au Cameroun pour l'année 2005.

MINFOF. 2006. Décision portant attribution des quotas des produits spéciaux au Cameroun pour l'année 2006.

MINFOF. 2007. Décision portant attribution des quotas des produits spéciaux au Cameroun pour l'année 2007.

Ndoye, O. Ruiz-Perez, M. Eyebe, A. 1997. The market of non-timber forest products in the humid forest zone of Cameroon. Rural Develoment Forestry Network Paper 22c. ODI. London, Royaume-Uni.

Nkuinkeu R, Wanty P. 2007. Vulgarisation des techniques d'exploitation des produits forestiers non ligneux : Prunus africana (Hook. F.) Kalkmann, plante medicinale surexploitee du Cameroun. Cameroon Journal of Ethnobotany 1 : 74-8

Onana JM. 2007. Etat de connaissance de la Flore du Cameroun. XVIIème Congrès de l'AETFAT, Yaoundé, Abstract.

Onana JM. 2017. Flore du Cameroun. Vol 43: Burseracee. Onana JM et Harvey YB ed. MINRESI. pp 94.

République du Cameroun 1994 Loi 94/01 du 20 janvier 1994 portant régime des forêts, de la faune et de la pêche, 57 p..

République du Cameroun 1995 Décret n° 95/531 du 23 août 1995 fixant les modalités d'application du régime des forêts, 66 p.

Sandjong Sani RC, Ntoupka M, Ibrahima A, Vroumsia Toua 2013 Etude écologique du Parc National de Mozogo-Gokoro (Cameroun): prospections préliminaires de la flore ligneuse et du sol pour sa conservation et son aménagement. Int. J. Biol. Chem. Sci. 7(6): 2434-2449.

Saotoing P, Vroumsia Toua, Tchobsala, Tchuenguem Fohouo F , Njan Nloga A-M, Messi J 2011 Medicinal plants used in traditional treatment of malaria in Cameroon. Journal of Ecology and the Natural Environment 3 (3):104-117.

Satabie, B. 1982. Richesse floristique du Cameroun. Revue Science et Technique, 2 (73 – 80).

Sow, M. et Anderson, J. 1996. La forêt vue par les villageois Malinké des alentours de Bamako au Mali, rev. UnasyLVa, 186 (47) : 22-27

Tchatat, M. Vabi, M. et Bidja, R. 2002. Gestion durable des produits forestiers non ligneux au Cameroun : état biologique et socio-économique du sous-secteur et éléments pour l'élaboration d'une stratégie nationale de gestion, Rapport non publié. Projet Développement de la Foresterie Communautaire (PDFC), Coopération Technique Britanique

Annexe

TERMES DE REFERENCE DU CONSULTANT SUR LA DECISION 18.205 - 18.208 DE LA CITES SUR Boswellia (*Boswellia* spp.)

PREAMBULE

En date du 10 Février 2020, une notification a été publiée par le Secrétariat Général de la Convention sur le Commerce international d'espèces de faune et flore sauvages menacées d'extinction (CITES), notification par laquelle le SG demande aux pays de l'aire de distribution de faire la situation de l'exploitation et du commerce des espèces du genre *Boswellia*.

Le Cameroun faisant partie des pays qui regorgent les populations de Boswellia, s'est donné pour mission de répondre à cette demande par des informations scientifiques et techniques sur différents aspects.

Le présent document définit les termes de références d'une étude à mener en vue de permettre au Ministère des Forêts et Faune, organe de gestion CITES du Cameroun, de présenter un rapport complet sur cette question.

ACTIVITES A MENER

De manière plus précise, l'étude devra :

a) rassembler des données biologiques sur les espèces du genre *Boswellia*, y compris la taille des populations, la répartition, l'état de conservation et les tendances des populations, des données d'identification, ainsi que leur rôle dans les écosystèmes dans lesquels elles sont présentes ;

b) rassembler des informations disponibles sur les niveaux de récolte et d'exploitation, les noms commerciaux, les parties prenantes associées à la récolte des espèces et les caractéristiques de la chaîne d'approvisionnement pour la consommation nationale et le commerce international ;

c) rassembler des informations sur les menaces pesant sur ces espèces, en particulier en ce qui concerne les causes sous-jacentes des faibles capacités de régénération et les impacts de l'exploitation de ces espèces :

d) rassembler des informations sur toute initiative visant à reproduire artificiellement ces espèces ou à en produire des plantations ;

e) préciser les réglementations en vigueur et les structures de propriété concernant les espèces, leurs habitats, les facteurs influant sur les habitats, ainsi que les mesures de gestion en place ou en cours d'élaboration, y compris les pratiques d'exploitation durable :

f) faire des suggestions de réunions ou d'autres évènements susceptibles de fournir des possibilités de collaboration ou d'échange d'informations sur l'exploitation et la gestion de ces espèces.

DELAI D'EXECUTION

Le délai de réalisation du marché est de **15 jours étalés sur 3 mois**

Parmi les individus exploités, les volumes d'ecorces prélevés vont de 1 360 cm3 à 40 482 cm3. Ces volumes varient en fonction de la circonference des individus. Le pourcentage des individus ayant subi des prélèvements a une hauteur inférieure à 50 cm est de 41 %, de 24 % pour des prélèvements à des hauteurs comprises entre 50 cm et 1 m et enfin, de 35 % pour les individus prélevés à plus de 1 m. Aucun individu mort sur pied n'a été rencontré dans le site d'étude (Kémeuzé et al. 2012).

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party: Eritrea	
1b.	Institution: Ministry of Agriculture, Regulatory Services Department	
1c.	Contact information of the representative who responded to the questionnaire:	Name: Mr. Yacob Yohannes IFTER
		Phone: +2917225956
		Email: yacobifter@gmail.com
		Other:

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

Boswellia papyrifera

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
• *Boswellia papyrifera*	☐	☐	☒		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• *Boswellia papyrifera*	☐	☐	☒		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2d.	For each species occurring in your country, please provide its habitat trends. Add rows if needed.					
	Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
•	*Boswellia papyrifera*	☐	☐	☒		☐
•		☐	☐	☐		☐
•		☐	☐	☐		☐

2e. Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.

Boswellia papyrifera was found in three administrative regions of Eritrea, Anseba, Gash-Barka and Debub. Out of the 30 villages visited in Anseba, Boswellia papyrifera was present in 8, had disappeared in 5 and was absent in 17 villages. In the 34 villages in Gash-Barka region these figures were 13, 10 and 11 respectively, meaning that the species is still present or was present in about two third of the villages. In Debub where 38 villages were visited the situation was the reverse Boswellia papyrifera was and is present in about one third of the villages. Boswellia papyrifera was and still is mainly found in the moist lowland agroecological zone. Woldeselassie Ogbazgi (2001), The roles played in the ecosystem are to reduce soil degradation, enrich soil fertility, sustain the microclimate of its surrounding, as animal fodder, medicine, timber and resin.

2f. Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.

Reports indicated that in western escarpment and western lowlands the area covered by Boswellia papyrifera was 2,198km^2. In the Anseba region, fragmented and rather sparse stands are mainly found in mountainous areas on sites that are not suitable for agriculture and inaccessible to livestock. This gives a distribution pattern in which the remnant stands are and separated by vast plains and riverine areas. In the Gash-Barka region on the other hand, a relatively large area of intact Boswellia papyrifera woodlands are found. (The distribution and regeneration of Boswellia papyrifera (Del.) Hochst in Eritrea, Woldeselassie Ogbazghi 2001).

2g.	Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats. Main threats are clearing of land for agriculture, grazing and also intensive tapping of trees for gum. The main drives of the threats were shortage of agricultural and grazing lands

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
1.	The Distribution and regeneration of Boswellia papyrifera (Del.) Hochst in Eritrea Woldeselassie Ogbazghi 2001)	
2	Indigenous Trees and Shrubs of Eritrea, Department of Forestry, Wildlife and Environment Ministry of Agriculture Asmara, Eritrea, 1994	
3.	The National Environmental Plan for Eritrea (NEMP-E) Mechanisms to Optimize Resource use and Sustainable Human Development, Prepared by the Government of Eritrea for the people of Eritrea January, 1995	

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use? *Boswellia papyrifra*
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)? For incense (resin), medicine for toothache (gum), carpentry (wood) and live hedge
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors. 3,000 quintals/year of Gum olibanum and gum Arabic are extracted from South western lowlands. (The National Environmental Management Plan for Eritrea (NEMP-E) January 1995).
3d.	What volume is exported (approximate annual export)? Most of the time Boswellia papyrifera is harvested for local consumption for use in coffee ceremony and ceremonials in churches About 30-50 tons/year are exported
3e.	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations. According to the tappers, the number of tapping points per individual tree is fixed in relation to tree size. Small trees ranging 10-20cm in diameter are tapped at four points and larger trees at six points. Therefore, intensive harvest usually affects the sustainability of Boswellia population as tapping affect flowering, seed production and seed viability.
3f.	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations. The present system of intensive annual tapping throughout the dry season and use of inappropriate tapping methods by unskilled labourers cause substantial damage to Boswellia trees and leads to low production of mainly of empty and non-viable seeds that negatively affects the regeneration capacity of Boswellia.

	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries.
3g.	Seedlings of Boswellia papyrifera are produced in nurseries by artificial propagation/cultivation and reforestation efforts through hillside closures, establishment of plantations and planting trees at community and household-levels have been undertaken for the last three decades but due to overgrazing by livestock survival rate is minimum.

3h.	What are the challenges to artificially propagate/cultivate *Boswellia* species in your country? Every year thousands of the species are propagated in nurseries and planted. The problem is there is no follow up of the planted species.	
3i.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Reports of the branch of the Ministry of Agriculture in the regions	
	The National Environmental Management Plan for Eritrea (NRMP-E) January 1995)	

Section 4: Supply chains and international trade (paragraph a), b) and f) of Decision 18.205)

4a. Who are the predominant legal or customary owners / custodians of *Boswellia*?

Government-owned ☒ Local communities ☒ Individual ownership ☒ Community-based or individual land tenure ☐

Please describe the land ownership structure where *Boswellia* spp. occur, including harvest rights.

In Eritrea, three major tenure systems have coexisted for many years. These are the 'Rsti' (family ownership), 'Dessa' (village or collective ownership'), and 'Demaniale' (State ownership). The land tenure system varies from place to place. A new land law issued in 1994 has officially replaced the three traditional land tenure systems, but in practice, the situation has not changed (Government of Eritrea 1994).

4b. If known, please specify who are the main harvesters of *Boswellia* specimens?

Individual collectors ☒ Collector associations ☒ Private companies ☒ Other ☐

Please provide further details on the types of harvesters.

1. Collector association (Like Incensifera Eritrea Share Company)
2. Private companies (Like Sachies Eritrea)

4c. Is there any in-country processing capacity for *Boswellia* specimens? Please describe.

Yes, Keren Incensifera Eritrea Share Company and Sachies Eritrea.

4d. Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones.

The main once are;
1. Incensifera Eritrea Share Company
2. Sachies Eritrea

4e. What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)?

Extracts

4f.	Which are the main known importing countries of *Boswellia* specimens sourced from your country? France, Saudi Arabia, Yemen and Dubai
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported. There is no importation of Boswellia species in the country.
4h.	What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)? No importation of any Boswellia specimens
4i.	What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen. ------
4j.	Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries. No there is no re-export of Boswellia specimens
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded. ------

4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade. -------
4m.	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206. 1. Mr. Estifanos Bein from Ministry of Land, Water and Environment, Department of Environment; Tel; +2917182601

4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a. Please describe any regulations or management measures in place or in preparation concerning

i. The conservation of *Boswellia* populations and/or habitats?

Efforts are made to establish closure areas for Boswellia papyrifera to avoid grazing from livestock and to stop tapping

ii. The sustainable harvest of *Boswellia* specimens?

Training is conducting to forestry experts on technics of tapping, like time for tapping and rest, how many tapping sites should be done in young and mature trees. Awareness programs are also provided to farmers and pastoralist as they usually cut the leaves of Boswellia papyrifera to feed their livestock.

iii. The export of *Boswellia* specimens?

Importation and exportation of forest and their products are conduct by permits.

iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.

The Ministry of Agriculture uses enclosures to rehabilitate degraded vegetation. In total more than 120,000 ha of land, sometimes with Boswellia papyrifera stands, have been enclosed (FAP 1997b). There are indications that the vegetation cover of the woody plants is improving.

5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Report (FAP 1997b)	

Section 6. Additional remarks or information

6a.	Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

- Establishment of enclosures is a promising approach to regenerate Boswellia species
- A less intense gum extraction mechanism should be introduced to minimise the adverse effects of the expoitation.

Thank you very much for your responses!

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party:	
1b.	Institution: Ethiopian Wildlife Conservation Authority	
1c.	Contact information of the representative who responded to the questionnaire:	Name: Wondifraw nega
		Phone:+251926855834
		Email:wonmahi2017@gmail.com
		Other:

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

There are about six types of Boswellia species in Ethiopia. They are *Boswellia papyrifera Boswellia pirottae, Boswellia rivae, Boswellia ogadensis, Boswellia neglecta* and *Boswellia microphyila*

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
• ***Boswellia papyrifera (Del.)Hochst. (1843)***	☐	☐	☐		☒
• ***Boswellia** pirottae Chiov.(1911)*	☐	☐	☐		☒
• *Boswellia rivae Engl. (1898)*	☐	☐	☐		☒
• ***Boswellia** ogadensls Vollesen (1985)*	☐	☐	☐		☒
• ***Boswellia neglecta S.Moore (1811)***	☐	☐	☐		☒
• *Boswellia microphyila Chiov. (1915).*	☐	☐	☐		☒

2c. For each species occurring in your country, please provide information on the **population trend**. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• ***Boswellia papyrifera***	☐	☐	☐		☒
• ***Boswellia** pirottae*	☐	☐	☐		☒
• *Boswellia rivae*	☐	☐	☐		☒

• ***Boswellia** ogadensls*	☐	☐	☐	☒
• ***Boswellia neglecta***	☐	☐	☐	☒
• *Boswellia microphyila*	☐	☐	☐	☒

2d. For each species occurring in your country, please provide its habitat trends. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• ***Boswellia papyrifera***	☐	☐	☐		☒
• ***Boswellia** pirottae*	☐	☐	☐		☒
• ***Boswellia rivae***	☐	☒	☐		☒

2e. Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.

1.Boswellia papyrifera:- Dry Acacia-Commiphora woodland and wooded grassland, Pterocarpus woodland, often dominant on steep rocky slopes, also on lava flows; grow in the altitude range of 950-1800 m. Tigray region, Gondar, Gojam and Somale. The resin is the raw material of the Ethiopian frankincense and is widely collected in North Ethiopia.
2. Boswellia pirottae:- Commiphora-Boswellia, Combretum and Acacia Lannea woodland, on steep rocky slopes; 1200-1800m. Gondar, Gojam(Amhara region), Wolega, Somale Keffa; not known elsewhere. A rare species which is only known from the Tekeze Abay and Gibe river systems. It is closest to *B. papyrifera* from which it differs in the rugose bark, subglabrous leaves, contracted inflorescence smaller flowers and different fruit.
3. Boswellia rivae:- Acucia-Commiphora wooded grassland and bushland, on red sandy to stony soil overlying limestone; 250-800 m. Sidamo, Bale and Harer. The resin is used locally for incense and is also chewed (Somali).
4. Boswellia ogadensis;- Acacia-Commiphora bushland on rocky limestone slope; 300-400 m. Harer; not known elsewhere. Only known from the type-collection. A most remarkable species which doesn't seem to be close to any other species
5. Boswellia neglecta;- Acacia-Commiphora woodland, wooded grassland and bushland, Acacia-Boswe/lia-Terminalia woodlan and wooded grassland, often on red sandy soil overlying limestone but also on basement rocks; 600-1150 m. GG SD BA HA
6. Boswellia microphyila:- Acacia-Commiphora wooded grassland and bushland, usually on red sandy to gravelly soil overlying limestone; Altitudinal range 400-1300 m. Sidamo Bale and Harerge. The resin is used locally for incense (Somali), and the bark is used for tanning (Borana).

- ✓ **Environmental or Ecological role:** The Boswellia species grows in dry and rocky sites where other tree species often fail. In northern Ethiopia, B. papyrifera trees are found in steep slope with an average gradient range of 30-40%. The majority of the soils (60-80%) in northern Ethiopia (where Boswellia grows) are about 20 cm deep. In those sites, it provides plant cover and produces litter and hence protects the soil from erosion and provides shade.
- ✓ The wood of Boswellia is used for poles and timber and for industrial manufacturing of matchboxes, boards and plywood. The leaves provide dry-season fodder, and the flowers are a good source of nectar for bees. Leaves, bark, and roots are also used in traditional medicines. The species is recommended for economic development and desertification control.

2f. Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.

- Already somehow summarized in the above but to know the size and their status requires further more studies.

2g.	Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.

- ✓ *Boswellia papyrifera* is very sensitive for natural or human interferences and could be damaged easily. The most common factors observed causing damage to the trees, in North Gonder Zone, were windfall, insect attack (unidentified whitish worm), termite, fire, improper tapping, clearing and de-branching by local farmers and trampling and browsing by cattle. Especially, the worm attack was very common.
- ✓ Collected for commercial use
- ✓ Accelerated deforestation rate mainly through land clearing for more agricultural land
- ✓ Frequent wildfires
- ✓ Overgrazing
- ✓ no forest management plan is in place in major producing areas, tapping is uncontrolled and enrichment planting is uncommon

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Flora of Ethiopia and Eritrea volume 3	
	Abeje (2002)	
	Stiles, 1988	

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use? ➢ ***Boswellia papyrifera*** **is the most widely used species for frankincense production but the other species *Boswellia neglecta, Boswellia rivae, Boswellia ogandensis*** **and *Boswellia microphyila*** **are somehow used for frankincense.**
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)? ➢ It is mainly harvested for incense and ***Boswellia papyrifera*** **is the chief gum and resin producing tree species.**
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors. ➢ There is a lack of reliable data on the resource base and its actual production potential but during this period (October-June), one taper collects, on the average, 10-12 quintals, and an average of 500 g of frankincense is obtained from Boswellia individual trees per tree per season
3d.	What volume is exported (approximate annual export)? ➢ Not Known
3e.	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations. ➢ Not Known the extent but it is highly affected the sustainability
3f.	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations. ➢ Not Known but generally, regeneration profiles of most species in the dry forests of Ethiopia are generally poor because of the open access nature of the forests, despite variations according to geographical location, vegetation formation, species type and the degree of disturbance.
3g.	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries. ➢ None

3h.	What are the challenges to artificially propagate/cultivate *Boswellia* species in your country? ➢ Not Known

3i.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Girmay, 2000	

Section 4: Supply chains and international trade (paragraph a), b) and f) of Decision 18.205)

4a.	Who are the predominant legal or customary owners / custodians of *Boswellia*? Government-owned ☒ Local communities ☒ Individual ownership ☒ Community-based or individual land tenure ☒ Please describe the land ownership structure where *Boswellia* spp. occur, including harvest rights. ➢ Land belongs to the government and the people of Ethiopia
4b.	If known, please specify who are the main harvesters of *Boswellia* specimens? Individual collectors ☒ Collector associations ☒ Private companies ☒ Other ☐ Please provide further details on the types of harvesters. ➢ Several problems arise in relation to access to and management of the resource base. In some areas, communities own and manage the resource, whereas in others (e.g. Amhara Region) local community access to the resource is severely restricted. Only commercial producers with adequate capital are allowed to collect and sell gums and resins. These companies are given licences to exploit an area for only 1 year. There are no forest management plans nor is there any monitoring system to ensure that gum collecting and exporting companies are managing the forest responsibly
4c.	Is there any in-country processing capacity for *Boswellia* specimens? Please describe. ➢ None, only manual raw product quality processing.
4d.	Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones.

	➢ There are only trading companies or investors but not processing companies in the country.
4e.	What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)? ➢ Unprocessed incense, Processing of the resin involves the manual cleaning, sorting and grading of the raw product. Accordingly, the collected gum is sorted into five grades on the bases of size, colour and brightness. The final products are, then, sold in international markets (the first 2 quality grades) and the least qualities for domestic use, which will be used in coffee ceremonies, churches, etc.

4f.	Which are the main known importing countries of *Boswellia* specimens sourced from your country? ➢ The major importing countries were China, United Arab Emirates, Germany, Egypt and Guatemala. China has become the largest importer of frankincense.
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported. ➢ Not well known
4h.	What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)? ➢ For Incense only
4i.	What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen. ➢ Not known
4j.	Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries. ➢ No
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded. ➢ No
4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade.

None		
4m.	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206. ➢ Ethiopian Biodiversity Institute, Environment forest and climate change commission and Ministry of agriculture. ➢ The contacts accessed in their website using their names.	
4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Girmay, 2000	

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a. Please describe any regulations or management measures in place or in preparation concerning

i. The conservation of *Boswellia* populations and/or habitats?

- Ethiopian forest law and Ethiopian wildlife conservation law

ii. The sustainable harvest of *Boswellia* specimens?

- no

iii. The export of *Boswellia* specimens?

- No

iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.

- Habitat protection that allows natural regeneration and protection

5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 6. Additional remarks or information

6a.	Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

Thank you very much for your responses!

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party: Germany	
1b.	Institution: CITES Scientific Authority – Bundesamt für Naturschutz	
1c.	Contact information of the representative who responded to the questionnaire:	Name: David Harter
		Phone: +49 228 / 8491-1442
		Email: david.harter@bfn.de
		Other:

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

N/A

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
•	☐	☐	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
•	☐	☐	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2d.	For each species occurring in your country, please provide its habitat trends. Add rows if needed.					
	Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
•		☐	☐	☐		☐
•		☐	☐	☐		☐
•		☐	☐	☐		☐
2e.	Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.					
2f.	Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.					
2g.	Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.					

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use?
N/A	
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)?
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors.
3d.	What volume is exported (approximate annual export)?
3e.	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations.
3f.	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations.
3g.	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries.

3h.	What are the challenges to artificially propagate/cultivate *Boswellia* species in your country?	
3i.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 4: Supply chains and international trade (paragraph a), b) and f) of Decision 18.205)

4a. Who are the predominant legal or customary owners / custodians of *Boswellia*?

Government-owned ☐ Local communities ☐ Individual ownership ☐ Community-based or individual land tenure ☐

Please describe the land ownership structure where *Boswellia* spp. occur, including harvest rights.

N/A

4b. If known, please specify who are the main harvesters of *Boswellia* specimens?

Individual collectors ☐ Collector associations ☐ Private companies ☐ Other ☐

Please provide further details on the types of harvesters.

N/A

4c. Is there any in-country processing capacity for *Boswellia* specimens? Please describe.

Please see answer to 4d.

4d. Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones.

Queries to a German supplier database resulted in 68 companies (www.wlw.de: “Weihrauch”, 25 March 2020) that trade in frankincense and/or processed products or do processing of frankincense raw materials in Germany, 35 of which classified as wholesalers.
However, there is no data available about traded volumes or market shares.

4e. What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)?

Germany does not have own *Boswellia* resources and is completely relying on imports. However, please see answer to question 4j.

4f.	Which are the main known importing countries of *Boswellia* specimens sourced from your country?
Ethiopia and Somalia are known to be major suppliers (ProFound and Duerbeck 2015). However, there are no data available on trade partners and specific trade volumes of *Boswellia* specimens.	
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported.
No exact data available.	
4h.	What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)?
German traders mainly import raw material with low levels of processing (only cleaning and grading) (ProFound and Duerbeck 2015).	
4i.	What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen.
No specific (unambiguously referring to *Boswellia* specimens) trade data available. UN Comtrade data do include *Boswellia* commodities in several HS codes, but these codes only represent rather broad commodity groups that include other species as well.	
4j.	Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries.
We have no knowledge about exact specimens exported from Germany and their volumes. However, in ProFound and Duerbeck (2015) it is noted that ‘Germany is an important and interesting market for gums and resins, particularly frankincense and myrrh. The country plays an important role in processing and distributing gums and resins to other European countries. Between 2010 and 2014, the value of Germany’s exports of gums and resins increased by 3.2 % annually on average to 30 million euros.’ And ‘A lot of gums and resins are only cleaned and graded before export to Germany. Most value addition by processing takes place in Germany by a small group of importers. These processors have complex industrial production systems for processing gums and resins, […] The importers receive requests from very diverse buyers, such as manufacturers of texturizing systems for food, manufacturers of aromatherapy products and manufacturers of flavourings and fragrances. (ProFound and Duerbeck 2015)	
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded.

Important commodity groups of processed Boswellia specimens include (but are not limited to) the raw gum-resin (frankincense), frankincense essential oils (steam-distillation of the gum-resin), resinoids (solvent extraction of the gum-resin, up to 75% soluble in alcohol), and resin absolute (filtration and vacuum concentration of the resinoid).

4l. If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade.

Not known.

4m. If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206.

In 2014 and 2015 an expert study funded by the German Scientific Authority compiled information on (inter alia) four *Boswellia* species in international trade, and sought to find out if CITES listing criteria apply for these species. The studied *Boswellia* species were *Boswellia frereana*, *Boswellia papyrifera*, *Boswellia sacra* and *Boswellia serrata*. We think that these reports might aid in implementing Dec. 18.206 and we are happy to put the reports at the Secretariat's disposal, attached to this questionnaire.

Further on, a conference on frankincense and medicinal plants has taken place in Oman in 2018. The German SA has not attended this conference. However, if available, proceedings might be helpful or contacting the organizers for more information (e.g. a list of experts):
https://conferences.squ.edu.om/icfmp2018/

4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	ProFound; Duerbeck, Klaus (2015): Product fact sheet: Gums and resins for the German market. Edited by Import Promotion Desk (IPD), Ministry of Foreign Affairs (CBI).	
	Boswellia frereana v3 final clean.pdf	
	Boswellia papyrifera v2 final clean.pdf	
	Boswellia sacra v3 final clean.pdf	
	Boswellia serrata v3 final clean.pdf	

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a. Please describe any regulations or management measures in place or in preparation concerning

i. The conservation of *Boswellia* populations and/or habitats?

N/A

ii. The sustainable harvest of *Boswellia* specimens?

N/A

iii. The export of *Boswellia* specimens?

N/A

iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.

N/A

5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 6. Additional remarks or information

6a.	Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

Thank you very much for your responses!

IMPORT PROMOTION DESK

CBI
Ministry of Foreign Affairs

Practical market insights into your product

Gums and resins for the German market

Germany is a leading importer of gums and resins in Europe. Gum arabic, Locust Bean Gum (LBG), frankincense and myrrh are valuable as natural ingredients with unique properties. Gum arabic and LBG stabilise and thicken, whereas frankincense and myrrh are mostly valued for their fragrance. They are versatile ingredients with a wide range of applications in the food, cosmetic and health products industries. As each of these applications requires very specific qualities of the gums, you need to pay extra attention to strict sorting and grading.

TABLE OF CONTENTS

PRODUCT DESCRIPTION

The product identity and classification of natural gums and resins is complex. Difficulties in identification arise from the variability of plant species and sources used for procurement of raw material.

Both gums and resins are solid/semi-solid substances. Gums are miscible in water and insoluble in liquids that dissolve resins, while resins – complex mixtures of organic compounds called terpenes including oleoresins and balsams – are soluble in certain organic solvents, but insoluble in water.

Next to providing information on the German market for gums and resins in general, this factsheet focuses on two specific gums as well as two specific resins:

Gums

1. Gum arabic (exudate gum)
2. Locust Bean Gum (seed gum)

Resins

3. Myrrh
4. Frankincense

For the purpose of chemical classification, myrrh and frankincense are classified as resins, although both contain a certain amount of gum ingredients. This is why both resins are sometimes also called “gum-resins” to describe a resinous material, which contains some gum.

ACACIA SENEGAL TREE

Source: FAO

GUM ARABIC DERIVED FROM ACACIA SENEGAL

Source: CBI

1. Gum arabic and other Acacia gums

Gums are derived from trees. The tree sources for gum arabic grow in the gum belt of Africa, which stretches from Senegal in the West to Somalia in the East.

Gum arabic is the dried exudation obtained from the stems and branches of Acacia trees, primarily *Acacia senegal* (L.), *Willdenow var. senegal (synonym: Acacia verek)* or closely related species (known by the local population of Sudan and surrounding countries as “hashab” or “kordofan”). After the bark of the tree is cut, gum exudates naturally in 3-8 weeks. The hardened sap is then regularly collected by pastoralists from the dispersed trees. Generally, the collection of gums and resins provides a source of income for pastoralists in areas with few other natural resources.

The designation “Gum arabic” is commonly taken to mean the gum from any Acacia species, therefore sometimes also referred to as “Acacia gum”. This leads to a lack of clarity in definition. For example, many people also use the name “gum arabic” for gum from *Acacia seyal (synonym: Vachellia seyal var. seyal)*. This gum, which has different properties than then gum obtained from the Acacia species mentioned above, also has another common name in Sudan and surrounding countries: “gum talha”.

Gum arabic from *A. senegal* is a pale to orange-brown coloured solid, which breaks with a glassy fracture. For this reason, it is also known as “hard gum” whereas gum from the *A. seyal* tree is known as “flaky gum”.

The gums consist of a mixture of arabinogalactan oligosaccharides, polysaccharides and glycoproteins. It is soluble in water and forms solutions over a wide range of concentrations without becoming highly viscous.

European food and beverage manufacturers use gum arabic mainly as an emulsifier and for its ability to stabilise a wide range of products.

Codes relevant for export of gum arabic:

- Harmonised System (HS): 130120 – Gum arabic
- E-number: E414
- Chemical Abstract Service (CAS) Registry Number: 9000-01-5[1]
- EC No.: 232-519-5
- Codex Alimentarius: SIN No 414, INS No 414

[1] A Chemical Abstract Service (CAS) Registry Number provides an unambiguous way to identify a chemical substance or molecular structure when there are many possible systematic, generic, proprietary or trivial names.

CERATONIA SILIQUE TREE

Source: Global Biodiversity Information Facility

LOCUST BEAN GUM

Source: ingredientsolutions.com

2. Locust Bean Gum

Locust Bean Gum (LGB) – also known as carob gum – is a vegetable gum extracted from the seeds of the tree *Ceratonia siliqua (L.) Taub*, most commonly known as carob tree or St. John´s bread. The carob tree is native to the Mediterranean region stretching from Southern Europe and Northern Africa to the Middle East into Iran. The gum is obtained from the endosperm of the carob's seed and is a white to yellowish powder without odour.

LGB consists of high-molecular-weight hydro colloidal polysaccharides, described chemically as galactomannan. Therefore, it is widely used as a gelling and thickening agent in the food industry.

The gum is partly dispersible in cold water and totally dispersible in hot water, while it can be converted to a gel by adding small amounts of sodium borate.

Codes relevant for export of LBG:

- Harmonised System (HS): 13023210 Mucilages and thickeners, whether or not modified, derived from locust beans
- E-number: E410
- Chemical Abstract Service (CAS) Registry Number: 9000-40-2
- EC No.: 232-541-5
- Codex Alimentarius: INS No. 410

3. Myrrh

Myrrh resin is a hardened reddish-brown exudate from the tree species *Commiphora myrrha (Nees) Engl. (synonym: Commiphora molmol)*. These small trees with short thorny branches grow in Yemen and Eastern Africa (Somalia, Ethiopia and Eritrea). Other species of *Commiphora* also yield resins. However, these are considered by German importers as adulterants which are inferior to myrrh. Exporters must take care to determine the exact source (i.e. species) of myrrh to prevent such adulteration.

COMMIPHORA MYRRHA TREE

Source: Steenbergs.co.uk

MYRRH DERIVED FROM COMMIPHORA MYRRHA

Source: Steenbergs.co.uk

Myrrh trees are cut in order to regularly harvest their "bleeding" resins. They are not cultivated, but are rather scattered around a vast territory. The harvesting is mainly done by local pastoralists.

Myrrh consists of water-soluble gum, alcohol-soluble resins and volatile oil. The volatile oil can be extracted by steam-distillation and consists primarily of sesquiterpenes and triterpenes. Myrrh also contains tannins. The resin and its derivatives, such as its essential oil, have a wide range of applications such as fragrances, mouthwashes and skin conditioning products.

Codes relevant for export of myrrh:

- Harmonised System (HS): 130190 – Lac; natural gums, resins, gum-resins and oleoresins (for example, balsams) other than gum arabic
- Chemical Abstracts Service (CAS): 9000-45-7
- EC No.: 232-543-6
- EINECS: 232-543-6
- FEMA: 2765

Codes relevant for export of myrrh essential oil:

- Harmonised System (HS): 3301 29 41 (Essential oils other than those of citrus fruit, mint, clove, niaouli and ylang-ylang; not deterpenated)
- Chemical Abstracts Service (CAS): 8016-37-3
- FEMA: 2766
- UN no.: 1169

BOSWELLIA PAPYRIFERA TREE

Source: FAO

FRANKINCENSE DERIVED FROM DIFFERENT BOSWELLIA SPECIES

Source: Takasago

4. Frankincense

Frankincense is an oleogum-resin exudated by several *Boswellia* species including *Boswellia carterii Birdw., Boswellia papyrifera (Del.) Hochst.* and *Boswellia neglecta S. Moore*. Frankincense is also commonly called "olibanum". Since frankincense from different species have different properties, exporters who can determine the exact source (i.e. species) of their frankincense can offer extra value to German buyers.

The collection of frankincense is similar to that of gum arabic and myrrh. It often involves scrubbing the bark of the trees which grow in dry areas to cause exudation of the gum-resin which can be collected at a later moment. In some areas, collectors only tap naturally exudated resin. The various *Boswellia* trees that are sources for frankincense mainly grow in the gum belt in Africa (Ethiopia, Somalia and Sudan) and India.

Steam-distillation of the gum-resin yields frankincense essential oil. Solvent extraction of the gum-resin, which is up to 75% soluble in alcohol, yields a resinoid. Filtration and vacuum concentration of the resinoid (i.e. alcohol solution) yield a resin absolute.

Codes relevant for the export of frankincense:
- Harmonised System (HS): 130190 – Lac; natural gums, resins, gum-resins and oleoresins (for example, balsams) other than gum arabic
- Chemical Abstracts Service (CAS): 8050-07-5 (olibanum)
- EC No.: 232-474-1 (olibanum)
- INCI name: Olibanum
- FEMA: 2765

Codes relevant for the export of frankincense extract:
- Harmonised System (HS): 3301 30 – Resinoids
- Chemical Abstracts Service (CAS): 89957-98-2 (Boswellia carterii extract) and 89957-99-3 (Boswellia papyrifera extract)
- EC No.: 289-620-2 (Boswellia carterii extract) and 289-621-8 (Boswellia papyrifera extract)

Codes relevant for the export of frankincense essential oil:
- Harmonised System (HS): 3301 29 41 – Essential oils other than those of citrus fruit, mint, clove, niaouli and ylang-ylang; not deterpenated
- Chemical Abstracts Service (CAS): 8016-36-2 (oil of Boswellia carterii)
- EINECS: 232-474-1
- FEMA: 2816
- UN no.: 1169

PRODUCT SPECIFICATIONS

As gums have many different uses and suitability of gums for each of these uses depends largely on product specifications, a thorough understanding of the factors determining your product's specifications is crucial. This requires that exporters can provide botanical identification to determine the exact source of their gum. For example, in the gum arabic trade, the quality of gum from Vachellia seyal trees is generally considered as inferior to gum from Acacia senegal trees. Similarly, myrrh from Commiphora myrrha trees is considered to be the only true myrrh, while gums from other Commiphora tree species are considered as adulterants.

QUALITY

General

- General specifications for food additives including gum arabic and LBG are defined by the European Commission in Regulation 231/2012 and can be found in Codex Alimentarius. Frankincense and myrrh are not allowed for use in food as resins. Their essential oils could be used as flavouring agents, but this is uncommon due to their high price.
- The main chemical constituents of the gums and resins in this study are identified in the table below:

TABLE 1: INDICATION OF MAIN CHEMICAL CONSTITUENTS OF SELECTED GUMS AND RESINS

Gum/resin	Major chemical constituents	Sources
Gum arabic (Acacia senegal)	Galactose, arabinose, glucuronic acid, rhamnose	Source: FAO, 1995
Myrrh (Commiphora myrrha)	30-60 % water-soluble gum, 20-40 % alcohol-soluble resin and 9-17 % volatile oil. Essential oil constituents: Furanoeudesma-1,3-diene (34 %), furanodiene (20 %), lindestrene (12%), ß-elemene (8.7 %), germacrene-B (4.3 %)	Source: Hanuš, Řezankab, Dembitskya and Moussaieffa, 2005
Frankincense (Boswellia papyrifera)	30–60 % alcohol soluble resins (diterpenes, triterpenes), 30-65 % polysaccharides (gum), 5-10 % essential oils (62 % ester, 15 % alcohol, 10 % monoterpene hydrocarbons, 7 % diterpenes, sesquiterpenes). Essential oil constituents: octyl acetate (56 %), ß-elemene (29 %), caryophyllene oxide (21%), n-octanol (8.0 %), limonene (6.5 %), linalool (3.2 %), a-pinene (2.6 %), n-hexyl acetate (1%).	Source: Comparative Phytochemical Analyses of Resins of Boswellia Species (B. papyrifera (Del.) Hochst., B. neglecta S. Moore, and B. rivae Engl.) from Northwestern, Southern, and Southeastern Ethiopia, 2014
Locust Bean Gum (Ceratonia siliqua)	Mannose (73-86 %), galactose (14-27 %)	Source: FAO, 2008

- Buyers often also determine the quality of gums and resins on a more subjective basis, looking at appearance (colour and viscosity) and aroma. Buyers generally prefer a light colour and minimum odour for gums with applications as hydrocolloids (e.g. thickeners). Buyers in the fragrance industry generally prefer a light colour as well, but often need a strong odour (i.e. high volatile oil content).
- Grading systems are used to sort gums and resins, to obtain a uniform product quality per grade. Price also differs depending on the grade available. Example of a grading system:

TABLE 2: GRADING SYSTEM FOR FRANKINCENSE (BOSWELLIA PAPYRIFERA) IN TIGRAY, ETHIOPIA

Grade	Description
1A	Size: > 6 mm; white
1B	Size: > 6 mm; creamy white
2	Size: > 4 mm < 6 mm; white
3	Size: > 2 mm < 4 mm; mostly white
4 – special	Any size; brown
4 – normal	Any size; black
5	Powder and bark

Source: CIFOR, 2011

TIP:

- Work together with a local university department to test your gum or resin. They can help determine the chemical composition of the gum or resin to be included in your product documentation.

Quality management

Pre-harvesting, harvesting and post-harvesting practices (including processing) affect quality of gums and resins. Exporters are responsible for the product they export and must often play an active role in raw material collection.

TIPS:

- Prevent contamination by e.g. sand, stones and undesired plant parts by training collectors to cut properly, use clean containers, keep storage rooms and equipment clean, and clean the gums or resins if necessary. Refer to the Good Practices for Gums of the Association for International Promotion of Gums (AIPG) for more details.
- As an alternative to the Good Practices for Gums, the IN2NI network provides Standard Operating Procedures (SOPs) and WINs (Working Instructions) for resource management and, importantly, resource use. At the resource tuse level, the SOPs and WINs address the following:
  - Pre-harvest
  - Harvest
  - Post-harvest
  - Sales communication
- Minimise variation in quality a lot by following strict grading and sorting standards for raw materials selection. Size and colour are major grading criteria for the exudate gums and resins next to impurity content and source area.
- Standardise and minimise significant variations in your product's quality by closely monitoring collection/harvesting practices through regular inspections and by blending gums or resins from different harvests (e.g. early and late harvests, or different areas). Always make sure that the quality of the standardised gums or resins (blend) matches the requirements of your buyer.
- Purify the product to improve its quality. For example, purify gum arabic using dry steps such as selection, kibbling, sieving and mechanical pulverisation of raw gum to produce a fine powder easily soluble in water. Improved purification requires more technology. After dissolution in water, remove insoluble matters (mineral and vegetable) by filtration and sterilisation of the gum syrup. Evaporate the water by spray-drying.
- Be clear on what quality you can supply continuously. Once you develop a quality standard, you must be able to maintain that same level of quality, also when up scaling your production.
- Prevent adulteration and contamination by foreign materials to preserve your reputation. Importers regularly analyse products for adulteration.

Labelling

Labelling of gums and resins for export is mandatory and mainly serves traceability and safety during transport and storage.

- As an exporter, facilitate traceability of individual batches with markings on each container and registration in an administrative system, whether they are produced by blending or not.
- Use the English language and EU measures (e.g. kilograms) for labelling unless your buyer has indicated otherwise.
- Labels must include the following:
  - Product name
  - Batch code
  - If the product is destined for use in food products
  - Place of origin
  - Name and address of exporter
  - Date of manufacture
  - Best before date
  - Net weight
  - Recommended storage conditions
- Organic, Kosher and Halal markings are optional.
- For **organic** certified gums specifically: add name/code of the inspection body and certification number.
- If you export essential oils from resins, refer to CBI's Product Factsheet 'Resin oils for cosmetics in Europe' for specific information on labelling for essential oils derived from gum-resins. Essential oils for cosmetics are regarded as chemicals and are subject to more strict labelling requirements.

Packaging

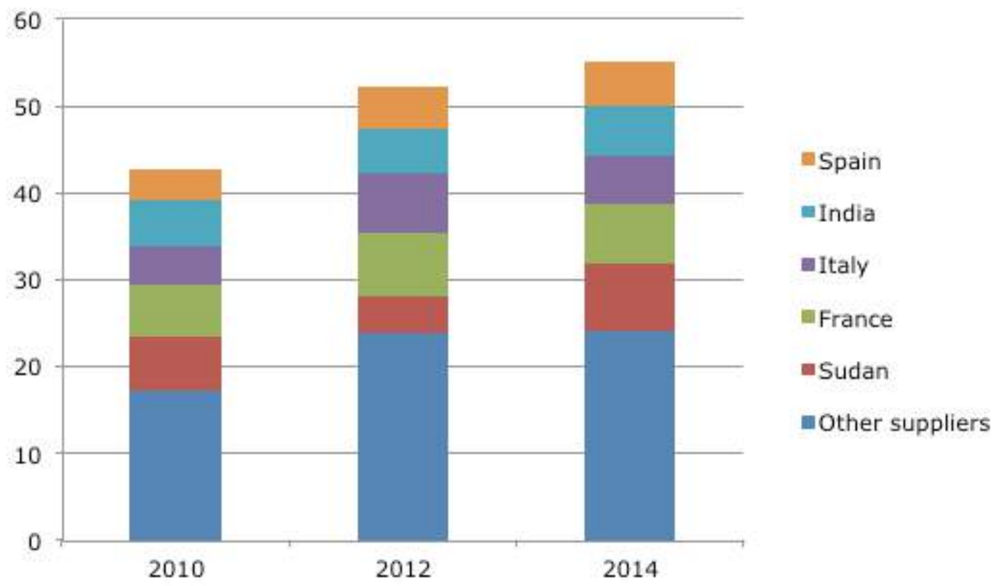
- Always consult your buyer for specific packaging requirements.
- Facilitate the re-use or recycling of packaging materials by, for example, using containers of recyclable material (e.g. jute or kraft paper bags).
- Common bag sizes: 10, 25, 50 kg.
- Store the bags in a dry, cool place to prevent quality deterioration.
- Organic gums should remain physically separated from conventional gums.
- If you export essential oils from resins, refer to CBI's Product Factsheet 'Resin oils for cosmetics in Europe' for specific information on packaging of essential oils derived from gum-resins. Essential oils for cosmetics are regarded as chemicals and are subject to more strict packaging requirements.

WHAT IS THE DEMAND FOR GUMS AND RESINS IN GERMANY?

IMPORTS

- As Germany does not produce any gums or resins, it is completely dependent on imports to satisfy demand.
- Between 2010 and 2014, the value of German gum and resins imports increased by 6.6 % annually on average to 55 million euros (see Figure 1). Higher prices in 2014 compared to 2010 explain for the entire increase, as import volumes were the same in both years (13 thousand tonnes).

FIGURE 1: SUPPLIERS OF GUMS AND RESINS* BY GERMANY AND MAIN ORIGINS, IN MILLION EUROS, 2010-2014



**Natural lac, gums, resins, oleoresins and LBG (excluding guar and other seed gums and xanthan gum), Source: Eurostat, 2015*

SUPPLIERS OF GUMS AND RESINS

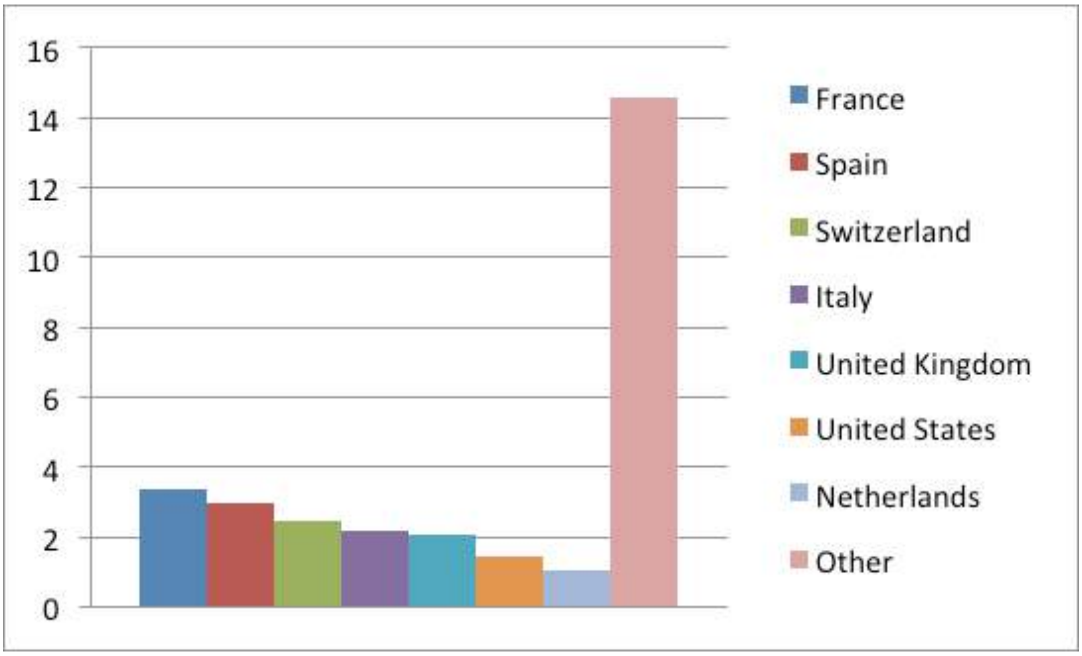
- Overharvesting of gums and resins is a particularly important cause of low availability of wild-collected gums and resins (e.g. gum arabic, myrrh and frankincense) and increasing prices. The sale of stocks from previous years allows the suppliers to maintain supply volumes to Germany. Refer to the section on prices for more information.
- Sudan is Germany's largest supplier of gums. Sudan is the main origin of gum arabic an particularly gum arabic from *A. senegal*. Nexira, a French importer dominates the gum arabic trade in Sudan and also accounts for much of the gum supplies to Germany from France. The company processes the gum arabic before re-exporting it, which explains why average prices of French gum supplies are almost twice as high as those of Sudanese gum supplies.
- The large roles of Italy and Spain in German imports are primarily related to their LBG production. Morocco is also a major producer of LBG, and Tunisia is a smaller one, but these countries do not supply any significant volumes to Germany directly. Spanish and Italian companies purchase much of the locust beans and LBG supplies from Morocco and Tunisia, process it and re-export it to Germany.
- Nigeria and Chad are other major developing country suppliers of gums to Germany with supply values of 1.3 million euros and 0.9 million euros respectively in 2014. Their supplies mainly consist of gum arabic. In the period 2010-2014, the role of Chad in German imports has grown considerably as its supplies increased by 37 % on average annually in terms of value.
- Ethiopia and Somalia are major suppliers of myrrh, frankincense and to a lesser extent of gum arabic. In 2014, their supplies to Germany amounted to 0.7 million euros and 0.4 million euros respectively.
- In Ethiopia, the Natural Gums Processing and Marketing Enterprise (NGPME) is the main exporter of frankincense. According to its brochure, NGPME exports around 1,000-1,500 tonnes annually and accounts for around 40 % of the country's total exports. In 2014, total Ethiopian exports of gums and resins (excluding gum arabic) amounted to 2,612 tonnes. Germany accounted for 139 tonnes. In this same year, Ethiopian exports of gum arabic only amounted to 359 tonnes and none of these exports were destined for Germany.

TIPS:

- To ensure availability of supply in the future, promote protection of gum and resin trees through development of sustainable natural resource management systems. For example, governments can increase the period of concession rights to encourage concession holders to protect trees and plant new ones.
- Prevent over-harvesting and improper wounding of gum and resin trees by applying Good Practices for Gums. Proper tapping can have a positive effect on long-term productivity of the tree. Prevention of over-harvesting is particularly relevant for collection of frankincense from *Boswellia ogadensis* (Vollesen) species in Ethiopia, as CITES has put this species on the IUCN Red List and classified it as 'vulnerable D2'.

EXPORT

FIGURE 2: EXPORT DESTINATIONS OF GUMS AND RESINS* FROM GERMANY, IN MILLION EUROS, 2010-2014



**Natural lac, gums, resins, oleoresins and LBG (excluding guar and other seed gums and xanthan gum), Source: Eurostat, 2015*

- Germany is an important and interesting market for gums and resins, particularly frankincense and myrrh. The country plays an important role in processing and distributing gums and resins to other European countries. Between 2010 and 2014, the value of Germany's exports of gums and resins increased by 3.2 % annually on average to 30 million euros.

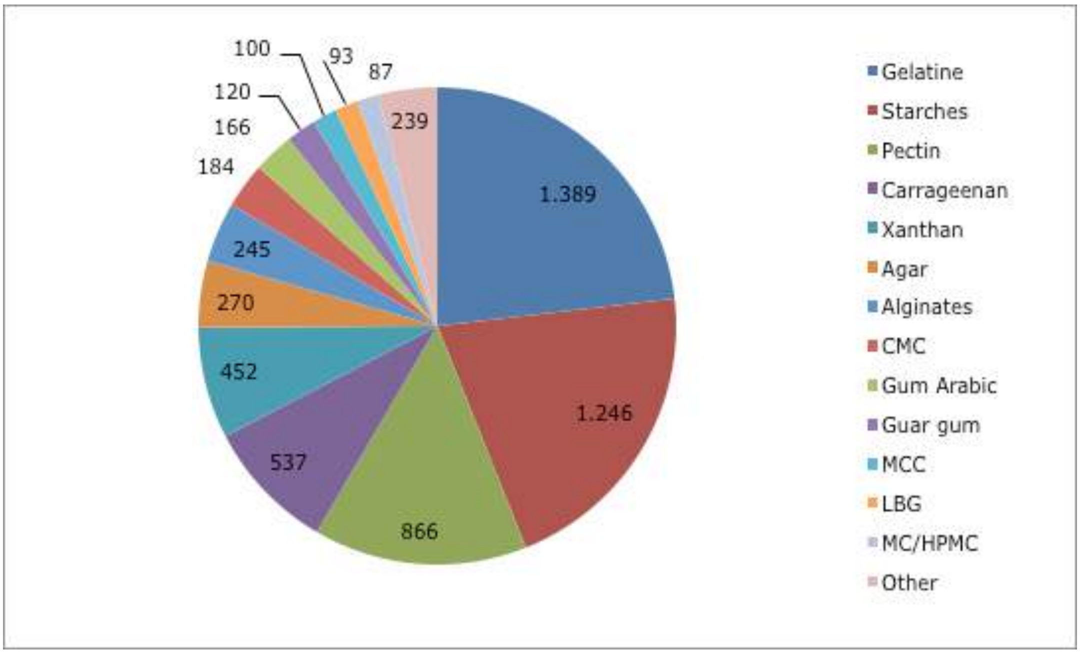
INDUSTRIAL DEMAND FOR GUMS AND RESINS

- Gums and resins have various applications in a range of industries from food to oil drilling. Food applications account for an estimated third of the global market for hydrocolloids, which consists for a large part of gums markets.

INDUSTRIAL DEMAND FOR GUMS AND RESINS FROM THE FOOD INDUSTRY

- Germany offers opportunities for gums and resins for their use in the food industry, which depends entirely on imports for gums supplies. Demand from the German food industry is estimated to be one of the largest in Europe, as Germany has the largest food industry in Europe. The German food industry accounts for 14 % of turnover of the entire European food industry of 1,244 billion euros (Food Drink Europe, 2015). Moreover, the strong presence of manufacturers of texturizing systems, flavourings and their sales offices in Germany indicates that demand for gums and resins is big. In the food industry, gum Arabic and LBG are commonly used in texturizing systems, while essential oils of gum myrrh and frankincense have some use in flavourings.

FIGURE 3: COMPOSITION OF GLOBAL FOOD HYDROCOLLOID MARKET*, IN MILLION EUROS, 2014



**Excluding Chinese market, Source: The World of Food Ingredients, June 2015 issue*

INDUSTRIAL DEMAND FOR GUMS AND RESINS FROM THE COSMETICS INDUSTRY

- In the German cosmetics industry, fragrant resins, such as myrrh and frankincense, have the most potential. Refer to the section on segments for more information on applications.
- Within the German cosmetics market, most opportunities for resins can be found in natural cosmetics, as opposed to cosmetics that mainly contain synthetic ingredients. In 2014, the German market for natural cosmetics grew by 10 % to 1 billion euros. Germany is the leading European market for natural cosmetics. Germany accounts for 8 % of the global market and its value is twice as high as that of the other European markets.

INDUSTRIAL DEMAND FROM THE HEALTH PRODUCTS INDUSTRY

- In terms of health products, most potential for gums and resins can be found in the food supplement and aromatherapy industries in Germany.
- In 2013, the German market for food supplements was the second largest market in Europe with a value of 935 euros million (Source: Nutraingredients, 2014). Food supplements sales in Europe are growing rapidly and registered an increase of 6.2% in the same year.
- Germany is also one of the main European markets for aromatherapy products, especially for medicinal aromatherapy products, but also cosmetic aromatherapy products without medicinal claims. The German market for medicinal aromatherapy is developing strongly, as health insurance companies are increasingly paying for alternative therapies. Compared to most West European countries, alternative therapies in Germany (such as aromatherapy) have a stronger focus on curing illness, as opposed to preventive health.
- Read more about the applications of gums and resins in health products in the section on market segments.

TIP:

- Be careful with the claims you make on your product. Consider not making claims at all and sell your gums or resins as natural ingredients based on proven product identity. If you want to make claims for your gums, resins or their derivatives, ensure you can back up these claims to any potential buyer. For more information on requirements for claims, refer to the section on legal requirements in this factsheet.

Apart from demand for gums and resins from above mentioned industries, gums and resins are also in demand for other markets. Although these markets are not covered in this CBI Product Factsheet, they may offer additional opportunities for your products. Particularly the incense market is an important market for frankincense. Gum arabic and LBG also have many uses in technical applications. For example, LBG is also widely used in the paper and textile industries.

WHAT TRENDS OFFER OPPORTUNITIES ON THE GERMAN MARKET FOR GUMS AND RESINS?

Natural ingredients

The German market for food, cosmetics, but also many other end-products, is increasingly propelled by the 'natural' trend, as awareness of environmental and social issues becomes more central to consumer choice. As this is a growing trend, producers are increasingly looking for new natural ingredients to include in their products. The 10 % growth in certified natural cosmetics in Germany in 2014 is illustrative in that respect.

In the food industry, clean labelling as a response to the natural trend is particularly relevant for gums to be used as thickeners (e.g. gum arabic and LBG). Clean labelling refers to the use of ingredient names on consumer product labels which are perceived to be natural and healthy. The clean labelling trend stimulates the use of natural gums over synthetic thickeners with less appealing names.

Ethical products

A growing interest in ethically sourced products provides an opportunity for fair trade and environment-friendly produced gums and resins. German buyers are particularly concerned about the lack of transparency in sourcing of wild-collected gums and resins, such as gum arabic, myrrh and frankincense. The lack of transparency makes it difficult if not impossible to guarantee ethical sourcing.

In addition, consumers are interested in the story behind the products. German manufacturers respond to this need by actively communicating about the ingredients in their products with the most compelling stories about product, production, origin, local benefits and traditions. They often stimulate suppliers to improve sustainability of their business by taking appropriate measures. Suppliers do not necessarily need to be certified accordingly. However, buyers appreciate certificates as proof.

Dietary fibre

Various gums including gum arabic have potential as a dietary fibre. Dietary fibres have the interest of European consumers which increasingly look for healthy products. However, the European Food Safety Authority (EFSA) has not (yet) approved any health claims related to gum arabic nor dietary fibres. At this moment, food manufacturers can only make nutrition claims for products with high fibre content.

- Source of Fibre: A claim that a food is a source of fibre, and any claim likely to have the same meaning for the consumer, may only be made where the product contains at least 3 g of fibre per 100 g or at least 1,5 g of fibre per 100 kcal.
- High in Fibre: A claim that a food is high in fibre, and any claim likely to have the same meaning for the consumer, may only be made where the product contains at least 6 g of fibre per 100 g or at least 3 g of fibre per 100 kcal.

Although gums like gum arabic are generally used in concentrations below 1% for thickening, they may be used in higher concentrations in functional foods. Growing demand for such functional foods may cause a significant increase in demand for the respective gums.

TIPS:

- Check your opportunities for supporting German buyers with their ethical sourcing. Consider certification when buyers need proof of your business' sustainability.
- In addition to certification, focus on the story behind your gum or resin in your promotional material. Helping German producers communicate stories which set them apart in the market will also help to position your own company better in the market.
- Be careful with health claims in your promotion, but keep track of possibilities to make health or nutrition claims related to dietary fibre and polysaccharides.

Please refer to CBI Trends for natural thickeners, CBI Product Factsheet: Resins in Europe and the CBI Product Factsheet: Aromatherapy in Europe for more market trends.

WHAT LEGAL REQUIREMENTS MUST MY PRODUCT COMPLY WITH?

Applicability of legislative requirements for export of gums and resins depends on their destination. In general, requirements are most strict when the gum or resin is destined for use in health products. Requirements are less strict when the gum or resin is destined for use in food or cosmetics.

TABLE 3: LEGISLATIVE REQUIREMENTS FOR GUMS AND RESINS IN GERMANY

Subject	Explanation	Reference
Applicable for food (including food supplements):		
Food safety	Food processors, including exporters processing gums, must have a food safety management system in place based on HACCP principles. This does not have to be certified. In the gums and resins trade, hygiene is a particular point of attention in facilities where cleaning, sorting and grading takes place.	EU Buyer Requirements for natural colours, flavours and thickeners
Permitted flavourings	Only permitted flavouring substances are allowed to be used in or on foods. All chemical constituents of a gum must be on the European Union list of flavouring substances. Checking if the gums or resins are allowed to be used in foods is a task of flavouring and food manufacturers in Europe.	EU Buyer Requirements for natural colours, flavours and thickeners
Applicable for cosmetics:		
EU Cosmetics Regulation	Restrictions on use of substances in cosmetics and requirements for so-called 'Cosmetic Product Safety Reports' and 'Product Information Files'. You cannot make medical claims on cosmetic ingredients. A list of cosmetic functions is available (reference only).	EU Buyer Requirements for Natural Ingredients for Cosmetics
Applicable for health products (aromatherapy and food supplements):		
Herbal medicinal products	Herbal medicinal products such as essential oils from resins for medicinal aromatherapy are subject to a more specific simplified regime compared to the legislation on conventional medicinal products.	CBI Product Factsheet: Aromatherapy in Europe
REACH	Legislation on Registration Evaluation and Authorisation of Chemicals (REACH) requires suppliers of chemicals including essential oils from resins for aromatherapy to apply strict rules on classification, labelling and packaging of chemicals. For example, it requires the use of symbols and risk phrases on the label of your product.	CBI Product Factsheet: Aromatherapy in Europe
Permitted botanicals for food supplements	Gums and resins are only permitted for use in food supplements in Germany when they are on the positive list of the Federal Office of Consumer Protection and Food Safety (BVL). Of the gums and resins under review only frankincense from *Boswellia serrata* is listed.	CBI Buyer requirements for food supplements

Also refer to the EU Export Helpdesk for more information on legislative requirements.

WHAT ADDITIONAL REQUIREMENTS DO BUYERS OFTEN HAVE?

The requirements listed below are common in Germany. Most of your competitors already comply with these requirements.

TABLE 4: COMMON REQUIREMENTS FOR GUMS AND RESINS IN GERMANY

Subject	Explanation	Reference
Applicable for all markets:		
Sustainability	German buyers prefer suppliers that can demonstrate good standards in sustainability. These can also be certified, for example with FairWild, according to BioTrade Principles and Criteria, or showing documentation of sustainable sourcing. This involves social and environmental responsibility as well as sustainable sourcing practices.	EU Buyer Requirements for Natural Ingredients for Cosmetics
Documentation	Ensure the buyer can access the following documentation: ■ Technical Data Sheet (TDS) or Specification ■ Certificates of analysis to support the claims of the specification ■ GMO, Halal and Kosher certificate (if requested) ■ Certificate of origin	EU Buyer Requirements for Natural Ingredients for Cosmetics CBI's Workbook 'Preparation of a Technical Data Sheet for food additives'
Representative samples	Your sampling method should result in lot samples that represent what you can deliver in terms of quantities, quality and lead time as specified by the buyer and in your Technical Data Sheet.	ISO 212:2007 for sampling of essential oils and ISO 356:1996 for preparation of essential oil test samples
Delivery terms	Pay attention to strict compliance with delivery terms as agreed upon with your buyer.	EU Buyer Requirements for natural colours, flavours and thickeners
Website	German buyers look for credible suppliers. You can improve the perceived credibility of your company by developing your website accordingly.	EU Buyer Requirements for natural colours, flavours and thickeners
Applicable for food:		
Certification of food safety	Many German food manufacturers require their suppliers to implement a HACCP-based food safety management system such as ISO 22000.	EU Buyer Requirements for natural colours, flavours and thickeners
Applicable for cosmetics:		
Good Manufacturing Practices (GMP)	The European Federation for Cosmetic Ingredients has developed a standard for GMP.	EU Buyer Requirements for Natural Ingredients for Cosmetics
International Fragrance Association (IFRA) Standards	IFRA Standards form the basis for the globally accepted and recognised risk management system for the safe use of fragrance ingredients.	EU Buyer Requirements for Natural Ingredients for Cosmetics
Documentation	Ensure the buyer can access the following documentation: ■ Technical Data Sheet including CAS number and information on allergens (in accordance with IFRA standards) Material Safety Data Sheet (Example of an MSDS in compliance with international standards)	EU Buyer Requirements for Natural Ingredients for Cosmetics

WHAT ARE THE REQUIREMENTS FOR NICHE MARKETS?

The requirements listed below are only relevant for specific market segments. Compliance with these requirements is only recommended for exporters targeting the corresponding niches.

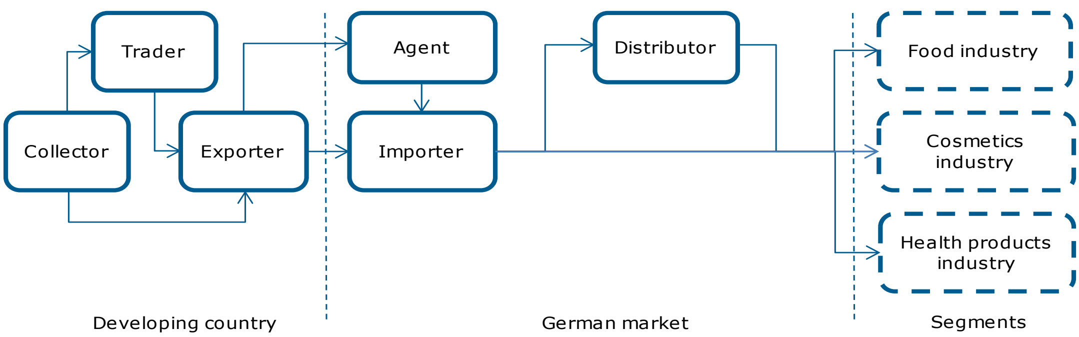
TABLE 5: NICHE REQUIREMENTS FOR GUMS AND RESINS IN GERMANY

Subject	Explanation	Reference
Applicable for all markets:		
Certification of sustainability	Certification of organic and/or fair production is increasingly appreciated by German buyers.	EU Buyer Requirements for natural colours, flavours and thickeners
Applicable for cosmetics:		
Natural cosmetics	'Natural cosmetics' are often referred to as cosmetics containing a certain minimum amount of natural ingredients. The introduction of standards defining natural cosmetics market has driven the development of private sector standards. The introduction of standards like NaTrue and Cosmos.	EU Buyer Requirements for Natural Ingredients for Cosmetics

WHAT DO THE TRADE CHANNELS AND INTERESTING MARKET SEGMENTS LOOK LIKE IN GERMANY FOR GUMS AND RESINS?

MARKET CHANNELS

FIGURE 4:



Source: ProFound

A lot of gums and resins are only cleaned and graded before export to Germany. Most value addition by processing takes place in Germany by a small group of importers. These processors have complex industrial production systems for processing gums and resins, including for example: dissolving, mixing, multiple filtering, pasteurization and atomization for gum arabic.

The importers receive requests from very diverse buyers, such as manufacturers of texturizing systems for food, manufacturers of aromatherapy products and manufacturers of flavourings and fragrances. These manufacturers usually prefer to source from importers instead of sourcing from suppliers in the countries of origin. They particularly value the year-round supplies, short delivery times and low minimum orders. In addition, manufacturers are often not interested in importing at all, as they do not have the required knowledge to import directly from the source.

TIP:

- Benefit from the experience and knowledge of specialised German importers and agents instead of approaching manufacturers directly. Especially for exporting specialised products, traders are the most suitable distribution channels.

MARKET SEGMENTS

As explained under the sections on industrial demand, gums and resins can be used in different market segments: food, cosmetics and health products. The lists below give an indication of potential applications in these market segments for the gums and resins covered in this study. These lists are not exhaustive, but cover the most interesting product uses.

Food

- German buyers in the food industry primarily consider LBG and gum arabic as hydrocolloids. The main use of gum arabic is stabilising and emulsifying of beverages, but also dairy products. For this application, German buyers prefer the Senegal grade.
- LBG also has applications in non-alcoholic beverages and dairy products (e.g. cheeses, puddings) in addition to bakery products (e.g. baking mixes, fillings), sauces and condiments, and jams and jellies. LBG is applied for both thickening and stabilising purposes.
- Coating of confectionary is another application of gum arabic. For this application, buyers often prefer the cheaper Seyal grade.
- Although the use of gums as soluble dietary fibre is still small, this market segment has the potential to grow rapidly in the next years. Especially if the European Food Safety Authority (EFSA) will approve health claims related to soluble dietary fibre. As concentrations of gums in applications which require gums as soluble dietary fibre (e.g. gum arabic) will have to be much higher than in applications which require gums for stabilising or thickening, users will prefer the cheaper grades such as gum arabic Seyal.

TIP:

- Check books on food additives uses, such as the Food Additives Data Book to find out more about applications of your gum or resin in food products.

Cosmetics

- German buyers in the cosmetics industry mostly purchase the fragrant resins (myrrh and frankincense) for distillation of the essential oil and subsequent use of the oil in fragrances for cosmetics (i.e. perfumes) and cleaning products.
- Oil of myrrh is considered a valuable ingredient in perfumes for its balsamic and heavy odour. Myrrh's warm, balsamic note is frequently used as a base note in oriental scents. Its distinctive aroma can evoke benzoin and frankincense, as well as moss. Serge Lutens built a fragrance around it in his Salons du Palais Royal Shiseido collection (Source: Osmoz).
- Although the perfumes segment of the cosmetics industry is estimated to be a major segment for derivatives of fragrant resins, the use of these resin derivatives (e.g. essential oils) in perfumes shows less growth than other uses. There is more product development for other segments of the cosmetics industry.
- The market segment for anti-ageing products and particularly skin care products with anti-ageing properties is one of the most promising growth market segments for frankincense and myrrh. According to CosIng, the cosmetic functions of frankincense and myrrh oil are masking and skin conditioning.
- Another major category of applications of myrrh is toiletries such as toothpaste and oral preparations such as mouthwashes.
- German buyers of fragrant resins are most interested in the higher grades, such as 1A and 1B grade frankincense. Users of these resins for traditional Chinese medicine, particularly in China, usually prefer the cheaper lower grades, such as grade 4 special frankincense.

TIPS:

- Consider to distil essential oils from myrrh or frankincense, as the cosmetics market often uses essential oils as ingredients instead of the unprocessed resins. Note that distillation requires investment in technology (including equipment and human resources) and that competition from European distillers is very strong.
- Find out about the efficacy of myrrh and frankincense as ingredients for anti-ageing products. Work with recognised laboratories that can provide these efficacy data. If you do not have the resources to do so, collaborate with your German buyer.

Health products

- Only ingredients with a monograph from the European Pharmacopoeia are allowed for use in medicinal products. The European pharmacopoeia lists monographs for:
  - Gum arabic (# 307: Acaciae gummi; # 308: Acaciae gummi, spray-dried)
  - Myrrh (# 1349: Myrrha; # 1877: Myrrh tinctura)
  - Frankincense (# 2310: Olibanum indicum).
- Although gum arabic is allowed for use in medicinal products, as it is listed in the European pharmacopoeia, this gum is not commonly used for its health properties in the German market.
- Myrrh and frankincense are also listed in the European pharmacopoeia and are allowed for use in this market. Myrrh is registered as both a resin and a tincture. The EMA monograph for myrrh tincture registers two traditional uses for myrrh tincture, an ethanol extract of myrrh. These registered uses are (1) to treat minor ulcers and inflammation in the mouth and (2) to treat minor wounds and small boils.
- The best opportunities for frankincense are in the market for food supplements. These are for internal use. Frankincense has been used traditionally for its anti-inflammatory properties, most specifically in joint health. Various studies have been conducted on the efficacy of boswellic acids.
- The essential oils of frankincense and myrrh are also used in aromatherapy. Frankincense oil is used for its calming and mood uplifting effects. Myrrh is used in various applications, e.g. oral care, skin care and treatment of joint pains.

TIPS:

- If you want to target the health market in Europe, you need to comply with relevant legislation. Refer to CBI Buyer Requirements for natural ingredients for health products for details on this legislation.
- Learn more about the market for frankincense as an ingredient for joint health products by reading the CBI Product Factsheet on Natural Ingredients for Joint Health.
- Learn more about the aromatherapy market for essential oils of frankincense and myrrh in the CBI Product Factsheet on Aromatherapy.
- Learn more about potential health applications from scientific research on myrrh as listed on the website of Cropwatch.

WHAT ARE THE END MARKET PRICES FOR GUMS AND RESINS?

PRICE DEVELOPMENTS

Although prices of gums and resins on the German market largely follow global market prices, German buyers are relatively price sensitive and demand low prices compared to many buyers in other countries. This makes them price competitive and contributes to their strong position in the market. This implies that the German market is particularly interesting for large-scale exporters with low prices which can benefit from economies of scale.

Sudan dictates global prices for gum Arabic, buyers will expect these same prices, or lower, from you. In the past decade, prices for gum arabic fluctuated strongly due to political unrest in Sudan. The lowest prices for cleaned and spray dried gum arabic Senegalese amounted to 2,300 euros/tonne. The highest prices amounted to 7,200 euros/tonne. In 2015, prices of Sudanese gum arabic (FOB Kordofan, Sudan) were on a notably higher level than in 2014 and averaged around 2,800 euros/tonne.

Global prices of frankincense and myrrh usually average around 2-3 euros/kg. However, you can add value to these raw materials if you can distillate them to obtain the essential oils. To illustrate, frankincense oil prices can be as high as 200-250 euros/kg, and myrrh oil can reach 300 euros/kg. Essential oils of resins fetch such high prices, because yields of distillation usually reach only 3-10 % for frankincense and 3-5 % for myrrh.

It is important to realise that price elasticity in the LBG market is limited by strong competition from substitutes, such as guar gum and Tara gum. Although demand for LBG is currently quite strong, prices have remained stable, as guar gum and tara gum prices are relatively low. In 2015, the regular price level for LBG is 7-8 euros per kg but it can range between 5 euros and 9 euros. Oganic LBG, however, is still scarce and prices have increased. It is estimated that organic LBG receives a price premium of about 10 %.

The price volatility for gums and resins in Germany has increased. This is the result of a growing speculation in the market. German importers used to keep inventory of gums and resins for a year. However, due to increases in working capital costs, this tactic is less common.

TIPS:

- Ensure that your prices reflect the quality of your product. Different grades of gums and resins fetch different prices. For example, if you supply gum arabic of the seyal variety, you cannot compare your price with that of gum arabic of the Senegalese variety.
- Monitor harvests in major production countries to anticipate price developments for your specific gum or resin. For example, monitor gum arabic harvests in Sudan to anticipate developments of gum arabic prices in global trade. You may request such information from importers. The German importer C.E. Roeper also provides regular market reports on their website.
- Improve prices of your gums or resins by cleaning and grading.
- Further increase export value of gums and resins by adding processing such as spray-drying, distillation or extraction to your operations. These types of processing are only feasible for companies that already apply strict sorting, grading and cleaning standards. Otherwise, European buyers will not accept the product, because they require very high quality consistency. Refer to CBI Market Intelligence 'The European market for essential oils for cosmetics' and the 'CBI Product Factsheet 'Resin oils for cosmetics in Europe' for more information on the markets for the value-added products.
- Refer to the list of suppliers of distillation equipment by the International Trade Center if you need such equipment to distil your gum-resins.

WHAT COMPETITION DO I FACE ON THE GERMAN MARKET FOR GUMS AND RESINS?

Barriers to entry in the German gum and resin market are relatively low. As German companies usually perform much of the processing such as spray-drying or extraction, technology requirements in the country of origin are low. Manual collection, sorting, grading and cleaning are possible and require very little technology. These activities also require little capital and basic skills.

Nonetheless, the need for concession rights to collect gums or resins in the country of origin or the long maturation period for cultivated trees can pose a market entry barrier. Moreover, the harsh environment of the production sites for wild-collected gums and resins discourages many collectors.

TIP:

- Organise collectors into cooperatives or producer groups to improve their capacity to produce bigger volumes and higher qualities. Larger groups allow for efficient value-addition activities such as sorting, grading, cleaning and also increase their supplier power.

Barriers to market entry for value-added products, such as texturizing systems or essential oils from resins for fragrances or aromatherapy are much higher. The value addition requires more technology, skilled personnel to work with the technology, highly educated technical staff for quality management and providing technical advice to buyers.

TIP:

- Only consider value addition through additional processing when you already have access to the market for unprocessed gums or resins. Additionally, you will have to investigate if you have the financial and human resources to invest in the new technology. If you have the resources, start with a small-scale pilot to develop the product and research its qualities.

The risk of substitution is relatively low for gums and resins. The unique properties of gums and resins make them difficult to replace by other products. Although German companies can synthetize many of the individual substances in gums and resins, the complex composition of many different substances is often still difficult to reproduce. Moreover, German manufacturers are generally in favour of using natural ingredients instead of synthetic ingredients.

Although all gums and resins have unique properties, the functional properties of LBG are very similar to those of guar gum and tara gum. In practice, food manufacturers frequently use these gums interchangeably depending on current price levels of each of these gums.

Refer to CBI Competition for natural thickeners, CBI Product Factsheet: Essential oils for fragrances in Europe, for more information on competition in the respective markets.

USEFUL SOURCES

SOME IMPORTERS

- C.E. Roeper GmbH, www.roeper.de
- Willy Benecke GmbH, www.willy-benecke.com
- W. Behrens GmbH & Co. KG, www.wbehrens.com

TRADE FAIRS

Visiting and especially participating in trade fairs is highly recommended as one of the most efficient methods for testing market receptivity, obtaining market information and finding prospective business partners. The most relevant trade fairs in Germany for exporters of gums and resins are:

- BioFach, Nuremberg, Germany – www.biofach.de/en
- Anuga, Cologne, Germany – www.anuga.com
- Other trade fairs for natural ingredients for food, cosmetics and/or health products, which are also visited by German buyers include:
  - Food Ingredients Europe – www.figlobal.com/fieurope/
  - Vitafoods, Geneva, Switzerland – www.vitafoods.eu.com
  - SANA in Bologna, Italy – www.sana.it
  - In-Cosmetics – www.in-cosmetics.com
  - Beyond Beauty Paris, France – www.beyondbeautyparis.com

MORE INFORMATION

- CBI market information – Promising EU export markets.
- EU Expanding Exports Helpdesk – http://exporthelp.europa.eu – go to ‘trade statistics’.
- Eurostat – http://epp.eurostat.ec.europa.eu/newxtweb – statistical database of the EU. Several queries are possible. For trade, choose ‘EU27 Trade Since 1995 By CN8’.
- International Trade Statistics – www.trademap.org – you have to register.

This survey was compiled for CBI by ProFound – Advisers In Development in collaboration with CBI sector expert Klaus Duerbeck, December 2015.

Boswellia frereana v3 final clean.docx

Recvd. 25.10.2015

Reviewed schp #

Boswellia frereana Birdw.

A. Summary of findings

Boswellia frereana is a slow growing deciduous tree species that is endemic to a small area of the Horn of Africa. The only Range States are north-eastern Somalia (the Puntland State of Somalia) and the neighbouring self-declared state of Somaliland (which is not internationally recognized as such, but is considered an autonomous region of Somalia). *B. frereana* trees are wild harvested for the most valuable type of frankincense (or olibanum), known as *maydi* (or *meydi*) in Somalia or Coptic frankincense in Europe.

Internationally, *B. frereana* resin is considered the most expensive type of frankincense (Zhang, et al., 2013). It is also prized as an incense in both Islam and in Christianity, such as by the Coptic Church of Egypt. Because *B. frereana* resin is not bitter (unlike resin from *Boswellia sacra*) it is also popular as a "chewing gum" in the Arabian Peninsula (Thulin & Warfa, 1987). As a result, Saudi Arabia is the largest importer of *maydi* frankincense, where the chewing quality grades (Grades 1-4) are chewed by Saudi middle-class households, particularly during weddings and religious festivals, most importantly for the duration of the Hajj (ITC - Eastern Africa, 2006a). The essential oils distilled from *B. frereana* resin are also used as a component of perfumes/ fragrances and flavours, medicinal products, cosmetic and body care products, soaps and detergents, incense and aromatherapy (Candlelight for Health, Education & Environment, 2006). In the European Union, *B. frereana* resin is also used in cosmetic products for its skin protectant function. *B. frereana* frankincense is exported alongside the major export of livestock from Somalia directly to Saudi Arabia (ITC - Eastern Africa, 2006a). This occurs from the ports of Berbera in Somaliland and Bosaso in Puntland. Recent initiatives to construct new seaports on in Puntland are likely to increase exports of livestock and quite possibly frankincense. Most illegally harvested *B. frereana* frankincense is exported via Djibouti to the Arabian Peninsula (Hall, 2005). Although Coulter (1987) estimated an annual production in Somalia of 1000 metric tonnes of *B. frereana* frankincense (Coulter, 1987) and Coppen (1995) suggested 800-900 tonnes were used annually (Coppen, 1995), this had halved to 500 metric tons by 2004 (PDRC, 2004). Prices for *B. frereana* frankincense have also declined over this period. Although superficially similar to other resins, *B. frereana* frankincense is characterized by lupeol and 3-epi-lupeol, together with triterpenes and dammarane (Chiavari, et al., 1991; Zhang, et al., 2013). In addition, *B. frereana* contains almost no boswellic acids (Meier & Spriano, 2010). This enables the look-a-like problem to be resolved through chemical analysis.

Despite having a much narrower distribution than *B. sacra* (which is listed as Lower Risk/near threatened (Thulin, 1998)), *B. frereana* is not on the IUCN Red List. In addition, the population dynamics and impacts of harvest on *B. frereana* are very poorly known in comparison to *B. papyrifera* or *B. sacra*. There is anecdotal evidence of declines in *B. frereana* populations to a combination of factors, including high intensity, destructive tapping coupled to grazing of seedlings and saplings. Recent field observations in Somaliland give rise for concern. For example, DeCarlo and Ali (2014a) point out that the combination of low prices paid locally, combined with rising unemployment of young people and weak tenure result in over-tapping and illegal harvesting leading to decline in the populations of *B. frereana* in Somaliland (DeCarlo & Ali, 2014a). It is likely that poor recruitment due to grazing by livestock and habitat loss due to clearing of farmland may also be contributing factors. Biological extinction is unlikely, however, due to the occurrence of remnant populations growing on steep cliffs inaccessible to livestock or resin tappers. Quantitative studies are needed, however, before CITES Appendix II listing is formally proposed.

Encouragingly, the draft new National Biodiversity Strategy and Action Plan (NBSAP) for Somalia (Federal Republic of Somalia, 2015) sets out clear goals for sustainable management of the country's frankincense resources that need to be achieved by 2020. The extent to which these can be achieved is uncertain due to the long-running political instability in Somalia. However in Somaliland, which by contrast has been relatively stable for twenty years, the Minister of Labour has publicly expressed similar sentiments regarding sustainable use and improved value chains (DeCarlo & Ali, 2014b).

B. Assessment on fulfilling the criteria of Res. Conf. 9.24 for this species

While it is likely that the criteria in Res. Conf. 9.24 for inclusion of *Boswellia frereana* in CITES Appendix II based on Art. IV 2(a) would be fulfilled, it is suggested that a proposal for CITES Appendix II listing is premature. There are three reasons for this. Firstly, the current political instability in Somalia, coupled to the fact that Somaliland, while stable, is not yet internationally recognized as an independent country or a CITES member. Secondly, anecdotal evidence of declining populations and the strong inferences that can be drawn from population biology of *Boswellia papyrifera* and *Boswellia sacra*, additional quantitative evidence is required. Thirdly, the religious importance of *B. frereana* resin in Saudi Arabia, including during the Hajj makes monitoring trade a sensitive issue that will need time to negotiate. Once quantitative data are gathered (and this is logistically possible in Somaliland) and political negotiations are concluded, then most likely proponent, given that *Boswellia frereana* is Somali endemic and that Somaliland is not recognized as a member of CITES, would be the United Republic of Somalia, ideally with input from the autonomous Puntland State of Somalia. This could be supported by Saudi Arabia, which after the Yemen is the largest single importer of *B. frereana* resin and incense products and major entrepot for the whole of the Middle East.

C. Supporting Statement

1. Taxonomy

1.1. Class

Angiospermae

1.2. Order

Sapindales

1.3. Family

Burseraceae

1.4. Genus and species

Boswellia frereana Birdw. (The Plant List, Version 1.1, 2013)

1.5. Scientific synonyms

There are no synonyms for this name (The Plant List, Version 1.1, 2013), although Mahony (1990) incorrectly gives *Boswellia hildebrandtii sensu* Chiov as a synonym for *Boswellia frereana* in his Flora of Somalia, when in fact *B. hildebrantii* is a synonym of *Boswellia neglecta* (Mahony, 1990).

1.6. Common names

Gekar, inaidi, luban, luban matti, luban meiti, lufod, maidi, meydi, uban, yagar, yagcar, yegaar, yigaar (Thulin & Warfa, 1987), Coptic frankincense (Groom, 1981).

2. Overview

See Section A.

3. Species characteristics

3.1. Distribution

Boswellia frereana is native to and distributed in north-eastern Somalia (USDA, ARS, National Genetic Resources Program, n.d.) (Figure 1).

Figure 1. A map of the Horn of Africa showing the distribution of *B. frereana* (data points redrawn from Thulin & Warfa, 1987) across north-eastern Somalia (the Puntland State of Somalia) and the neighbouring self-declared state of Somaliland.

The autonomous state of Puntland (Somalia) is the most important production area of *B. frereana* frankinscense. *Acacia, Commiphora* and *Boswellia* species dominate the range. Total area of the State of Puntland is 212,510 km2, (roughly one-third of Somalia's geographical area) (Dalsen Consultants, 2013). The neighbouring self-declared state of Somaliland (which is internationally considered an autonomous region of Somalia) is the second most important production area of *B. frereana*. More than 40% of Somalia's total resin production comes from this region. The major production area is Sanaag region followed by Sahil and Sool. The Sanaag region lies in both Somaliland and Puntland. The northern face of the Golis mountain range including Abayid and Medeshi are prime areas of production being the only true mist forest areas of Somalia and important centres of biological diversity (Soloviev & Abdi, 2013).

3.2. Habitat

Boswellia frereana grows on coastal mountains at altitude of 200 - 1,100m a.s.l. level on rocky slopes and gullies, limestone boulders and cliffs, or in holes, even clinging to vertical rock faces. The sea mists in this zone provide vital moisture for the trees. Associated woody plants are *Acacia* spp., *Commiphora* spp., *Moringa peregrine*, *Lannea obovata* and *Boswellia brichettii*. Generally, the upper limit of *B. frereana* is the lower limit of *B. sacra*. Occasionally the two species can be seen growing in the same location but this is rare (Thulin & Warfa, 1987).

Figure 2. The earliest herbarium specimen of *B. frereana*, collected in 1862 by Captain Playfair, who recorded the local names for the species and took *B. frereana* seeds to cultivate in Aden (Yemen). Photo: Royal Botanic Gardens, Kew.

3.3. Biological characteristics

There is little information on biology of *B. frereana*. and relatively specimens of this species have been collected since the type specimen was collected in 1862 (Figure 2). A very low rate of germination (<8%) even in hormone treated seeds has been observed (PROTA4U, n.d.). In common with most re-seeders, natural populations of *Boswellia* species, including *B. frereana* trees are generally single stemmed, reflecting their regeneration from seed. The seedlings of *B. freereana* are generally 3-lobed (Thulin & Warfa, 1987) and like other *Boswellia* species, are palatable to livestock. *B. frereana* is, however, easy to propagate from cuttings, with a survival rate between 75-80% of transplanted cuttings observed over a seven-year period (PROTA4U, n.d.). Although Soloviev's (2013) manul on harvesting suggests that *B. frereana* trees grow to about 3 m in 10 years, this is highly unlikely given the arid conditions. Although there will be variation in growth rates between slow growing trees on cliff faces and the faster growing trees growing on deeper, seasonally moister soils at the bases of hills, it is more likely that a 3 m *B. frereana* tree is at least 100 years old. This suggestion is based on ecological insights from field observation in arid systems and Farah's (2008) radiocarbon dating of Boswellia sacra, where 3m high trees were 150 or more years old and a one 2 m tree was 205±38 years old (Farah, 2008).

3.4. Morphological characteristics

Boswellia frereana trees are 3 -8 m tall, without spines and have a characteristic swollen, curved trunk that has a basal diameter of 70 – 100 cm. As Thulin and Warfa (1987) point out, *B. frereana* is a particularly distinct and fairly uniform species which is straightforward to distinguish from *B. sacra* due to its glabrous or sub-glabrous foliage, flowers in thyrses, reddish petals the and 6(-8)-locular fruits. Most other *Boswellia* species have 3- or 4-locular fruits. The outer bark is yellowish-brown with a flaking papery layer on the outside, with reddish-brown resin containing inner bark. The leaves are oblong to lanceolate, glabrous and up to 30 cm long (Figure 2). The flowers are borne in raceme-like compact panicles, with greenish red petals, 3.5 (5) x 1.5 (2.5) mm (Thulin, 2008).

3.5. Role of the species in its ecosystem

The ecological role of *Boswellia frereana* is poorly known, but the trees are likely to provide a habitat and food source for insects and small animals.

4. <u>Status and trends</u>

4.1. Habitat trends

The Horn of Africa is considered to be a highly degraded biodiversity hotspot, with only about 5% of its original habitat left (Federal Republic of Somalia, 2015). An environmental report on Puntland by Dalsen Consultants (2013) indicated that 70% of this 143,000 km^2 region suffers (50% severely) from soil erosion and massive gullies (20% of the land area). Vegetation is mainly dry deciduous woodland and thicket with *Acacia* and *Commiphora* in the upland areas and semi-desert grasslands and deciduous shrubland along the Puntland coasts (Dalsen Consultants, 2013). Because the population area lies in regions where administrative infrastructure is limited or non-existent and where civil disturbance has been frequent over many years there is limited or no nationwide data collection and scientific investigation of the woodland habitat in recent years. Nevertheless, based on data collected before the outbreak of the Somali Civil War in 1991, the global conservation significance of the Somali Montane Xeric Woodland ecoregion is well known (Olson, et al., 2001). Biogeographically, this ecoregion, contains remnant plant species with links to Mediterranean and Afromontane biota. In the escarpment and plateau areas, the Somali Montane Xeric Woodland ecoregion, habitats are relatively intact as a result of inaccessibility and low numbers of people. This has not saved large mammal populations, which have been decimated by uncontrolled hunting, but it has kept the vegetation relatively intact. The ability of *Boswellia frereana* to grow on sheer cliff faces as one of the habitats is a positive attribute that will save this species as long as the recommendation by ITC-Eastern Africa (2006) that frankincense tappers are supplied with climbing equipment is not implemented.

Climate change affecting the rainfall and mist patterns in the region and tree clearance for charcoal and firewood is threatening the tree population (Beyomol – Neo Trading, 2010).

4.2. Population size

There are no quantitative studies of *Boswellia frereana* population size. A Dubai-based company (Maydi Frankincense, n.d.) estimate that they have 100,000 *B. frereana* trees on their land alone, but quantitative studies are needed. Applying the Rabinowitz "seven forms of rarity assessment", *B. frereana* has a narrow geographical spread, wide habitat, and a large and dominant population size. Table 1, based on Rabinowitz et al. (1986), summarizes the geographic distribution (Section 3.1), habitat specificity (Section 3.2) and population size (Section 4.2) of *B. frereana* across its range (Rabinowitz, et al., 1986). Populations may be larger that estimated, as climatically challenging remote areas remain largely untapped (U. Feiter, pers. comm., 2015).

Table 1. The Rabinowitz matrix approach (Rabinowitz, et al., 1986) can be applied at a variety of scales, from local through to a national or international scale, leading to a single choice out of 8 boxes (A-H) that is then ranked. In this report, we highlight the section of this matrix relevant to *L. clavatum* from the perspective of an international scale.

GEOGRAPHIC DISTRIBUTION		**LARGE**		**SMALL**	
HABITAT SPECIFICITY		**Wide**	**Narrow**	**Wide**	**Narrow**
POPULATION SIZE	**Large & dominant somewhere**	A. Locally abundant, several habitats over large geographic area	C. Locally abundant in a specific habitat over large geographic area	E. Locally abundant, several habitats over small geographic area	G. Locally abundant in a specific habitat over small geographic area
	Small & non-dominant	B. Constantly sparse in several habitats over a large geographic area	D. Constantly sparse in a specific habitat over a large geographic area	F. Constantly sparse in several habitats over a small geographic area	H. Constantly sparse in a specific habitat over a small geographic area

4.3. Population structure and trends

No data for *B. frereana*. Poor recruitment of young trees has been confirmed for habitats of *B. frereana* in Somaliland (U. Feiter, pers. comm., 2015). Because of the higher rainfall in the coastal mountains where *B. frereana* flourishes, however, one would expect tree density to be somewhat higher, but this needs to be confirmed through quantitative surveys.

4.4. Geographic trends

No data available.

5. <u>Threats</u>

Boswellia frereana has not yet been assessed for the IUCN Red List.

Due to grazing impacts, little or no tree regeneration occurs in much of the natural range of this species and mortality of adult trees is further increased by destructive tapping techniques. In regions where commercial tapping is undertaken by means of slashing the trunks wood boring insect attacks are often experienced. In the Sanaag region where the majority of Somaliland and Puntland *Boswellia frereana* is found the main causes of land degradation is reported to be charcoal production (31% of the cases), overgrazing (26%) and other natural causes such as the invasion of non-native species like *Leucaena leucocephala* (24%) (Dalsen Consultants, 2013).

Information collected on several environmental threats to both *B. papyrifera* and *B. sacra* probably apply to *B. frereana* where woodlands are negatively affected by several factors. These include current land use, where woodlands are cleared for farmland, fire and grazing by livestock. In addition, both *B. papyrifera* and *B. sacra* trees affected by wood boring beetle attack following high intensity and frequency resin harvest that leaves wood exposed to infestation. In Dhofar, Oman, Strumia et al (2007) recorded several wood-boring beetles affecting *Boswellia sacra* (Strumia, et al., 2007). And in their study on *B. papyrifera*, Abiyu et al (2006) found that infestation by this beetle species was higher in areas with tapped trees than those with untapped trees and that trees died due to borer attack. Separating cause from effect is difficult as such beetles tend to attack damaged, sick and dying trees (Abiyu, et al., 2006).

Human population growth and associated increasing demand for agricultural land is resulting continuous deforestation of the more populated areas in the range. Although it is widely accepted that *Boswellia* trees need 3 - 4 years of rest to recover from a full season of tapping, continuous tapping has been observed. Based on recent field observations and interviews in Somaliland, Decarlo & Ali (2014a) point out that: "*Desperate and irresponsible harvesters are reported as making too many cuts on the trees to drain resin as well as cutting in ways that can and does kill the trees. Thus across the interviewees almost everyone reported over harvesting leading to decline of the trees and in some cases pleaded that without intervention the most valuable species could be lost within the decade*" (DeCarlo & Ali, 2014b).

6. <u>Utilization and trade</u>

6.1. National utilization

All uses are from wild *B. frereana* populations. Somalian *B. frereana* is considered to be the most important source of olibanum fetching the highest prices in the marketplace (FAO, 2010). The resin of *B. frereana* is called "lobãn majdi" or commonly "maydi" (or "meydi") (Basar, 2005). *Boswellia frereana* resin is burned for religious purposes in mosques, churches, synagogues, temples and homes. Known as Coptic Frankincense in the west. *B. frereana* is widely used in the Coptic Church of Egypt but the majority is sold in Saudi Arabia for use by pilgrims going to Mecca for Haj (Groom, 1981). *B. frereana* is also used for chewing purposes and for special types of incense. In Yemen, common uses of Somalian "maydi" include a) as chewing gum to remove unpleasant odours and bad breath; b) as medicinal substance to strengthen teeth and treat mouth infections; c) as confectionery chewing for women during celebrations, especially weddings; d) as fumigation by wealthy people; and e) large pieces are used as house decorations (Aden, 2014). It is seldom used for distillation or extraction being generally limited in supply and too expensive. Nonetheless, the essential oil of the resin is used to some extent as a component of perfumes/fragrances and flavours, medicinal products, cosmetic and body care products, soaps and detergents, incense and aromatherapy (Candlelight for Health, Education & Environment, 2006). In the European Union, resin of *B. frereana* is used as a component of cosmetic products for skin protecting function whilst essential oil of the resin is used for masking ('reduces or inhibits the basic odour or taste of the product') function (Directorate General for Health and Consumers, n.d.). Meydi type frankincense resin is very delicate and breaks up easily if not transported carefully. Moreover, it deteriorates rapidly and cannot be stored for longer than one year before becoming unpleasant to chew. Meydi also melts at high temperatures. Handling is hence manual and great care is given to handling and transport of the higher grades.

Details of harvest methods: Tree growth is slow and can be subjected to tapping when it reaches about 3 m in height (Soloviev, 2013). Annual tapping is not recommended. The trees should be tapped only once every three years. The cycle usually begins in July to August (*hagaa* season). Tapping is done with a tool called "mingaf", consisting of two blades attached to both sides of a handle with prominent edges to protect the harvesters' hands. An initial wound is made by shaving a thin outer layer of bark, 2 mm deep and about 50 mm in diameter. An incision is made by a vertical downward movement of the mingaf, with care not to wound the sapwood, which can seriously damage the tree. After the initial tapping, resin will ooze but yield is low and of poor quality. About 2-3 weeks later, the wound is renewed, repeating for the next 3-4 cycles, from which the yield remains low and still of poor quality. For the 10 months starting July/August trees are tapped 12-13 times. Harvest is most abundant and of best quality at the end of the season (May-June). The first harvest is known as called "*fiirto*", and later in the season "*jadar*". The latter provides the highest grade of "*meydi*". The wound created early in the season requires closing at the end of the season, a process known as "*jalebe*" (Soloviev, 2013). One man can reportedly collect about 550 kg of *B. sacra* gum per season but much less *B. frereana* (around 250 kg per season) (Frankincense co-operative, n.d.), but these yields need to be substantiated through quantitative studies.

Gum/resin from *B. frereana* (Meydi) is not suited for mechanical processing due to fragility. Longer, higher valued pieces of frankincense from *B. frereana* are separated by hand and cleaned, avoiding breakage and sorted according to size and colour. Smaller pieces of *meydi* are also not suitable for mechanized sifting since they are powdery and brittle. Impurities are separated and chaff is removed using a knife. Then the product is sifted and graded by three different sieve sizes. The first grade, *mushaad* is usually handpicked. The rest four grades are acquired through 3 different sieves, see section 6.3 (Aden, 2013).

6.2. Legal trade

Precise information about production and trade in this region is limited. Historically, northern Somalia (now Somaliland and the north-eastern region) had been the world's largest producer and supplier of two species of frankincense, *B. sacra (formerly B. carteri)* ("beyo") and *B. frereana* ("maydi"), obtained from mountainous areas of Sanaag region (northern) and Bari region (north-eastern) (Candlelight for Health, Education & Environment, 2006). Although Coulter (1987) estimated an annual production in Somalia of 1000 metric tonnes of *B. frereana* frankincense (Coulter, 1987) and Coppen (1995) suggested 800-900 tonnes were used annually (Coppen, 1995), this had halved to 500 metric tons by 2004 (PDRC, 2004). Production and export levels are apparently much lower today. Frankincense production and exporting, prior to the war, was state-controlled and the government had trade agreements with China, France and Germany. During the civil war (1988-1990), both the trade and its regulatory mechanisms were disrupted. According to a 2006 study on the impact of the Somali Civil War on natural resources, "*Somali gum collectors, who are predominantly nomads, are exploited by the existing merchant chain. The merchants buy gums from collectors at throwaway prices during the harvest period when the gum is plentiful. The collectors are at disadvantage, as in most of the cases the harvest time coincides with the dry season when the nomads can earn the least income from their livestock*" (Candlelight for Health, Education & Environment, 2006).

Information on prices paid for frankincense from *B. frereana* are contradictory. For example, DeCarlo and Ali (2014a) suggest that prices are much less today than they were before the Somali Civil War, pointing out that "*during the time of the Siyaad Barre government the frankincense industry was highly regulated. The product could only be sold to government buyers, thus sustaining an appropriate price per kilo. The price at that time was reported to be about $50 per kilo for the highest grade of B. frereana. The government also supplied other forms of support such as advances of food for harvesters and protection for the trees".* Based on their interviews in Somaliland, they point out that: "*today the situation is entirely different. Harvesters sell their product to any buyer with whom they have the opportunity, often underbidding each other in a desperate attempt to sell their resin, thus driving the prices even lower. Current reported selling prices range from $2 to $10 per kilo"* (DeCarlo & Ali, 2014a).

Exports of frankincense from Puntland averaged around 500 tonnes per annum in 2003 roughly 50% of the estimated production potential of the region. Market prices were also surprisingly stable at around $9-11/kg (Ministry of Planning and Statistics, 2003). Based on data from FAO and Global Development Solutions LLC (GDS), Somaliland's 2011 capacity for "*meydi*" production was 200 tonnes corresponding to revenue of US$ 2 million with a potential capacity of 300 tonnes (Soloviev & Abdi, 2013). Current estimates of production in Somaliland vary widely from 200 to 700 tonnes per year (U. Feiter, pers. comm. 2015). The estimated total potential production varies from 1,000 to 2,500 tonnes of olibanum and myrrh combined, of which an estimated 40% of this being *B. frereana*.

Somaliland exports gums and resins products mainly to Djibouti, Ethiopia (lower grades of *beyo* (*B. sacra*) and Middle East including Saudi Arabia, UAE and Yemen (higher grades of *meydi* (*B. frereana*). The extent to which formal monitoring of frankincense exports are monitored at the ports of Berbera in Somaliland and Bosaso in Puntland, is uncertain, as much of this trade in on direct shipments of livestock to Saudi Arabia. Recent initiatives to construct new seaports on in Puntland are likely to increase exports of livestock and quite possibly frankincense. Most illegally harvested *B. frereana* frankincense is exported via Djibouti to the Arabian Peninsula (Hall, 2005).

Since the collapse of the Somalia State, Saudi Arabia emerged as a major transhipment point to international markets which reportedly has contributed to marginalization of Somali traders (Candlelight for Health, Education & Environment, 2006). In Saudi Arabia, the top grades of "*maydi*" pieces are sold to consumers by the gram for reportedly high prices. The only apparent value-adding (in Saudi Arabia) is a final polishing, smoothing of jagged pieces and packaging in plastic. Merchants in the UAE have also started selling Somalian material obtained from Saudi Arabia labelled by gum type and grade (ITC - Eastern Africa, 2006b). Yemen also imports high grades of "*maydi*" ("*mushaad*" and "*mujarwal*") and 73% of Yemen's imports of HS1301901 (natural gums and resins) in 2013 were from Somalia, of which Somaliland's share is 29% and the rest is from Somalia/Puntland. In 2011, about 70% of imported gums and resins were for local consumption, but this has decreased by over 25% since the start of the crisis in Yemen due to collapse of community income sources. Yemen is re-exporting to neighbouring Arabian countries, mainly Saudi Arabia. There is some value-addition in Yemen of lower grades of *maydi* by agglomerating and transforming into new grades known as "*sana'e*" (Aden, 2014).

A report for the EU rehabilitation programme for Somalia/Somaliland states that "Saudi Arabia was and remains the largest importer of Grades 1-4 of "maydi" frankincense which is a prestigious chewing product consumed by Saudi middle-upper class households peaking during religious festivals, especially the Hajj. There was direct exporting of "maydi" frankincense from Somaliland to Saudi Arabia with livestock shipments prior to the livestock ban" (ITC - Eastern Africa, 2006b).

Saudi Arabia may be the only country that has assigned a specific tariff code for 'frankincense' (HS 1301.90.7000). Table 2 shows that in 2011, 2012 and 2013 Saudi Arabia imported frankincense exclusively from Somalia although it is not possible to sort out the relative amounts for the different species of *Boswellia* from Somalia.

Table 2. Saudi Arabia 2011-2013 imports of HS 1301907000 (Frankincense)

Somalia origin only	Quantity (kg)	Trade Value (SAR) *
2011	318,000	1,158,000
2012	278,000	789,000
2013	275,000	731,000

Source: Kingdom of Saudi Arabia Central Department of Statistics & Information. Import Statistics Bulletin.

* **Note:** 1 SAR (Saudi Arabian Riyal) = US$ 0.266688 (at the time of this report).

Table 3 shows that Somalia also supplies the majority of natural gums and resins to Yemen. For the 2011-2013 period, Yemen imported on average 532,250 kg of HS 130190 annually, of which an average of 287,733 (54%) originated in Somalia. It is not known what portion of the total imported amount is represented by *B. frereana*.

Table 3. Yemen 2011-2013 imports of HS 130190 (natural gum, resin, gum-resin, excluding gum arabic)

Year	Total import Qty (kg)	Total import Trade Value (US$)	Qty (kg) imported from Somalia	Trade Value (US$) from Somalia
2011	359,284	$583,987	225,614	$451,853
2012	459,424	$712,130	303,227	$469,847
2013	778,044	$820,838	334,358	$432,155

Year	Total import Qty (kg)	Total import Trade Value (US$)	Qty (kg) imported from Somalia	Trade Value (US$) from Somalia
3-year total	1,596,752	$2,116,955.00	863,199	$1,353,855.00
Annual average	532,250	$705,652	287,733	451,285

Source: UN COMTRADE Database. Copyright © United Nations 2015

Table 4 shows that in 2013, Somalia ranked at #6 in terms of trade value for supply of 'gums and resins' (olibanum, myrrh and dragon's blood) to China. China's 8-digit tariff code HS13019020 includes *Boswellia spp.*, *Commiphora* spp., *Daemonorops spp.*, and *Dracaena* spp., among other gums and resins. It is not known what portion of China's imports of HS13019020 are comprised of *B. frereana* resin. China is believed to be importing frankincense more for the manufacture of incense sticks than for traditional medicines as was previously supposed. China is reportedly the single largest importer of "*beyo*" type frankincense (*B. sacra*) and myrrh (Chikamai & Casadei, 2005).

Table 4. China 2013 imports of HS 13019020 (Olibanum, Myrrh, and Dragon's blood)

Exporter	Quantity (kg)	Trade Value (US$)
Ethiopia	1,165,395	3,417,396
Sudan	295,896	893,201
Singapore	4,078	731,088
Indonesia	2,922	608,000
Kenya	97,506	213,127
Somalia	37,998	117,239
Nepal, FDR	82,810	107,104
India	34,846	91,577
Total	**1,721,451**	**6,178,732**

Source: China Trade Data

6.3. Parts and derivatives in trade

Customs tariff codes used for *B. frereana* articles of commerce are shown in Table 5. All codes shown are general codes with the exception of Saudi Customs (SC), which has assigned a specific tariff code for 'frankincense' HS1301907000, although not species-specific for differentiating imports of different *Boswellia* species.

Table 5. HS tariff codes used for 'Natural Gums & Resins' including *Boswellia* species

Traded form	BTI	CCC	CCCCS	CROSS	SC	SMOTI
Dried resin	130190 0000	1301902200	13019020	1301909090	1301907000	13019032
Tincture	300390 0000					
Essential oil	330129 41			3301295050; 3301295150		
Incense sticks	330741 0000			3307410000		

Legend:
BTI: Binding Tariff Information rulings of the European Commission Taxation and Customs Union
CCC: Standard Classification of Commodities of the Republic of China (Taiwan)
CCCCS: Commodity Classification for China Customs Statistics (PRC)
CROSS: Customs Rulings Online Search System (U.S. Customs & Border Protection)
SC: Saudi Customs, Kingdom of Saudi Arabia Central Department of Statistics & Information
SMOTI: Somaliland Ministry of Trade and Investment

Somaliland Ministry of Trade and Investment states "*The main quality aspects of gums and resins in Somaliland are measured according to traditional grading systems used in trade with the Arabic peninsula. These classifications depend on the size and colour of the gum resin. In some cases certain customers, mainly from European markets, who are buying gums and resins, demand certain grades and provide the specifications for these grades*" (Soloviev & Abdi, 2013). Table 6 shows the 7 different grades of "maydi" frankincense used in Somaliland. The raw product unsorted is called "marbuush‟. The cleaned and sorted grades are described in the table.

Table 6. Somaliland grades of "meydi" frankincense

Grade Serial Number	Grade Name	Description	Average Selling Price (US$) of batches Sep-Nov 2013
1	Mushaad	Large white pieces >20 mm	11.24 – 15.75
2	Mujarwal	Medium to large white pieces 12-20 mm	7.50 – 14.00
3	Fas kabiir	Medium round pieces 6-12 mm	6.30 – 14.23
4	Fas saqiir	Small to medium round pieces 4-6 mm	14.23
5	Jidhiidh	Mixture of gum and bark	No data
6	Budo	Powder	1.95
7	Kasaar	Bark	1.28 – 4.59

Source: Republic of Somaliland Ministry of Trade and Investment

Grades 1-4 of "meydi" are currently exported mainly to Yemen and UAE with possible re-export to Saudi Arabia by intermediary dealers. Grades 5-6 are exported mainly to Ethiopia, Yemen, Eritrea and Egypt (Aden, 2013).

6.4. Illegal trade

In Somaliland, according to DeCarlo and Ali (2014), "*Illegal harvesting is rampant. Youth with few opportunities are reported to sneak into these remote areas during the harvesting season and take the resin before the legitimate harvesters reach it […] illegal harvesters also collect resin by making additional cuts onto the bark after the 5-month legal harvesting season has ended. Desperate and irresponsible harvesters are reported as making too many cuts on the trees to drain resin as well as cutting in ways that can and does kill the trees*" (DeCarlo & Ali, 2014a). Most of the illegally exported "meydi" reportedly first goes to Djibouti for re-export to Arabia. In the past, the reason for trading on the illegal market was that it is more profitable and practical (Farah, 1994; Hall, 2005).

6.5. Actual or potential trade impacts

Gum harvesting and trading in Somalia is of significant economic importance for local livelihoods and economies and for international trade. Continued significant trade coupled with loss of habitat can be considered a threat to the species as well as to rural livelihoods. In Somalia, an estimated 10,000 people are involved in gums and resin production and trade as a source of income (Lehoux & Chakib, 2012).

7. <u>Legal instruments</u>

7.1. National

B. frereana is not covered by endangered-species legislation in Somalia. Weak governance and well-intentioned but counter-productive regulatory frameworks are a challenge. Low government capacity in more remote rural areas results in a gap between policy goals and implementation. There is also a dispute between the two semi-autonomous states of Somaliland and Puntland the production zone. Moreover, they are not recognised by the United Nations as sovereign states.

Prior to the collapse of the central Somalia government in 1991, the frankincense trade was government-controlled. The state actively supported the production and export of the commodity by providing financial incentives and regulating the market prices 'good practices' in tree tapping and husbandry was promoted. The 'tears' harvested almost contained no bark. Double tapping within the same calendar year was banned. Young trees were exempt from exploitation till they became mature enough to withstand tapping. Those in violation were severely punished with their harvest confiscated and, at times, even imprisoned.

7.2. International

The species is not yet included in the CITES Appendices; thus its exploitation is not subject to CITES regulations.

B. frereana has not been assessed by the IUCN and is not even listed in the Catalogue of Life. The lack of taxonomic definition has certainly restricted research and survey work on this species of *Boswellia*.

8. Species management

8.1. Management measures

In the past, *Boswellia frereana* trees were reportedly better managed through a system of customary ownership that was well known. According to ITC - Eastern Africa (2006a), tenure and tapping rights are now unclear and over-exploitation is common (ITC - Eastern Africa, 2006a).

Different types of land tenure affect the relative sustainability of frankincense production in Somaliland and Puntland. Under one system the family with customary tenure over the *Boswellia* woodland will harvest the trees on a rotating basis (*gaafeysi*). In the other system individuals pay rent (*cawaaji*) to the owning family and have the right to collect the harvest of the entire season. The former system is more likely to be sustainable than the latter as farmers have a direct incentive not to overharvest their trees. Under the *cawaaji* system this is not the case.

Due to political disturbances in the region there has been major migrations both from and to Puntland from other parts of Somalia. This has understandably disturbed traditional land tenure systems and collection protocols. There have been no surveys of the impact of these mass migrations on the harvesting of *B. frereana* in the region.

B. frereana management is also affected by disputes over land and the uncertainty this causes for land and tree tenure. Some parts of the Sanaag region, one of the best areas for *B. frereana*, are claimed by both Somaliland and Puntland, for example. The whole issue of sovereignty in this region of the world calls into question any attempt to enforce any internationally recognised regulations.

The collapse of central Government in Somalia left the frankincense trade very weak as the original state-sponsored trade monopoly had virtually wiped out the private sector. In many parts of the country nomadic pastoralists or transient labour trying to make quick gains to survive were either over-tapping, double tapping or cutting deep wounds to try to yield as much gum from a tree in a single harvest. Demand for firewood and charcoal is also a constant threat in unregulated areas where outsiders simply cut down the tree or remove large branches doing irreparable damage to the tree and the environment (Ali, 2015).

With Somalia often reported to be a "failed state" any attempt to have Government organised management measures for any endangered species could be difficult. A few studies have looked at the issue but not in detail (Candlelight for Health, Education & Environment, 2006). The private sector in Somaliland who have tenure over large areas of *Boswellia* woodlands have instituted a range of measures to develop and expand sustainable cultivation techniques (Beyomol – Neo Trading, 2010). However, for Organic or Fairwild inspectors to monitor such measures may well be very difficult. Since this species only grows in Somaliland and Puntland, governments in other francincense production areas such as Ethiopia, Sudan, Kenya and Oman have no vested interest in developing management techniques for what is often known as the "King of Frankincense".

8.2. Population monitoring

No official population monitoring has been undertaken of *B. frereana*.

8.3. Control measures

8.3.1. International

None.

8.3.2. Domestic

It is known from quantitative studies of *Boswellia papyrifera* that population decline due to multiple factors is not a new problem. Instead, it is something that in the *B. papyrifera* case in north-east Africa, has been 40 years in the making (Tolera, et al., 2013). Based on years of research on *B. papyrifera* (Lemenih, et al., 2014) and *Boswellia* species on Socotra and in Oman (Coppi, et al., 2010) the type of interventions that would make a difference are known. The introduction of any control on the harvesting of this species will require both local acceptance and government support. Acceptance will only happen if the official authorities in return control grazing and land use rights to traditional authorities, help control bush fires and enforce regulations on tapping techniques and frequency.

8.4. Cultivation and propagation

According to a private company processing and marketing *B. frereana* resin products from Dubai, there are well-managed woodlands for *Boswellia* where sustainable harvesting practices are being adopted (Maydi Frankincense, n.d.). The extent to which this is true or provided for marketing reasons needs to be verified. The claim is that while local recommendations state that trees should be left alone for one full season after every five or six seasons of being tapped, each tree is only tapped once every *two* years. The Somali expatriate owners of this company which has distillation units in Dubai claim to have over 100,000 trees that "*have never been harvested because there has not yet been enough market demand*". They claim that this area could easily produce double or triple the present amount of frankincense resin using the same sustainable techniques (Maydi Frankincense, n.d.).

B. papyrifera can be grown vegetatively using leafless branch cuttings, which if successfully implemented on a large enough scale could help overcome the poor recruitment into wild populations (Haile, et al., 2011). Whether this would be successful for *B. frereana* is not known, but while technically possible, would require strong tenure over the planting areas and the trees within them.

8.5. Habitat conservation

The recent draft of National Biodiversity Strategy and Action Plan (NBSAP) for Somalia (Federal Republic of Somalia, 2015) sets out clear goals for sustainable management of the country's frankincense resources that need to be achieved by 2020. These goals are that:

- "*By 2016, the status of Non-wooded Forest Products (NWFP) such as Frankincense, Myrrh, medicinal and aromatic plants of the Golis range in Somaliland and Puntland and the genetically diverse cultivated plants and farmed & domesticated animals of Juba – Shebelle basins are adequately assessed and elaborate plan for sustainable management is in place;*

- *By 2018, the implementation of the management plan is commenced; and that*

- *By 2020, improved management of frankincense, myrrh and other tree species including the Commiphora; reseeding, exploitation and developing strategic marketing routes and protected pricing are in place and at least two sophisticated Gene & Seed banks are in place to preserve the threatened genes and seed species*".

The extent to which these aspirations can be achieved is uncertain due to the long-running political instability in Somalia. However in Somaliland, which by contrast has been relatively stable for twenty years, the Minister of Labour has publicly expressed similar sentiments regarding sustainable use and improved value chains (DeCarlo & Ali, 2014b).

9. Information on similar species

Frankincense from *B. frereana* is considered a high quality source of incense (Langenheim, 2003), with higher prices paid for the high grades of *meydi*. While this may be a driver of adulteration in order to get better prices for what is purported to be *B. frereana* resin, there are solutions to this problem. Although superficially similar to other resins, *B. frereana* frankincense is characterized by lupeol and 3-epi-lupeol, together with triterpenes and dammarane (Chiavari, et al., 1991; Zhang, et al., 2013). In addition, *B. frereana* contains almost no boswellic acids (Meier & Spriano, 2010). Even without sophisticated chemical analysis, the fact that *B. sacra* resin is bitter and *B. frereana* resin is not (Thulin & Warfa, 1987) helps avoid adulteration, given that use of high grade *B. frereana* for chewing is significant part of the market in Saudi Arabia. These factors enable the look-a-like problem to be resolved through chemical analysis.

10. Experts consulted

Consultations were held with Earth Oils (www.eartholis.com), Enfleurage (www.enfleurage.com), Beymol (www.beymol.com), Maydi Frankincense Ltd (www.maydifrankincense.com), Neals Yard Remedies (www.Nealsyardremedies.com), Fairwild Foundation (www.fairwild.org).

11. References

Abiyu, A., Vacik, H. & Glatzel, G., 2006. Population viability risk management applied to Boswellia papyrifera (Del.) Hochst in North-eastern Ethiopia. *Journal of the Drylands,* Volume 1, pp. 98-107.

Aden, A., 2013. *Grading and classification system used for export of gums and resins in Somaliland,* Hargeisa, Somaliland: SOFREGO.

Aden, A., 2014. *Value Chain Development Project – Somaliland Gums & Resins Markets in Yemen,* s.l.: SOFRECO.

Ali, M., 2015. *Is the production of frankincense in Somaliland under threat?.* [Online]
Available at: http://lubanaromatics.com/production-frankincense-somaliland-threat/
[Accessed 1 6 2015].

Basar, S., 2005. *Phytochemical investigations on Boswellia species. Comparative studies on the essential oils, pyrolysates and boswellic acids of Boswellia carterii Birdw., Boswellia serrata Roxb., Boswellia frereana Birdw., Boswellia neglecta S. Moore and Boswellia rivae.* s.l.:Thesis.

Beyomol – Neo Trading, 2010. *Presentation on the aromatic gums market in Somaliland,* Hargeisa, Republic of Somaliland: Beyomol Company.

Candlelight for Health, Education & Environment, 2006. *Impact of Civil War on Natural Resources: A Case Study for Somaliland,* Hegiras, Somaliland: Candlelight for Health, Education & Environment.

Chiavari, G., Galletti, G., Piccaglia, R. & Mohamud, M., 1991. Differentiation between resins Boswellia carterii and Boswellia frereana (frankincense) of Somali origin. *Journal of Essential Oil Research,* 3(3), pp. 185-6.

Chikamai, B. & Casadei, E., 2005. *Production and Marketing of Gum Resins: Frankincense, Myrrh and Opoponax.,* Nairobi, Kenya: Network for Natural Gums and Resins in Africa (NGARA).

Coppen, J., 1995. Flavours and fragrances of plant origin. In: *Non-wood forest products 1.* Rome: Food and Agriculture Organization of the United Nations, pp. x, 101p.

Coppi, A., Cecchi, L., Selvi, F. & Raffaelli, M., 2010. The Frankincense tree (Boswellia sacra, Burseraceae) from Oman: ITS and ISSR analyses of genetic diversity and implications for conservation. *Genetic resources and crop evolution,* 57(7), pp. 1041-52.

Coulter, J., 1987. *Market Study for Frankincense and Myrrh from Somalia,* Chatham: Natural Resources Institute.

Dalsen Consultants, 2013. *Baseline survey report.,* s.l.: Africa Development Solutions, Care International in Somalia and Ministry of Environment, Puntland..

DeCarlo, A. & Ali, S., 2014a. *Sustainable Sourcing of Phytochemicals as a Development Tool: The Case of Somaliland's Frankincense Industry,* s.l.: IEDS.

DeCarlo, A. & Ali, S., 2014b. *Frankincense and Sustainable Livelihoods in Somaliland / Somalia.* [Online] Available at: https://www.youtube.com/watch?v=DoKY3IIaBp8 [Accessed 1 6 2015].

Directorate General for Health and Consumers, n.d.. *Cosmetic Ingredients and Substances (CosIng®) Database.* [Online].

FAO, 2010. *Guidelines on sustainable forest management in drylands of sub-Saharan Africa,* Rome: Arid Zone Forests and Forestry Working Paper No. 1..

Farah, A., 1994. *The milk of the Boswellia forests: frankincense production among the pastoral Somali.* Oxfordshire: Cab Direct.

Farah, M., 2008. *Non-Timber Forest Product (NTFP) Extraction In Arid Environments: Land-Use Change, Frankincense Production And The Sustainability Of Boswellia Sacra In Dhofar (Oman),* s.l.: University of Arizona.

Federal Republic of Somalia, 2015. *National Biodiversity Strategy and Action Plan (NBSAP). FAO, GEF, CBD draft report.* [Online] Available at: http://nbsapforum.net/uploads/1410.pdf [Accessed 1 6 2015].

Frankincense co-operative, n.d.. *Frankincense / Olibanum.* [Online] Available at: http://www.frankincensemyrrh.co.uk/frankincense.php [Accessed 1 6 2015].

Groom, N., 1981. *Frankincense and Myrrh. A Sudy of the Arabian Incense Trade..* Harlow & Beirut: Longman & Libraire du Liban.

Haile, G., Gebrehiwot, K., Lemenih, M. & Bongers, F., 2011. Time of collection and cutting sizes affect vegetative propagation of Boswellia papyrifera (Del.) Hochst through leafless branch cuttings. *Journal of Arid Environments,* Volume 75, pp. 873-877.

Hall, A., 2005. *Viability of a Sustainable Frankincense Market in Somaliland: A Historical and Economical Analysis.,* s.l.: Somaliland Cyberspace.

ITC - Eastern Africa, 2006a. *Review and Synthesis of Local Economic Development (LED) Materials: Puntland,* s.l.: The European Union's 5th Rehabilitation Programme for Somalia/Somaliland.

ITC - Eastern Africa, 2006b. *Review and Synthesis of Local Economic Development (LED) Materials: Somaliland.,* s.l.: The European Union's 5th Rehabilitation Programme for Somalia/Somaliland.

Langenheim, J., 2003. *Plant resins. Chemistry, Evolution, Ecology, Ethnobotany..* Portland, OR: Timber Press.

Lehoux, H. & Chakib, A., 2012. *Non Wood Forest Products Subregional Report 2012 – Eastern Africa.,* s.l.: Food and Agriculture Organization, FOPP.

Lemenih, M., Wiersum, K., Woldeamanuel, T. & Bongers, F., 2014. Diversity and dynamics of management of gum and resin resources in Ethiopia: a trade-off between domestication and degradation. *Land Degradation & Development,* Volume 25, pp. 130-42.

Mahony, D., 1990. *Trees of Somalia: a field guide for development workers.* Oxford: Oxfam Research Papers.

Maydi Frankincense, n.d.. *Our mission..* [Online] Available at: http://www.maydifrankincense.com/our-mission.html [Accessed 1 6 2015].

Meier, B. & Spriano, D., 2010. Modern HPTLCA Perfect Tool for Quality Control of Herbals and Their Preparations. *Journal of AOAC International ,* Volume 93, pp. 1399-1409.

Ministry of Planning and Statistics, 2003. *Puntland Facts and Figures,* s.l.: Puntland State of Somalia.

Olson, D. et al., 2001. Terrestrial ecoregions of the world: a new map of life on Earth. *Bioscience,* 51(11), pp. 933-38.

PDRC, 2004. *Macro -economic analysis in Puntland. Draft report.* [Online] Available at: http://www.somali-jna.org/downloads/13%20Macro-

economic%20Draft%20Report%20PDRC.pdf
[Accessed 1 6 2015].

PROTA4U, n.d.. *Boswellia frereana Birdw..* [Online]
Available at:
http://www.prota4u.org/protav8.asp?fr=1&h=M4&t=Boswellia,frereana&p=Boswellia%20frereana
[Accessed 1 6 2015].

Rabinowitz, D., Cairns, S. & Dillon, T., 1986. Seven forms of rarity and their frequency in flora of the British Isles. In: M. Soule, ed. *Conservation Biology, the Science and Scarcity of Diversity.* Sunderland, Massachusetts: Sinauer, p. 182–204.

Soloviev, P., 2013. *Manual on Good Tapping and Harvesting Practices for Gums & Resins produced in Somaliland.* s.l.:Somaliland Ministry of Trade & Investment.

Soloviev, P. & Abdi, A., 2013. *Directory for Somaliland gums, resins and essential oils.,* Hargeisa: SOFRECO.

Strumia, F. et al., 2007. Notes on some insects associated to frankincense tree (Boswellia sacra fluckiger 1867 Burseraceae) in Dhofar (Sultanate of Oman). *Atti Soc. tosc. Sci. nat., Mem., Serie B,* Volume 114, pp. 135-9.

The Plant List, Version 1.1, 2013. *Boswellia frereana Birdw..* [Online]
Available at: http://www.theplantlist.org/tpl1.1/record/kew-2680557
[Accessed 1 June 2015].

Thulin, M., 1998. *Boswellia sacra. The IUCN Red List of Threatened Species.* [Online]
Available at: http://www.iucnredlist.org/details/34533/0
[Accessed 1 6 2015].

Thulin, M., 2008. *BOSWELLIA frereana Birdw. [family BURSERACEAE].* [Online]
Available at: http://plants.jstor.org/stable/10.5555/al.ap.flora.flos000549
[Accessed 1 6 2015].

Thulin, M. & Warfa, A., 1987. The frankincense trees (Boswellia spp., Burseraceae) of northern Somalia and southern Arabia. *Kew Bulletin,* pp. 487-500.

Tolera, M. et al., 2013. Frankincense tree recruitment failed over the past half century. *Forest Ecology and Management,* Volume 304, pp. 65-72.

USDA, ARS, National Genetic Resources Program, n.d.. *Germplasm Resources Information Network - (GRIN).* [Online]
Available at: http://www.ars-grin.gov./cgi-bin/npgs/html/taxon.pl?310552
[Accessed 1 6 2015].

Zhang, Y. et al., 2013. Triterpenoid resinous metabolites from the genus Boswellia: pharmacological activities and potential species-identifying properties [abstract only]. *Chemistry Central Journal ,* 7(1), p. 153.

Boswellia_papyrifera_barrierefrei_ v2_clean_rev-BfN_29-Sept-2015-TC-30-Sept-JB, TB_final-review-schp.docx

Recvd.3.9.2015, Reviewed schp 29.9.15

29.9.15 TC edit, 30.9.15 JB edit, TB edit

final review schp: 6.10.2015

Boswellia papyrifera

A. Summary of findings

Boswellia papyrifera is one of the main sources of an oleo-resin known as frankincense or olibanum, which is widely used in religious rituals and as a raw material in cosmetic, chemical, food and pharmaceutical industries. *B. papyrifera* occurs from south of the Sahara, from Nigeria in the west to Ethiopia and Eritrea and southwards to NE Uganda. According to Farah (1994), resin from *B. papyrifera* is the world's most widely traded frankincense. The main frankincense producing countries are Ethiopia, Eritrea and Sudan (Farah, 1994). Globally, the People's Republic of China is considered the single largest importer of frankincense and myrrh (Chikamai & Casadei, 2005). Ethiopia is the world's largest producer and exporter of frankincense and *B. papyrifera* contributes up to 90% of Ethiopia's total annual gum and resin trade (Yilma, et al., 2015). Trade is dominated by the "Tigray type" frankincense (from *B. papyrifera*) rather than Ogaden type frankincense (from *B. rivae*) or Borana type (from *B. neglecta*). Frankincense from *B. papyrifera* is the most widely traded in Ethiopia, both domestically and internationally, accounting for 91% of value and 93% of exported quantity (Millenium Cities Initiative (MCI) Mikelle Investment Team, 2013). Annual production of frankincense from *B. papyrifera* in Eritrea has been estimated at 450 tonnes. Although Khalid et al. (2007) estimated an export volume of *B. papyrifera* resin from (former) Sudan of 701 tonnes, Abtew et al. (2012) considered that most from *B. papyrifera* produced in the Republic of the Sudan was consumed internally and only a limited amount was exported. Trade data of 2013 show that China is the main frankincense importing country for Ethiopian frankincense, followed by the United Arab Emirates, Tunisia, Vietnam and Greece. Chikamai & Casadei (2005) suggested that China imported frankincense more for the manufacture of incense sticks than for traditional medicines as was previously supposed. Religious rather than medicinal use of frankincense is also a significant part of the frankincense trade in Europe and North America and probably accounts for most of imports into Greece. Twenty years ago, Coppen (1995) estimated that in Europe and Latin America, Orthodox and Roman Catholic Churches used approximately 500 tonnes of frankincense per year. The current scale of the frankincense trade for church use is unknown. According to Abtew et al. (2012), the main importers of Sudanese frankincense include United Arab Emirates, Kingdom of Saudi Arabia, China, France, Germany, and Italy (Abtew, et al., 2012). Khalid et al. (1997) observed increased demand for Sudanese *B. papyrifera* causing new companies and exporters to join the international market in the mid-1990s. Sudanese export quantities, however, dropped significantly during the 2000's, down to 76 MT by 2007 (Konandreas, 2009). Adulteration with resins from other species and "look-alike" problems are common. For example, a study on frankincense samples collected from markets in China showed that out of fifty commercial samples, 27 were Official Frankincense and 23 were fake (Zhong et al., 2012). This challenge can be resolved in relation to confusion with frankincense from *Boswellia serrata* and *Boswellia sacra* using the identification method developed by Paul et al. (2012).

Across its geographic distribution, however, *B. papyrifera* populations are declining due to habitat loss to farmland, fire and intensive grazing of seedlings and young plants. Major declines in populations of *B. papyrifera* have occurred in all three major frankincense exporting countries, based on quantitative studies in Ethiopia (Abiyu, et al., 2010; Groenendijk, et al., 2012; Tolera, et al., 2013), Eritrea (Ogbazghi, et al., 2006) and Sudan (Abtew, et al., 2011; Abtew, et al., 2012). Due to grazing impacts, little or no tree regeneration occurs in much of the natural range of this species and mortality of adult trees is increased due to destructive tapping techniques compounded by wood-boring insect attack. In countries where commercial tapping is practiced (by slashing the trunks of *B. papyrifera* trees), this also has a detrimental effect. Many *B. papyrifera* populations have few (or no) saplings or small trees less than 10 cm in diameter at breast height (DBH) (Groenendijk, et al., 2012). In their recent study in Ethiopia for example, Tolera et al. (2013) showed that population decline has occurred over the past 50 years due to lack of recruitment of young *B. papyrifera* trees into the population they studied. Similar challenges are faced in Eritrea (Ogbazghi, et al., 2006). Based these and other studies, this appears to be a widespread problem due to intensive grazing and fire linked to increased settlement of people into *B. papyrifera* dominated woodland areas. Based on a detailed study of 12 *B. papyrifera* populations across northern Ethiopia, Groenendijk et al. (2012) concluded that if current practices continue, then there will be a 90% decline in the size of both tapped and untapped *B. papyrifera* populations within 50 years and a 50% decline in frankincense yield within 15 years. Based on their population projections using computer-based modelling, this dismal situation concluded that frankincense production could only be sustained through intensive management that results in full sapling recruitment and a 50–75% reduction in mortality of adult *B. papyrifera* trees. If a "business as usual" approach to *B. papyrifera* management continues, Lemenih et al. (2014b) conclude that by 2040, the stem density *B. papyrifera* populations in the Metema and Abergelle districts of Ethiopia will be respectively reduced to 3% and 11% of their current size (Lemenih, et al., 2014b).

B. Assessment on fulfilling the criteria of Res. Conf. 9.24 for this species

Based on the criteria for the inclusion of species in CITES Appendix II, there is compelling evidence for adding *Boswellia papyrifera* to Appendix II. Declines in populations of *B. papyrifera* have occurred in all three major frankincense exporting countries, based on quantitative studies in Ethiopia (Abiyu, et al., 2010; Groenendijk, et al., 2012; Tolera, et al., 2013), Eritrea (Ogbazghi, et al., 2006) and Sudan (Abtew, et al., 2011; Abtew, et al., 2012). Quantitative studies by Tolera et al. (2013) that show that several *B. papyrifera* populations have been in decline for at least 50 years. Unregulated resin tapping has been widely shown to have a detrimental impact on wild *B. papyrifera* populations, so closer monitoring of trade would be useful.

C. Supporting statement

1. Taxonomy

1.1. Class

Angiospermae

1.2. Order

Sapindales

1.3. Family

Burseraceae

1.4. Genus and species

While *Boswellia papyrifera* (Caill. ex Delile) Hochst. is listed as the currently accepted name by the Germplasm Resources Information Network (GRIN) (USDA, ARS, National Genetic Resources Program, n.d.) and by The Plant List (The Plant List Version 1.1, 2013), *Boswellia papyrifera* (Delile) Hochst. is the presently accepted name in the African Plant Database (Conservatoire et Jardin botaniques & South African National Biodiversity Institute, 2012).

1.5. Scientific synonyms

Amyris papyrifera Delile, *Boswellia chariensis* Guillaumin, *Boswellia occidentalis* Engl., *Boswellia odorata* Hutch. (Conservatoire et Jardin botaniques & South African National Biodiversity Institute, 2012).

1.6. Common names including trade names of the oleo-resin

Frankincense from *Boswellia papyrifera* is traded for use in pharmaceutical, food, cosmetic and chemical industries, where the oleo-resin is known as frankincense, olibanum, Tigray frankincense, Tigray olibanum (Lemenih & Kassa, 2011a), and Sudanese frankincense (Forest Ecology and Forest Management Group, n.d.).

2. <u>Overview</u>

See Section A.

3. <u>Species characteristics</u>

3.1. Distribution

In dry Sudano-Sahelian woodlands in Cameroon, Central African Republic, Chad, Ethiopia, Eritrea, Sudan and Uganda (USDA, ARS, National Genetic Resources Program, n.d.), with most commercial frankincense production in Ethiopia, Somalia and Sudan (Figure 1).

3.2. Habitat

Boswellia papyrifera occurs across a fairly wide altitudinal range (400 – 1850 m AMSL) frequently as a dominant tree species, including in mono-dominant stands on seasonally dry rocky hillsides and sometimes in sandy valleys. In the main resin exporting countries (Ethiopia and Eritrea) *B. papyrifera* usually occurs in dry woodlands at 800-1850 m in altitude that have a mean annual rainfall of 360 - 800 mm, with Professor S. Demissew (pers. comm., 2015) recording *B. papyrifera* in western Ethiopia (Benishangul-Gumz Regional State) growing where the rainfall is about 1000 mm/year. Within these woodlands, the abundance and distribution of *B. papyrifera* is influenced by altitude, land-use intensity and soil type.

Figure 1. Distribution of *Boswellia papyrifera* from Nigeria eastwards to Ethiopia and Eritrea.

3.3. Biological characteristics

Reproduction of *B. papyrifera* in the wild is primarily from seed or from root suckers. Experimental propagation from branch cuttings and root suckers has been demonstrated. Seed from untapped trees has a high (>80%) germination rate with untapped trees producing three times more viable seeds than tapped trees (Rijkers, et al., 2006). In contrast, a high proportion of seed from tapped trees is not viable, with <16% germination success due to embryos being absent and/or insect attack (Lemenih & Kassa, 2011a; Rijkers, et al., 2006). Despite the high germination rates, recruitment of young trees into the population is poor, commonly due to the effects of grazing (Groenendijk, et al., 2012; Tolera, et al., 2013).

3.4. Morphological characteristics

Boswellia papyrifera is a tall (up to 12 m) deciduous tree, usually with a single stem and a spreading crown, in seasonally dry Sudano-Sahelian woodlands.. The bark is smooth and pale, peeling off in wide strips. The leaves are imparipinnate, often clustered at the ends of branches. The bisexual flowers have 5 petals and occur in panicles. Each has a 2-4 locular ovary, forming drupes with a single seed per locule.

Primarily a re-seeder, it typically has a single straight trunk with off-white to pale brown flaky bark. The bark exudate contains fragrant oleo-resin. The leaves are large, compound, arranged on long stalks with 11 to 29 narrowly ovate to oblong leaflets with wavy or toothed margins. *B. papyrifera* flowers range from white to pink in colour and are arranged on long red flower stalks. The fruits are obtetrahedral with red capsules about two centimetres long, usually containing three tapered seeds (Vollesen, 1989).

3.5. Role of the species in its ecosystem

Boswellia papyrifera is considered to be an ecologically important tree of dry woodlands (Abiyu, et al., 2006), but the full extent of the ecological role of this species needs further investigation.

4. Status and trends

4.1. Habitat trends

As Lemenih & Kassa (2011b) point out in their management guidelines to *B. papyrifera,* even taking the conservative estimation, into account, the official land allocation of 2 ha per household is taken into account in Metema area of Ethiopia, then at least 37,172 ha of woodland in the district was lost to farmland in just 4 years. In the same area, over a 30 to 35 year period, almost 303,180 ha of woodland was cleared for farmland and in Tigray Regional State of Ethiopia, over 177,000 ha of *B. papyrifera* woodland was converted to farmland over a 20 year period (Gebrehiwot, 2003).

4.2. Population size

The total population of *B. papyrifera* in dry woodlands from Nigeria in the west to Eritrea and southwards to Kenya is unknown, but likely to still be large, despite past declines. In Ethiopia, *B. papyrifera* tree density was 175 stems/ha at Lemlem Terara (Metera district) and 87 stems/ha at Kisha (Tegede Armachiho, district) but recruitment of young trees was poor at both of these sites. In the North Gondar area, Ethiopia, for example, where there is extensive tapping, *B. papyrifera* stands covered 419,246 ha in North Gondar Zone.

Table 1. The Rabinowitz matrix approach can be applied at a variety of scales, from local through to a national or international scale, leading to a single choice out of 8 boxes (A-H) that is then ranked. In this report, we highlight the section of this matrix relevant to *B. papyrifera* from the perspective of an **international** scale.

GEOGRAPHIC DISTRIBUTION		**LARGE**		**SMALL**	
HABITAT SPECIFICITY		**Wide**	**Narrow**	**Wide**	**Narrow**
POPULATION SIZE	**Large & dominant somewhere**	A. Locally abundant, several habitats over large geographic area	C. Locally abundant in a specific habitat over large geographic area	E. Locally abundant, several habitats over small geographic area	G. Locally abundant in a specific habitat over small geographic area
	Small & non-dominant	B. Constantly sparse in several habitats over a large geographic area	D. Constantly sparse in a specific habitat over a large geographic area	F. Constantly sparse in several habitats over a small geographic area	H. Constantly sparse in a specific habitat over a small geographic area

4.3. Population structure

Boswellia papyrifera tree height varies, with trees in the lowlands double the height of trees in highland areas. Lack of regeneration from seedlings is widely reported and under the current intensive annual tapping system throughout the dry season decreased seed production and production of non-viable seeds occurs. To get higher resin yields in the short term, the number of tapping spots is increased, but this detrimentally affects the trees in various ways. For example, Mengistu et al. (2013) have shown that the high intensity and frequency tapping method commonly used in Ethiopia is likely to deplete carbon storage in *B. papyrifera* trees (Mengistu, et al., 2013). Larger trees, and in particular, slower growing individuals produce higher quantities of resin (Tolera, et al., 2015). As stored carbons provide a reserve that is important when plants are under stress, depletion of carbon reserves negatively affects resin production, leaf production (Mengistu, et al., 2012), fruit yield and seed viability (Rijkers, et al., 2006). In addition, young plants are killed due to grazing by livestock. Combined with clearing woodlands for farmland, fire and infestation by wood-boring beetles, these factors raise concern about *B. papyrifera* stocks and future yields of frankincense. In Benishangul-Gumuz National Regional State, western Ethiopia for example, while *B. papyrifera* trees were abundant, recruitment of small trees into the population was poor (Yilma, et al., 2015). Many *B. papyrifera* populations have few (or no) saplings or small trees less than 10 cm DBH (Groenendijk, et al., 2012). In their recent study in Ethiopia for example, Tolera et al. (2013) showed that population decline has occurred over the past 50 years due to lack of recruitment of young *B. papyrifera* trees into the population they studied. Similar challenges are faced in Eritrea (Ogbazghi, et al., 2006; Ogbazghi, 2001).

4.4. Population trends

Although 12 Boswellia species with a narrower geographic range than *Boswellia papyrifera* are on the IUCN Red List, *B. papyrifera* has not been assessed yet by IUCN. Nevertheless, across its wide geographic distribution, *B. papyrifera* populations are declining due to habitat loss to farmland, fire and intensive grazing of seedlings and young plants. In Ethiopia, Eritrea and Sudan, where commercial tapping is practiced by slashing the trunks of *B. papyrifera* trees, this also has a detrimental effect. An important secondary effect of tapping is damage by the horned wood boring beetle (*Indactus spinipennis,* Cerambycidae). Abiyu et al. (2006) found that infestation by this beetle species was higher in areas with tapped trees than those with untapped trees and that trees died due to borer attack. Based on studies by Groenendijk et al. (2012), Tolera (2013) and Yilma et al. (2015), poor recruitment of young trees appears to be a widespread problem. Intensive grazing and fire linked to increased settlement of people into *B. papyrifera* woodland areas and not just intensive tapping are reasons for declining *B. papyrifera* populations. Based on a detailed study of 12 *B. papyrifera* populations across northern Ethiopia, Groenendijk et al. (2012) concluded that if current practices continue, then there will be a 90% decline in the size of both tapped and untapped *B. papyrifera* populations within 50 years and a 50% decline in frankincense yield within 15 years. Based on their population projections using computer-based modelling, this dismal situation concluded that frankincense production could only be sustained through intensive management that results in full sapling recruitment and a 50–75% reduction in mortality of adult *B. papyrifera* trees. If a "business as usual" approach to *B. papyrifera* management continues, Lemenih et al. (2014b) conclude that by 2040, the stem density *B. papyrifera* populations in the Metema and Abergelle districts of Ethiopia will be respectively reduced to 3% and 11% of their current size (Lemenih, et al., 2014b). For the Darfur region, a quantitative comparison of changes in stocking densities, composition, and distribution of *B. papyrifera* was made by comparing the results of the 1955 and 1996 forest national inventories of Sudan. Occurring in Zone III ("*Anogeissus-Acacia seyal-Lannea-Albizzia* association"), distribution was 25% in 1955 and 15.7% in 1996. The stocking percent (species tree number in percent of all trees enumerated) was 5.0% in 1955 and 5.7% in 1996 (Ahmed, 2013).

4.5. Geographic trends

As discussed above, *B. papyrifera* has a wide geographic distribution across dry Sudano-Sahelian woodlands from Nigeria, Cameroon, Chad, Central Africa, Uganda and Sudan to Ethiopia, with most commercial frankincense production in Ethiopia, Eritrea and Sudan.

5. Threats

The major threats are firstly, the high mortality of *B. papyrifera* trees and secondly, the poor recruitment of young trees (Lemenih, et al., 2014b). As discussed above, *B. papyrifera* woodlands are negatively affected by several factors. These include current land use, where woodlands are cleared for farmland, fire, grazing by livestock and opportunistic resin harvest rather than sustainable management, which in turn leads to infestation by wood-boring beetles (Lemenih & Kassa, 2011a; Lemenih, et al., 2014).

6. Utilization and trade

6.1. National utilization

The known uses of the oleo-resin are primarily as a raw material exported for the manufacture of processed ingredients used in cosmetic, food, and medicinal products as well as incense for religious purposes. In Ethiopia, the Ethiopian Orthodox Church uses about 2,050 tonnes of frankincense/year, with an additional 440 tonnes/year are used for cultural reasons at people's homes in Addis Ababa alone (Gebremedhin, 1997). The wood is also used for pole and timber locally whilst the leaves and seeds are used as dry season fodder livestock (Abtew, et al., 2011). Almost all *B. papyrifera* frankincense is produced from wild populations. In the North Gondar area of Ethiopia, for example, *B. papyrifera* stands covered 419,246 ha in North Gondar Zone with the estimated potential incense production of 117,261 tonnes per year whereas the maximum actual incense production was 720.5 tonnes per year in 2001 by two organizations. To stimulate resin production, circular cuts (or "tapping spots") are made in the trunk bark during the dry season and continues until the start of the rainy season. The first "tapping spots" are around 1–2 cm high, 1–1.5 cm wide and 0.5–1.0 cm deep, with three tapping spots usually are made on each side of the trunk, starting at about 0.5 m from the base of the tree (Lemenih & Kassa, 2011a). This wounding process is repeated every 15–20 days, reopening and enlarging each "tapping spot" by cutting bark from the upper edges of the former wound and by slicing lower down 2 cm from the lower edge. According to Lemenih & Kassa (2011), each tree is tapped 8–12 times per year. By the end of the season, the "tapping spot" ends up being 10 cm or more wide.

6.2. Legal trade

Precise quantification of the international trade of *B. papyrifera* is not presently possible due to the absence of species-specific tariff codes and because two of the main producing countries have not publicly reported values or volumes for their exports of goods under general HS Code 130190 [Natural gums & resins, excluding gum arabic]. Twenty years ago, Coppen (1995) estimated that in Europe and Latin America, Orthodox and Roman Catholic Churches used approximately 500 tonnes of frankincense per year. This trade for church use continues, but its current scale, although unknown, is likely to be significant. Annual production of olibanum from *B. papyrifera* in Eritrea has been estimated at 450 tonnes. China is believed to be importing frankincense more for the manufacture of incense sticks than for traditional medicines as was previously supposed (Chikamai & Casadei, 2005). According to Abtew et al. (2012) the majority of olibanum from *B. papyrifera* produced in Republic of the Sudan is consumed internally and only a limited amount is exported. Main importers of Sudanese frankincense include United Arab Emirates, Saudi Arabia, China, France, Germany, and Italy (Abtew, et al., 2012). China is reportedly the single largest importer of frankincense and myrrh (Chikamai & Casadei, 2005). Khalid et al. (1997) observed increased demand for Sudanese *B. papyrifera* causing new companies and exporters to join the international market in the mid-1990s. They estimated export volume of *B. papyrifera* from (former) Sudan at 701 tonnes (Khalid, et al., 2007). Abtew et al. (2011) reported, however, that exports from (former) Sudan gradually declined from about 1,119 tonnes in 2001/2002 to about 182 tonnes in 2006/2007, suggesting an association with a decline of the tree population and degradation of *Boswellia* stands. A 2009 study prepared for the Ministry of Foreign Trade, Government of Sudan and the European Commission reported an even steeper decline of Sudan's olibanum exports at 1,726 MT in 2001, 112 MT (2002), 865 MT (2003), 375 MT (2004), 358 MT (2005), 169 MT (2006), and down to 76 MT (2007) (Konandreas, 2009).

Estimated annual production of olibanum in Ethiopia is 57,100 tonnes [Tigray type (*B. papyrifera*), Ogaden type (*B. rivae*), and Borena type (*B. neglecta*)], of which Tigray type is the most widely traded both domestically and internationally accounting for 91% of value and 93% of exported quantity (Millenium Cities Initiative (MCI) Mikelle Investment Team, 2013). Of the three *B. papyrifera* producing countries (Eritrea, Ethiopia, Sudan), there are export trade data available for (former) Sudan and Ethiopia, under the general tariff code HS130190 (Natural Gums and Resins excluding Gum Arabic). Table 2 shows exports of HS130190 from Eritrea, Ethiopia, and Sudan for 2010 through 2013. It is not known what percentage of these natural gum and resin export volumes are specifically *B. papyrifera* oleo-resin.

Table 2: Eritrea, Ethiopia, Sudan: 2010-2013 exports of Natural gums and resins excluding Gum Arabic (HS 130190): Frankincense/Olibanum (*Boswellia* spp.), Gum Karaya (*Sterculia setigera*), and Myrrh (*Commiphora* spp.

Year	Exporter	Trade Value (US$)	Qty. (kg)
2010	Eritrea	Not reported	Not reported
	Ethiopia	$12,023,242	3,558,403
	(former) Sudan	$1,540,882	1,432,300
2011	Eritrea	Not reported	Not reported
	Ethiopia	$11,312,680	3,445,980
	(former) Sudan	$2,603,764	2,373,070
2012	Eritrea	Not reported	Not reported
	Ethiopia	$10,246,654	2,740,192
	(former) Sudan	$13,727,252	Not reported
2013	Eritrea	Not reported	Not reported
	Ethiopia	$12,184,560	3,268,647
	Republic of the Sudan	Not reported	Not reported

Source: UN COMTRADE Database

Gum and resin exports from Ethiopia (the majority comprised of olibanum) have been increasing consistently since 1998 when the export level was 1,456.4 tonnes. By 2003 and 2004 the average export level had increased to about 2,700 tonnes, with an annual growth rate of >10% 1998-2005. From 2005 to 2006 exports increased from 2,922.8 tonnes to 4,292.8 tonnes (+46.8%) (Industrial Projects Service, 2007). Table 3 shows that Ethiopia's 2013 total export quantity (of HS130190) was 3,269 tonnes, the majority of which exported to China. It is not known what percentage of these natural gum and resin export volumes are specifically *B. papyrifera* oleo-resin.

Table 3: Ethiopia 2013 exports of Natural gums and resins (HS 130190): Frankincense/Olibanum (*Boswellia* spp.), Gum Karaya (*Sterculia setigera*), and Myrrh (*Commiphora* spp.)

Partner	Trade Value (US$)	Quantity (kg)
China	$3,804,930	1,276,500
United Arab Emirates	$2,063,741	385,750
Tunisia	$1,443,276	264,000
Viet Nam	$1,283,302	461,995
Greece	$1,115,103	284,130
China, Hong Kong SAR	$645,495	210,000
Yemen	$302,541	71,000
Jordan	$281,857	51,000
Germany	$273,758	50,000
Guatemala	$221,380	46,150
USA	$204,795	44,481
Saudi Arabia	$120,898	35,000
France	$119,625	23,000
Oman	$88,749	16,000

Partner	Trade Value (US$)	Quantity (kg)
Armenia	$87,768	16,000
Netherlands	$56,311	15,000
Iraq	$28,908	5,000
Italy	$22,691	11,330
Belgium	$13,163	255
Israel	$5,706	1,750
Australia	$563	306
World Total	**$12,184,560**	**3,268,647**

Source: UN COMTRADE Database

Table 4 shows that China's 2013 imports of HS13019020 originated mainly from Ethiopia. It is not known what percentage of these 'Olibanum, Myrrh, and Dragon's blood' import volumes are specifically *B. papyrifera* oleo-resin.

Table 4: China 2013 imports of HS 13019020 (Olibanum, Myrrh, and Dragon's blood)

Partner	Quantity (kg)	Trade Value (US$)
Ethiopia	1,165,395	3,417,396
Sudan	295,896	893,201
Singapore	4,078	731,088
Indonesia	2,922	608,000
Kenya	97,506	213,127
Somalia	37,998	117,239
Nepal, FDR	82,810	107,104
India	34,846	91,577
Total	**1,721,451**	**6,178,732**

Source: China Trade Data

There is also COMTRADE data for Ethiopia (but not Eritrea or Sudan) for export of "incense sticks" under tariff code HS330741; 5,872 kg (2010), 10,374 kg (2011), 2,328 kg (2012), and 3,532 kg (2013). It is not known what percentage of incense stick composition or export volume is specifically made up of *B. papyrifera* oleo-resin.

6.3. Parts and derivatives in trade

Dried gum resin (Tigray type frankincense/olibanum) sorted into various different quality grades, essential oil distilled from the gum resin, and incense sticks. Table 5 shows various general HS Codes that are used for *Boswellia* species materials. The main exporters of the dried resin and incense sticks are Ethiopia, Eritrea and Sudan. The main importer is China, but United Arab Emirates is also a major importer. Significant quantities are also imported by European countries including Germany, France, Netherlands, and Italy. Value added forms such as essential oils and extracts (e.g. tinctures) are manufactured in European countries for use in cosmetic, food and pharmaceutical products.

Table 5: General HS tariff codes used for Natural Gums & Resins products which include *Boswellia* species

Traded form	BTI	CCC	CCCCS	CROSS
Dried resin	1301.90.0000	1301.90.2200	1301.9020	1301.90.9090
Essential oil	3301.29.41			3301.29.5050; or 3301.29.5150
Incense sticks	3307.41.0000			3307.41.0000

Traded form	BTI	CCC	CCCCS	CROSS
Tincture	3003.90.0000.V999			

Legend:
BTI: Binding Tariff Information rulings of the European Commission Taxation and Customs Union
CCC: Standard Classification of Commodities of the Republic of China (Taiwan)
CCCCS: Commodity Classification for China Customs Statistics (PRC)
CROSS: Customs Rulings Online Search System (U.S. Customs & Border Protection)

6.4. Illegal trade

There is insufficient data available to describe or quantify the level of illegal trade. The species is not yet included in the CITES Appendices, thus its exploitation is not subject to CITES regulations. Abdalla (2014) reports illicit felling of *B. papyrifera* by local communities in Blue Nile State, Republic of the Sudan, either for timber or fodder for cattle rather than producing resin (Abdalla, 2014).

6.5. Actual or potential trade impacts

Frankincense harvesting and trading in rural Ethiopia is of significant economic importance. Therefore, there could be an impact on rural collectors. In a survey by Mekonnen et al. (2013), "*about 93% of the interviewed households engaged in collecting, marketing, or both activities. Gums and resins contributed up to 14% of the average annual cash income of the households*" (Mekonnen, et al., 2013). Frankincense is used domestically for medicinal, cultural and religious purposes in the major exporting countries (Ethiopia, Eritrea and Somalia). In Ethiopia, for example, the Ethiopian Orthodox Church uses about 2,050 tonnes of frankincense/year and an additional 440 tonnes/year are used for cultural purposes at homes in Addis Ababa (Gebremedhin, 1997). Nevertheless, the international export trade is also significant.

7. <u>Legal instruments</u>

7.1. National

Boswellia papyrifera is not covered by endangered-species legislation, but there are *B. papyrifera* populations that are protected inside some forest reserves and conservation areas. Outside of these areas, there is a major gap between existing policies and effective, on the ground practice of conservation and sustainable use of *B. papyrifera* in all three Range States that are commercial exporters of frankincense. Weak governance is a challenge. Low government capacity in more remote rural areas results in a gap between policy goals and implementation. As a result, rapid degradation of the dry woodland habitat and unsustainable *B. papyrifera* harvest are occurring in Ethiopia, Eritrea and Sudan. Although complementary policy interventions aimed at sustainable use and poverty reduction are possible (Tilahun, et al., 2013) these have not yet been implemented.

7.2. International

None at present.

8. <u>Species management</u>

8.1. Management measures

Due to studies by Ethiopian scientists, including Prof. Frans Bongers' group at Wageningen University, there is an impressive amount of research on *B. papyrifera* compared to almost any other gum or resin producing species. In Ethiopia, there are new efforts by the State and NGOs to try to improve *B. papyrifera* management with clear recommendations on how to do so (Lemenih & Kassa, 2011a). Lemenih & Kassa (2011a) have recommended a tapping intensity of six "tapping spots" per *B. papyrifera* tree for trees of < 20 cm DBH, a total of 12 spots (3 spots on each of the 4 sides) for trees of 20–30 cm DBH and a total of 16 spots (4 spots on each of the 4 sides) for trees > 30 cm DBH. Having relevant, practical research insights is one thing. Implementing management in remote drylands is challenging. In Ethiopia all land belongs to the State. Balancing tapping and land rights with prices that are high enough to provide incentives to reduce the unsustainably high frequency and intensity of tapping are key issues. At present, tapping frankincense is a labour intensive activity for low economic return. In one of the production areas in Ethiopia, for example, no local villagers were involved in the collection or processing of frankincense. Instead, labour migrancy has occurred, with about 1,300 daily labourers coming from the Tigray region to undertake tapping to earn a small income, also generating income for the government in the process.

8.2. Population monitoring

Population level studies have shown declines in populations of *B. papyrifera* in all three major frankincense exporting countries, based on quantitative studies in Ethiopia (Abiyu, et al., 2010; Groenendijk, et al., 2012; Tolera, et al., 2013), Eritrea (Ogbazghi, et al., 2006) and Sudan (Abtew, et al., 2011; Abtew, et al., 2012).

8.3. Control measures

8.3.1. International

None at present.

8.3.2. Domestic

There is a major gap between existing policies and effective, on the ground practice of conservation and sustainable use of *B. papyrifera* in all three countries that are commercial exporters of frankincense. Weak governance and well-intentioned but counter-productive regulatory frameworks are adding to the rapid degradation of both the dry woodland habitat and to sustainable harvest of this species in Ethiopia and Sudan. Although complementary policy interventions aimed at sustainable use and poverty reduction are possible (Tilahun, et al., 2013) these have not yet been implemented.

8.4. Cultivation and propagation

Haile et al. (2011) have shown that *B. papyrifera* can be grown vegetatively using leafless branch cuttings, pointing out that if successfully implemented on a large enough scale, this could help overcome the poor recruitment into wild populations (Haile, et al., 2011).

8.5. Habitat conservation

Boswellia papyrifera populations occur in several National parks in Ethiopia, including Awash National Park (Mekonnen, et al., 2009).

9. Information on similar species

Just as there is a long history of grading frankincense according to quality, there also is a long history of adulteration, particularly where commercial harvests occur in landscapes with a high diversity of commercially exploited species. This is less of a problem in places such Tigray, where *B. papyrifera* is the only *Boswellia* species growing in the dry woodlands of northern and north-western Ethiopia. However, in the Borana and Ogaden areas of Ethiopia, frankincense is adulterated with resins from other *Boswellia* species (*B. neglecta, B. rivae, B. ogadensis* and *B. microphylla*) or even mixed with *Commiphora* exudates. The complex taxonomy of *Boswellia* species also poses a challenge, due to confusion over valid vs. outdated species names. Research by Zhong et al. (2012) on frankincense samples collected from markets in ten cities in China is a good example: out of fifty commercial samples, 27 were Official Frankincense and 23 were fake. Nevertheless, Paul et al. (2012) state that they have developed a method that "*allows unambiguous identification of three different frankincense sources"* (*Boswellia papyrifera*, *Boswellia serrata* and *Boswellia sacra* (Paul, et al., 2012). Hamm et al. (2005) have similarly shown that it is possible to determine the taxonomic origin of frankincense samples.

10. Experts consulted

This review has benefitted from comments from Professor Sebsebe Demissew (Professor of Plant Systematics & Angiosperm Phylogeny, Addis Ababa University).

11. References

Abdalla, A., 2014. Some socio-economic aspects of Boswellia papyrifera and resin production in Blue Nile State-Sudan. *Journal of Natural Resources and Environmental Studies,* 2(1), pp. 32-38.

Abiyu, A. et al., 2010. Incense Woodlands in Ethiopia and Eritrea: regeneration problems and restoration possibilities. In: F. Bongers & T. Tenningkeit, eds. *Degraded Forests in Eastern Africa. Management and Restoration..* London: Earthscan, pp. 133-152.

Abiyu, A., Vacik, H. & Glatzel, G., 2006. Population viability risk management applied to Boswellia papyrifera (Del.) Hochst in North-eastern Ethiopia. *Journal of the Drylands,* Volume 1, pp. 98-107.

Abtew, A., Pretzsch, J., Mohamoud, T. & Adam, Y., 2011. *Population structure, density and natural regeneration of Boswellia papyrifera (Del.) Hochst in Dry woodlands of Nuba Mountains, South Kordofan State, Sudan.* Bonn, DITSL GmbH, p. 245.

Abtew, A., Pretzsch, J., Mohmoud, T. & Adam, Y., 2012. Commodity chain of Frankincense from the dry woodlands of Nuba Mountains, South Kordofan State, Sudan. *Small-scale Forestry,* 11(3), pp. 365-388.

Ahmed, A., 2013. Quantitative comparison between 1955 and 1996 forest national inventories of Sudan. *University of Bakht Alruda Scientific Journal,* December, Issue 9, pp. 153-165.

Chikamai, B. & Casadei, E. eds., 2005. *Production and Marketing of Gum Resins: Frankincense, Myrrh and Opoponax.* Nairobi: Network for Natural Gums and Resins in Africa.

Conservatoire et Jardin botaniques & South African National Biodiversity Institute, 2012. *Boswellia papyrifera (Delile) Hochst..* [Online] Available at: http://www.ville-ge.ch/musinfo/bd/cjb/africa/details.php?langue=an&id=7737 [Accessed 31 August 2015].

Coppen, J., 1995. Flavours and fragrances of plant origin. In: *Non-wood forest products 1.* Rome: Food and Agriculture Organization of the United Nations, pp. x, 101p.

Farah, A., 1994. *The milk of the Boswellia forests: frankincense production among the pastoral Somali.* Oxfordshire: Cab Direct.

Forest Ecology and Forest Management Group, n.d. *Tree Factsheet: Boswellia papyrifera (Del.) Hochst..* [Online] Available at: https://www.wageningenur.nl/upload_mm/e/7/1/39335c20-b53d-46b1-b45a-b39df3c2559a_bospapf.pdf
[Accessed 31 August 2015].

Gebrehiwot, K., 2003. *Ecology and management of Boswellia papyrifera (Del) Hochst dry forests in Tigray, North Ethiopia.* Gottingen: Georg-August-Universität Göttingen.

Gebremedhin, T., 1997. *Boswellia papyrifera from the Western Tigray. Opportunities, Constraints, and Seed Germination Responses,* Skinnskattebergy: s.n.

Groenendijk, P. et al., 2012. Limitations to sustainable frankincense production: blocked regeneration, high adult mortality, and declining population. *Journal of Applied Ecology,* Volume 49, pp. 164-173.

Haile, G., Gebrehiwot, K., Lemenih, M. & Bongers, F., 2011. Time of collection and cutting sizes affect vegetative propagation of Boswellia papyrifera (Del.) Hochst through leafless branch cuttings. *Journal of Arid Environments,* Volume 75, pp. 873-877.

Hamm, S., Bleton, J., Connan, J. & Tchapla, A., 2005. A chemical investigation by headspace SPME and GC–MS of volatile and semi-volatile terpenes in various olibanum samples. *Phytochemistry,* 66(12), pp. 1499-1514.

Industrial Projects Service, 2007. *Profile on Natural Gum and Incense Collection and Processing,* s.l.: The Southern Nations Nationalities and Peoples Regional State (SNNPR) of Ethiopia.

Khalid, H., El-Kamali, H. & Elmanan, A., 2007. Trade of Sudanese Natural Medicinals and their role in Human and Wildlife Health Care. *Cropwatch Newsletter,* November, Volume 10, pp. 1-15.

Konandreas, P., 2009. *Final Study: Assessing Sudan's Export Diversification Potential in Agricultural Products,* London: Maxwell Stamp PLC.

Lemenih, M., Arts, B., Wiersum, K. & Bongers, F., 2014b. Modelling the future of Boswellia papyrifera population and its frankincense production.Journal of Arid Environments. *Journal of Arid Environments,* Volume 105, pp. 33-40.

Lemenih, M. & Kassa, H. eds., 2011a. *Opportunities and challenges for sustainable production and marketing of gums and resins in Ethiopia.* Bogor: CIFOR.

Lemenih, M. & Kassa, H. eds., 2011b. *Management guide for sustainable production of frankincense.* Bogor: CIFOR.

Lemenih, M., Wiersum, K., Woldeamanuel, T. & Bongers, F., 2014. Diversity and dynamics of management of gum and resin resources in Ethiopia: a trade-off between domestication and degradation. *Land Degradation & Development,* Volume 25, pp. 130-142.

Mekonnen, M., Gebrehiwot, K., Birhane, E. & Tewoldeberhan, S., 2009. Regeneration, Density and Diversity of Woody Vegetation in Awash National Park, Ethiopia. *Journal of the Drylands,* Volume 2, pp. 101-109.

Mekonnen, Z. et al., 2013. Economic Contribution of Gum and Resin Resources to Household Livelihoods in Selected Regions and the National Economy of Ethiopia. *Ethnobotany Research & Applications,* Volume 11, pp. 273-288.

Mengistu, T., Sterck, F., Anten, N. & Bongers, F., 2012. Frankincense tapping reduced photosynthetic carbon gain in Boswellia papyrifera (Burseraceae) trees. *Forest Ecologoy and Management,* Volume 278, pp. 1-8.

Mengistu, T., Sterck, F., Fetene, M. & Bongers, F., 2013. Frankincense tapping reduces the carbohydrate storage of Boswellia trees. *Tree Physiology,* Volume 33, pp. 601-608.

Millenium Cities Initiative (MCI) Mikelle Investment Team, 2013. *Investment opportunity in Mekelle, Regional State of Tigray, Ethiopia. Production of Essential Oils and Extracts from Aromatic Gums,* New York: Earth Institute at Columbia University.

Ogbazghi, W., 2001. *The Distribution and Regeneration of Boswellia papyrifera (Del.) Hochst. in Eritrea.* Wageningen: Wageningen University.

Ogbazghi, W., Rijkers, T., Wessel, M. & Bongers, F., 2006. The distribution of the francincense tree Boswellia papyrifera in Eritrea: the role of environment and land use. *Journal of biogeography,* Volume 33, pp. 524-535.

Paul, M., Brüning, G., Bergmann, J. & Jauch, J., 2012. A Thin-layer Chromatography Method for the Identification of Three Different Olibanum Resins (Boswellia serrata, Boswellia papyrifera and Boswellia carterii, respectively, Boswellia sacra). *Phytochemical Analysis,* 23(2), pp. 184-189.

Rijkers, T. O. W., Wessel, M. & Bongers, F., 2006. The effect of tapping for frankincense on sexual reproduction in Boswellia papyrifera. *Journal of Applied Ecology,* 43(6), pp. 1188-1195.

The Plant List Version 1.1, 2013. *Boswellia papyrifera (Caill. ex Delile) Hochst..* [Online]
Available at: http://www.theplantlist.org/tpl1.1/record/kew-2680574
[Accessed 31 August 2015].

Tilahun, M. et al., 2013. *Rural households' demand for frankincense forest conservation in Tigray, Ethiopia: a contingent valuation analysis,* Leuven (Heverlee): s.n.

Tolera, M. et al., 2013. Frankincense tree recruitment failed over the past half century. *Forest Ecology and Management,* Volume 304, pp. 65-72.

Tolera, M. et al., 2015. Frankincense yield is related to tree size and resin-canal characteristics. *Forest Ecology and Management,* 1 October , Volume 353, p. 41–48.

USDA, ARS, National Genetic Resources Program, n.d. *Boswellia papyrifera (Delile ex Caill.) Hochst..* [Online]
Available at: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?310554
[Accessed 31 August 2015].

Vollesen, K., 1989. Burseraceae. In: I. Hedberg & S. Edwards, eds. *Flora of Ethiopia, Vol. 3, Pittosporaceae to Araliacae.* Addis Ababa: Addis Ababa University Press, p. 442– 478.

Yilma, Z. et al., 2015. Status of populations of gum and resin bearing and associated woody species in Benishangul-Gumuz National Regional State, western Ethiopia: implications for their sustainable management. *Forests, Trees and Livelihoods.*

Zhong, M., Rao, W. & Xiao, C., 2012. Study on Determination Methods and Investigate on the Commercial Samples for Olibanum. *Chinese Journal of Modern Applied Pharmacy,* Volume 5, p. 011.

Boswellia_sacra v3 final clean.docx

Recvd. 25.10.2015

Reviewed schp #

Boswellia sacra Flueck.

A. Summary of findings

Boswellia sacra is a slow growing deciduous tree restricted to north-eastern Somalia (including Somaliland) and the southern Arabian Peninsula (the Sultanate of Oman and the southern part of the United Republic of Yemen). Somaliland's 2011 capacity for *B. sacra* ("*beyo*") production was 200 tonnes, corresponding to revenue of US$ 0.5 million with a potential capacity of 1,000 tonnes (Soloviev & Abdi, 2013). Current estimates of frankincense production in Somaliland (all species) vary widely from 200 to 700 tonnes per year with almost all of this destined for export. China is reported to be the biggest importer of raw cleaned and graded *B. sacra* frankincense from Somalia (including Somaliland). China is believed to be importing frankincense more for the manufacture of incense sticks than for traditional medicines as was previously supposed. Somalia also supplies the majority of natural gums and resins to Yemen, with 44% of imports of frankincense into Yemen from Puntland (Somalia), 29% Somaliland, with the remainder balance from Ethiopia, Kenya and Sudan (from *Boswellia* species other than *B. sacra* or *B. frereana*). Regional exports are mainly to Djibouti, Ethiopia the Arabian Peninsula, including Saudi Arabia, UAE and Yemen. Exports are also to the EU (France, Germany and the UK) and the USA where *B. sacra* frankincense is mainly resold for essential oil distillation. Trade data collected for this report show that in 2011, 2012 and 2013, Saudi Arabia imported frankincense exclusively from Somalia although it is not possible to sort out the relative amounts for the different species of *Boswellia* from Somalia. Omani Customs and Saudi Customs may be the only national authorities that have assigned a specific tariff code for 'frankincense' (HS 1301.90.7000). However, the foreign trade statistics shown in the website of Oman's Directorate General of Customs are not current and only up to 2008.

Although some plantations were established in Somalia prior to the 1991 civil war, it appears that all frankincense from *B. sacra* is wild harvested. Radiocarbon dating carried out by Farah (2008) showed that some trees were up to 457 years old. The main threats to *B. sacra* habitat in Oman are gravel mining and intensive browsing by livestock (primarily camels), who quite literally are able to browse *B. sacra* to death, eating not only the leaves, but also the bark off tall old trees, exposing the wood to termite attack. Browsing by livestock is also a factor in parts of Somalia, but in all Range States, *B. sacra* populations growing on cliff faces are relatively secure. Habitat loss and impacts on *B. sacra* populations are worst along *wadis* close to human settlements, with gravel mining and browsing by camels the major factors causing degradation of *B. sacra* habitats. In more remote areas with little water and sparse human settlements, habitats are in a better condition. In addition to tapping *B. sacra* for resin, harvesters also lop the leaves off for sale as camel fodder and collect fruits from the trees to take out the seeds, which are then sold. Surveys in Oman indicate a decline in frankincense collection. In 2000, for example, there were only 43 harvesters extracting frankincense inside the 4,500 km^2 Jabal Samhan Nature Reserve compared to about 2,000 before the 1970's (Farah, 1994). During the 1998-99 harvesting season in western Dhofar (Qamar Nejd) there were 150 harvesters while in eastern Dhofar (Samhan Nejd), 43 frankincense harvesters were active. Illegal harvesting is common in Somaliland (DeCarlo & Ali, 2014) and in Oman, where illegal Somali tappers cross the border from Yemen (Farah, 2008). Conservation threats to *Boswellia sacra* have implications for a range of other organisms, including endophytic fungi. In a recent study on endophytic fungi associated with *B. sacra* in Oman, for example, El-Nagerbi et al. (2014) found 43 species fungi were associated with *B. sacra*, 35 species of which were new records for the mycoflora of Oman and 12 species were new records for the fungal flora of the Arabian Peninsula (El-Nagerabi, et al., 2014). In summary, therefore, *Boswellia sacra* is suggested for inclusion in CITES Appendix II based on the criteria in Res. Conf. 9.24. This will enable better monitoring of trade, aided by the fact that through the use of Thin-layer chromatography (TLC), Paul et al. (2012) have shown that samples of olibanum from *Boswellia papyrifera*, *Boswellia serrata* and *Boswellia sacra* can be clearly distinguished from one another (Paul, et al., 2012).

B. Assessment on fulfilling the criteria of Res. Conf. 9.24 for this species

Based on the evidence presented in this review, the criteria in Res. Conf. 9.24 for inclusion of *Boswellia sacra* in CITES Appendix II based on Art. IV 2(a) are fulfilled. In summary, the high trade volume, coupled to threats imposed by habitat loss due to gravel mining and intensive browsing, including death of *B. sacra* due to bark consumption by camels are of serious concern. While resin tapping is sustainable in some places, lopping of leaves for fodder and the poor recruitment of young plants into populations of this very slow growing species combine to warrant CITES Appendix 2 listing of *B. sacra*. International demand may likely in part be related to a shortage of *Boswellia serrata*. Therefore, this proposal needs to be considered in conjunction with that for *B. serrata*.

Although Somalia (Puntland and Somaliland) is the major exporter of *B. sacra* frankincense and the United Republic of Yemen is the major importer of frankincense from Somalia, the most likely proponents of this proposal would be the Sultanate of Oman, supported by Germany, as an importer of *B. sacra* frankincense and essential oils. The reasons for this suggestion are firstly, that Somalia is in a state of conflict and while Somaliland has been peaceful since it declared itself independent in 1991, it is not recognised internationally, or a separate member of CITES. The Sultanate of Oman, on the other hand, is highly committed to the conservation of *B. sacra* and is the home of the only UNESCO world heritages site dedicated to the frankincense trade and with several countries in the European Union (EU) importing *B. sacra* products, Germany would be a strong supporter of a CITES Appendix II proposal by the Sultanate of Oman.

C. Supporting statement

1. Taxonomy

1.1. Class

Angiospermae

1.2. Order

Sapindales

1.3. Family

Burseraceae

1.4. Genus and species

Boswellia sacra Flueck. (The Plant List Version 1.1, 2013).

1.5. Scientific synonyms

B. bhau-dajiana Birdw., *B. bhau-dajiana* var. *serrulata* Engl., *B. carteri* Birdw., *B. carteri* var. *subintegra* Engl., *B. carteri* var. *undulato-crenata* Engl., *B. undulato-crenata* (Engl.) Engl. (The Plant List Version 1.1, 2013).

There is a long history of confusion about the correct botanical name for *Boswellia sacra* since 1846 when Dr H. J. Carter made the first scientific collection of Arabian frankincense at Rakhyut in Oman, thinking that he had collected *Boswellia serrata*, a South Asian species. In 1867, Carter's specimens were re-examined and described as *B. sacra* (Flueckiger, 1867). Three years later, British botanist Sir G. C. M. Birdwood reviewed the entire genus *Boswellia*, concluding that Carter's specimens were the same as material from Somalia that he then described as *B. carteri(i)* (Birdwood, 1870). A century later, Hepper (1969) also considered that *B. sacra, B. carteri, B. bhau-dajiana* and *B. frereana* were separate species (Hepper, 1969). On the basis of thorough fieldwork in Somalia, backed up by taxonomic studies and cultivation experiments, Thulin and Warfa (1987) concluded that while *B. frereana* clearly was a distinct species, *B. carteri* and *B. bhau-dajiana* were not. As a result of their thorough studies, *B. carteri* (including *B. carteri* Birdwood var. *undulato-crenata* Engl. and *B. carteri* Birdwood var. *subintegra* Engl.) and *B. bhau-dajiana* (including *B. bhau-dajiana* Birdwood var. *serrulata* Engl.) were all sunk under the original name, *B. sacra,* given 160 years earlier by the Swiss chemist and botanist F. A. Flueckiger (Thulin & Warfa, 1987).

1.6. Common names including trade names of the oleo-resin

Frankincense, olibanum, gum olibanum, mogar (transliterated Arabic), moxor (Somali), Omani luban (from the Arabic name for the tree, *shajarat al-luban*) (USDA, ARS, National Genetic Resources Program, n.d.), *beyo* (Somali), *sheehaz* (Arabic, for the resin), *megerat* or *megerot* (southern Arabic dialects of Yemen and Dhofar (Oman)). In Oman, four grades are locally known as *Hoojri, Najdi, Shathari*, and *Shaabi* in Jibali Arabic (Al-Saidi, et al., 2012). In southern Arabia, the best grades of gum are referred to as *hanzob* ("beads"), *fizzet* ("silver") or in Arabic *fusus* ("gemstones") (Morris, 2012).

Taxonomic research has confirmed that African and Arabian specimens (including *B. bhau-dajiana*) are one and the same and suggested they should all be called *B. sacra* (Thulin & Warfa, 1987). Confusingly, however, Basar (2005) suggests that there are different trade names used for trees and resins of three formerly separate species now considered to be synonyms. For example, *B. sacra* tree is referred to as "maghrayt *d'sheehaz*" and the resin it produces as "*lubãn dhakar*" whilst *B. carteri* and *B. bhau-dajiana* have been called "*moxor*" (or "*mohor*") and the resins that both species produce are generally called "*lobãn dakar*" or more commonly as "*beeyo*" (or "*beyo*") quality (Basar, 2005).

2. Overview

See Section A.

3. Species characteristics

3.1. Distribution

Boswellia sacra is restricted to north-eastern Somalia and the southern Arabian Peninsula (the Sultanate of Oman and the United Republic of Yemen) (USDA, ARS, National Genetic Resources Program, n.d.). In Arabia *B. sacra* extends from Dhofar, Oman, west to the eastern part of the Hadramaut of South Yemen. *B. sacra* occurs across a wide altitudinal range. In north-eastern Somalia, *B. sacra* occurs from 700m to 1,230m a.s.l. (Thulin & Warfa, 1987) and in Oman, for example, *B. sacra* can occur from 60m a.s.l. in Wadi Adonib (Jarbeeb) to as high as 1,770m a.s.l. in the Wadi Kharish of Jabal Samhan (Farah, 2008).

3.2. Habitat

Boswellia sacra is a characteristic tree of xeric woodland on the escarpment of mountains in Dhofar in Oman, extending into Yemen. In Oman, *B. sacra* occurs mainly along the arid leeward areas of the Qamar, Qara and Samhan mountains (locally known as *Nejd*), away from the influence of monsoon rains (Farah, 2008; Miller & Morris, 1988). *B. sacra* trees are concentrated along the seasonally dry stream channels (*wadis*) that drain the higher, mountains of the Dhofar "fog oasis" (Hildebrandt & Eltahir, 2006). Common plants along these wadis are *Acacia tortilis, Acacia raddiana* and *Acacia gerrardii*, *Balanites aegyptiaca, Salvadora persica, Moringa peregrina, Capparis decidua, Cordia gharaf, Calotropis procera, Lavandula nubica* and *Ziziyphus spina-christi*. *B. sacra* also occurs in small fragmented patches along the coastal plains of Oman and in some isolated parts of the seaward facing slopes south of the Kharish and Harkak mountain passes in the Jabal Samhan (Farah, 2008). In Somaliland, *B. sacra* trees grow on the northern slopes of the Golis range of mountains, where *B. sacra* occurs at relatively high altitudes (750-1,500m) on rocky bare cliff faces and limestone escarpments. Associated woody plants in the sparse vegetation are *Acacia* spp., *Commiphora* spp., *Moringa peregrina, Lannea obovata* and *Boswellia brichettii* (Miller & Morris, 1988; Beyomol – Neo Trading, 2010).

3.3. Biological characteristics

A long period of co-evolution between pollinators and *B. sacra* flowering biology is evident in the changes in *B. sacra* flower nectary from yellow to bright red to attract pollinators (Giuliani, et al., 2012). Although reproduction is by seed, fruit production rates are low, despite this co-evolution with pollinators (Lippi, et al., 2011). Germination rates are low (less than 8%), with flowering and seed set both affected by browsing. These factors result in poor recruitment from seed, even in the absence of commercial seed collection, fodder harvests and browsing by livestock. Tree height varies with rainfall and soil type and depth (PROTA4U, n.d.). Tree form varies according to where *B. sacra* grows. For example, Thulin & Warfa (1987) note that *B. sacra* growing on rocks near Mait, Somalia had a more pronounced swollen bases to their trunks. In

Oman, *B. sacra* growing in north and east draining *wadis* of Sharqiya were taller and more diverse than in other frankincense-producing zones (Farah, 2008). *B. sacra* also grows in cracks in rocks with little soil or moisture and in these sites is very slow growing. Radiocarbon dating carried out by Farah (2008) showed that some small *B. sacra* trees could be three times older than trees more than twice their height. Only seven of the samples Farah (2008) had dated were younger than 58 years old and the rest of the trees ranged from 68 to 457 years old.

3.4. Morphological characteristics

Boswellia sacra trees are 1.5 to 8 m tall, unarmed by spines (Thulin & Warfa, 1987). All parts of the tree highly resinous. The resin is milky, drying to a yellowish brown. *B. sacra* has a single basal stem, which can be swollen, commonly branching out into multiple stems from main base of the tree. The bark is papery. Leaves are alternate, obovate to oblong, 6-8 sets of sub-opposite leaflets, 15-40 mm x 8-20 mm, margins crenate with a rounded tip and are densely crowded at shoot apices. The flowers are white ~3 x 4 mm, borne in 9-12 cm long racemes at the end of branches. The fruit is an obovoid, 3-4 (sometimes 5) locular capsule with an acute tip, ~10 x 7 mm that is reddish-brown in colour (Miller & Morris, 1988).

3.5. Role of the species in its ecosystem

Conservation threats to *Boswellia sacra* have implications for a range of other organisms, including as fodder for wildlife, insect food-plants and a substrate for endophytic fungi (the fungi that spend part of their life cycle on or inside leaf tissues without negative impact on plants). In a recent study on endophytic fungi associated with *B. sacra* in Oman, for example, El-Nagerbi et al. (2014) found 43 species fungi were associated with *B. sacra*, 35 species of which were new records for the mycoflora of Oman and 12 species were new records for the fungal flora of the Arabian Peninsula (El-Nagerabi, et al., 2014). Given that that six out of the 20 most commonly prescribed medications originate from fungi and that endophytic fungi have great potential for new products (Schulz, et al., 2002), there are wider reasons for conserving *B. sacra* populations than just biodiversity conservation.

4. Status and trends

4.1. Habitat trends

The main threats to *B. sacra* habitat in Oman are gravel mining and intensive browsing by livestock (primarily camels). Browsing by livestock is also a factor in parts of Somalia, but in all Range States, *B. sacra* populations growing on cliff faces are relatively secure. In Dhofar, however, on plains and *wadis*, improved veterinary services, cheap fodder and the sinking of boreholes have resulted in larger herds and greater grazing pressure. Habitat loss and impacts on *B. sacra* populations are worst along *wadis* close to human settlements, with gravel mining and browsing by camels the major factors causing degradation of *B. sacra* habitats. In more remote areas with little water and sparse human settlements, such as in Arah, Ndur and Afol, habitats are in a better condition. It is worth noting that "*B. sacra's low levels of heterozygosity may have negative consequences. It is predicted that genetically depauperate taxa or populations* *are more vulnerable to habitat changes and prone to extinction than species with high variability*" (Coppi, et al., 2010).

4.2. Population size

The autonomous region of Somalia known as Puntland (with an area of 212,510 km^2, roughly one-third of Somalia's geographical area) is one of the most important producing areas of both *B. sacra* (and *B. frereana*) in the world. Precise counts of *B. sacra* populations in Oman and the Hadramawt and Mahra regions of Yemen are not available (Raffaeli, et al., 2003; Raffaeli, et al., 2006; Alaamri, 2012; Dalsen Consultants, 2013). In 2009 the Environment Society of Oman (ESO) estimated the number of "fully-grown" *B. sacra* trees in Dhofar and in coastal plains around Reysut at between 400,000 and 500,000 trees (Times of Oman, 2013).

Using the Rabinovitz seven forms of rarity assessment format *Boswellia sacra* has large (multinational) geographical spread, narrow habitat and a large and dominant population size in some places. Table 1, based on Rabinowitz et al. (1986), summarizes the geographic distribution (Section 3.1), habitat specificity (Section 3.2) and population size (Section 4.2) of *B. sacra* across its range (Rabinowitz, et al., 1986)

Table 1. The Rabinowitz matrix approach (Rabinowitz, et al., 1986) can be applied at a variety of scales, from local through to a national or international scale, leading to a single choice out of 8 boxes (A-H) that is then ranked. In this report, we highlight the section of this matrix relevant to *B. sacra* from the perspective of an **international** scale.

GEOGRAPHIC DISTRIBUTION		LARGE		SMALL	
HABITAT SPECIFICITY		Wide	Narrow	Wide	Narrow
POPULATION SIZE	Large & dominant somewhere	A. Locally abundant, several habitats over large geographic area	C. Locally abundant in a specific habitat over large geographic area	E. Locally abundant, several habitats over small geographic area	G. Locally abundant in a specific habitat over small geographic area
	Small & non-dominant	B. Constantly sparse in several habitats over a large geographic area	D. Constantly sparse in a specific habitat over a large geographic area	F. Constantly sparse in several habitats over a small geographic area	H. Constantly sparse in a specific habitat over a small geographic area

4.3. Population structure

Limited data is provided by Farah (2008), Raffaelli et al. (2003 and 2006) and Alaamri (2012) for populations in Oman. Heavy browsing causes specimen to rarely flower or set seed (PROTA4U, n.d.) and can kill large *B. sacra* trees (Farah, 2008). In Oman, the healthiest *B. sacra* populations with large trees and good recruitment of young saplings are along the Sharqiya wadis (Qobyr, Ndur, Arah, Sanwik, Atbaram, Dahnoot and Rakhyut) (Farah, 2008). Farah (2008) considered that Sharqiya was the only area with small areas of contiguous young seedlings and *B. sacra* populations with a variety of height classes.

Plant regeneration is impacted by a reduced or eliminated seed bank.

4.4. Population trends

B. sacra is highly traded and at the same time affected by various threats, such as habitat clearing, grazing, browsing, tapping, and in some cases, weevil infestation of the seeds and damage by wood-boring beetles. In Oman, surveys of the sustainability of the frankincense trade have been undertaken over several years. Reports of resource management and land use trends that the sustainable use of *B. sacra*, are contradictory, however. In a comprehensive study in Oman, for example, Farah (2008) concluded that*: "Luban production and processing are sustainable because the numbers of harvesters are very low to have a detrimental impact. In addition, the owner's threat to suspend group harvesting rights, who engage in harmful gum-resin extraction methods, is an effective management tool that fosters self- monitoring among harvesters. Since harvesters depend on frankincense to maintain their livelihood, work parties exercise considerable self-policing that encourages sustainable low impact harvesting methods in order to protect group usufruct rights".*

In contrast, another report indicates that with climate change threats and current harvesting practices the populations in the Dhofar region could eventual become extinct, particularly in the more vulnerable areas Jarbof eeb, Wadi Dowkah and Wadi Adonib. In 2009, when the Environment Society of Oman (ESO) estimated the number of *B. sacra* in Dhofar and in coastal plains around Reysut at between 400,000 and 500,000, they reported that while not all trees were being tapped, in some areas the trees had almost completely vanished (Times of Oman, 2013). Research has also shown that untapped trees produced more flowers and reproduced more effectively than trees that had been heavily tapped (Miller & Morris, 1988; Farah, 1994).

4.5. Geographic trends

No data available.

5. <u>Threats</u>

The IUCN Red List Category for *Boswellia sacra* is Lower Risk (LR)/near threatened (Thulin, 1998). It is noted that this assessment needs updating. Browsing by livestock, particularly camels and, to a lesser extent, goats, appear to be a widespread threat across all Range States. In some cases, camels also eat the bark from the trunks of *B. sacra* trees, resulting in tree death (Farah, 2008).

Figure 1. Camels eating the bark off *Boswellia sacra* trees in Oman, exposing the trees to termite attack, with very few trees surviving as a result (from Farah, 2008).

Although seed harvesting practices have been curtailed, frankincense harvesters collect *B. sacra* fruits. After the fruits had been sun-dried, the seeds are packed and sold in Salalah (Farah, 2008).

Unmanaged grazing of livestock in *B. sacra* habitat coupled with heavy lopping of branches to produce fodder for animals threatens the resource by hindering regeneration of plants and recruitment of seedlings. For example, as Miller & Morris (1988) point out: "*Those at work tapping the gum would also fill sacks with the leaves and send them back to the livestock encampments as feed or would sell them to the cameleers who moved back and forth between the coastal towns and the frankincense-gathering work camps, bringing food to the labourers and taking back with them the loads of gum to be stored in the merchants' warehouses*".

In Oman, *B. sacra* is heavily browsed and consequently rarely flowers or sets seed. In some locations, trees appear to be dying and regeneration is poor (Alaamri, 2012; PROTA4U, n.d.; Thulin, 1998). Farah (2008) points out, however, that larger trees with deep and extensive root systems and taller canopies are much better able to withstand the impact of animal grazing than the young trees. Farah (2008) also highlights that continuous tapping over a long period without any rest period interferes with the plants reproductive system and resin yields. In extreme instances over-harvesting can even result in tree mortality (Farah, 2008). To make ends meet, nomadic pastoralists in Somalia resort to over-tapping and double tapping. Trees are also heavily debarked to increase the harvest weight. Some 'logging' of resin-bearing trees has also been reported (Ali, 2015).

When deep tapping cuts are made, exposing the wood, these enable adult wood boring beetles in the Buprestidae and Cerambycidae families to lay their eggs and enter the trunk of *B. sacra* trees (Farah, 1994). What may be a newly introduced beetle, *Spenoptera chalcichroa*, as well as two Cerambycidae (*Neoplocaederus atlanticus* Rungs) and *Derolus martini* ssp. *hayekae* Villiers) are posing a potentially serious threat (Alaamri, 2012; Strumia, et al., 2007).

6. Utilization and trade

6.1. National utilization

Although most Catholic churches today use incense that is a mix of balsams (66% frankincense (from various *Boswellia* species), 27% benzoin (from *Styrax benzoin*) and 7% storax (from *Liquidambar orientalis*) (Grieve, 1959, cited in Langenheim, 2003), demand is driven by use in religious ceremonies of several of the world's major religions. particularly the Coptic Christian Greek and Russian Orthodox and Roman Catholic Church. Frankincense is also widely used by followers of Islam and Judaism (Van Vuuren, et al., 2010). The ancient Egyptians used frankincense as a fumigant and as an important ingredient in the embalming process.

The autonomous State of Puntland, Somalia is the world's largest production area of frankincense from *B. sacra*, followed exports from by the neighbouring self-declared state of Somaliland (which is internationally considered an autonomous region of Somalia). More than 40% of Somalia's total production comes from Somaliland and the most of the rest from Puntland. The main production areas in Somaliland are Sanaag, Sahil and Sool (Soloviev & Abdi, 2013; Miller & Morris, 1988). All uses appear to be from wild *B. sacra* populations, although at least one large plantation was established by the frankincense co-operative near Gardo, Somalia in 1982 (see Section 8.5 and Thulin and Warfa, 1987). Surveys in Oman indicate decline in frankincense collection. In 2000 there were only 43 harvesters extracting frankincense inside the 45,000 km^2 Jabal Samhan Nature Reserve compared to about 2000 before the 1970's (Farah, 1994). During the 1998-1999 harvesting season in western Dhofar (Qamar Nejd) there were 150 harvesters while in eastern Dhofar (Samhan Nejd), 43 frankincense harvesters were active. Many of the frankincense harvesters in western Dhofar are Somali, who enter Oman illegally through Jabal Qamar. Proximity to the city of Salalah is also a factor, firstly, because Somali migrants are able to link up to the social network of other Somalis and Somali-Omani citizens living in Salalah and secondly, because frankincense harvesters are attracted to Salalah so they can sell their frankincense more profitably there by selling directly in the open markets, cutting out the middlemen. In addition, illegal harvesters can travel back across the border with Yemen to avoid prosecution. The higher number of harvesters in Samhan Nejd is evident from more incisions on individual trees and more *B. sacra* trees being tapped (Farah, 2008).

Relevant to accurately assessing national utilization, the terminology used by different institutions concerning frankincense and specifically *B. sacra* can cause confusion and misinterpretation. Even pharmacopoeias and trade specifications are sometimes vague and confused concerning definitions of the product concerned. Historically, northern Somalia (now Somaliland and the north-eastern region of Puntland) had been the world's largest producer and supplier of two species of frankincense, *B. sacra* (syn. *B. carteri*) ("beyo") and *B. frereana* ("maydi"), obtained from mountainous areas of Sanaag region (northern) and Bari region (north-eastern). Table 2 provides a summary of the types and extent of known uses of *B. sacra* in range states.

Table 2. *Boswellia sacra* sources, and uses across range states.

Range State	Source (wild or cultivated)	Uses
Oman	Wild	Oleo-gum resin of *B. sacra* is one of the most commonly used natural plant products in Oman, traditionally used for spiritual as well as for therapeutic purposes (Al Kitani & Khan, 2013). In Dhofar province of southern Oman the five main grades of frankincense sold locally are reportedly called 'super hougari green' , 'hougari regular' , 'royal hougari white' 'hougari yellow' and 'shabi frankincense' (Al-Harrasi, et al., 2013).
Somalia	Wild	*Boswellia sacra* resin is harvested almost entirely (about 99%) for the export market. It is burned for religious purposes in mosques, churches, and homes.
Yemen	Wild	In Yemen, Somalian frankincense of *B. sacra* ("beeyo") is locally known as "Luban Shurbi" meaning Olibanum for drinking. It is dissolved in water with garlic or onion for medicinal purposes, particularly for respiratory congestion, respiratory tract infections, and to resolve stomach and urinary tract problems. It is also used as a fumigant, burned in homes to diffuse bad odours and to purify the atmosphere, to perfume clothes, and also as an insect (mosquito) repellent (Aden, 2014).

In the European Union, gum resin of *B. sacra* is used quite widely in cosmetics. The dried gum is used in hair, nail and skin conditioners while the essential oil or absolute is used in a range of perfumes especially those with an oriental note (Directorate General for Health and Consumers, n.d.).

Details of harvest methods: A network of resin ducts exists within *Boswellia* trees. The collection of frankincense involves a deep, lengthwise incision in the tree trunk. Roughly 8cm bark strips are removed. When the outer bark is stripped away, resin bleeds out through the ducts. The incision is deepened and upon exposure to air the oleo-resin hardens into tears within about 3 months, which are then scraped off. The resin that has dribbled down the bark onto the ground is collected separately as this is a lower quality product. In Somaliland collection lasts from May until around Mid-September – the onset of the rains which prevents harvesting (Frankincense co-operative, n.d.). According to the Beyomol Company, *B. sacra* trees, which grow on the northern slopes of the Golis range of mountains in Sanaag region, produce 'Dikir' type olibanum, which is mainly distilled to produce essential oils for use in the perfumery industry (Beyomol – Neo Trading, 2010). Tree growth is slow; it can be subjected to tapping when it reaches about 3 m in height. Based on data collected in Oman using radio-carbon dates of *B. sacra* tree cores, a 3m high tree could be 150 years old or even older, depending on the site (Farah, 2008). Annual tapping is not recommended and the trees should be tapped only once every three years (Soloviev, 2013). The cycle usually begins in July to August (*hagaa* season). An initial incision is then made. This wound is then regularly cleaned and deepened to allow a continuous flow of resin. This is done with a *mengaf*, a tool with two blades fixed on both sides of a handle with a prominent edge to protect the harvesters hand. The incision is made by removing a 2 mm x 50 mm external layer of bark. The incision must not be too deep or it will wound the sapwood, which can result in tree death. After the initial tapping, resin will ooze but yield is low and of poor quality. About 2-3 weeks later, the wound is renewed, repeating for the next 3-4 cycles, from which the yield remains low and still of poor quality. For the 10 months starting July/August trees are tapped 12-13 times. Harvest is most abundant and of best quality at the end of the season (May-June). The first harvest is known as called "*fiirto*", and later in the season "*jadar*". The wound created early in the season requires closing at the end of the season, a process known as "*jalebe*" (Soloviev, 2013).

6.2. Legal trade

Precise information about production and trade in this region is limited. In Somalia, frankincense production and exporting, prior to the war, was state-controlled and the government had trade agreements with China, France and Germany. During the civil war (1988-1990), both the trade and its regulatory mechanisms were disrupted. According to a 2006 study on the impact of the Somali Civil War on natural resources, "*Somali gum collectors, who are predominantly nomads, are exploited by the existing merchant chain. The merchants buy gums from collectors at throwaway prices during the harvest period when the gum is plentiful. The collectors are at disadvantage, as in most of the cases the harvest time coincides with the dry season when the nomads can earn the least income from their livestock*". Since the collapse of the Somalia State, Saudi Arabia emerged as a major transhipment point to international markets for most high grade Somali frankincense ("*beyo*"), myrrh and opoponax gums, which reportedly has contributed to marginalization of Somali traders (Candlelight for Health, Education & Environment, 2006).

A report for the EU rehabilitation programme for Somalia/Somaliland states "China was and remains the biggest importer of raw cleaned and graded beyo frankincense… "Grade one beyo frankincense and best quality myrrh and opoponax are also shipped from Saudi Arabia to buyers and wholesalers in Marseilles, Hamburg and the UK where it is mainly resold for essential oil distillation" (Intermediate Technology Consultants (ITC) – Eastern Africa, 2006). One company, Allamagan Trading Co. (Burao, Somaliland), reports that European countries and the USA are its main export destinations for "beyo" grades 1 to 3 whilst Djibouti, Ethiopia, and Eritrea are the main export destinations for grades "beyo" 4 and 5 (Aden, 2013). Based on data from FAO and Global Development Solutions LLC (GDS), Somaliland's 2011 capacity for B. sacra ("beyo") production was 200 MT corresponding to revenue of US$ 0.5 million with a potential capacity of 1,000 (Soloviev & Abdi, 2013). Current estimates of frankincense production in Somaliland (all species) varies widely from 200 to 700 tonnes per year with more than 99% destined for export. The 1% left for domestic consumption is mainly a lower grade of 'beyo' also known as 'fooh' (Abdi, 2013). Somaliland exports gums and resins products mainly to Djibouti, Ethiopia (lower grades of 'beyo' (B. sacra)) and Middle East including Saudi Arabia, UAE and Yemen (higher grades of 'meydi' (B. frereana)). Higher grades of beyo are exported to Europe (France and Germany) as well as USA. 'Dikir' (B. sacra) type olibanum is mainly distilled for extraction of essential oils that are used in the perfumery and cosmetics industry (Beyomol – Neo Trading, 2010).

Omani Customs and Saudi Customs may be the only national authorities that have assigned a specific tariff code for 'frankincense' (HS 1301.90.7000). However, the foreign trade statistics shown in the website of Oman's Directorate General of Customs are not current and only up to 2008. In 2008, Oman reportedly exported 66,707 kg of 'frankincense' (Royal Oman Police, Directorate General of Customs, 2015). Table 3 shows that in 2011, 2012 and 2013 Saudi Arabia imported frankincense exclusively from Somalia although it is not possible to sort out the relative amounts for the different species of *Boswellia* from Somalia.

Table 3. Saudi Arabia 2011-2013 imports of HS 1301907000 (Frankincense)

Somalia origin only	Quantity (kg)	Trade Value (SAR)*
2011	318,000	1,158,000
2012	278,000	789,000
2013	275,000	731,000

Source: Kingdom of Saudi Arabia Central Department of Statistics & Information. Import Statistics Bulletin.
*** Note:** 1 SAR (Saudi Arabian Riyal) = US$ 0.266688 (at the time of this report)

Yemen is a major importer and consumer of frankincense. 44% of imports of frankincense into Yemen are from Puntland, 29% Somaliland and the balance from places like Ethiopia, Kenya and Sudan (not *B. sacra* type). Table 4 shows that Somalia also supplies the majority of natural gums and resins to Yemen. For the 2011-2013 period, Yemen imported on average 532,250 kg of HS 130190 annually, of which an average of 287,733 (54%) originated in Somalia. It is not known what portion of the total imported amount is represented by *B. sacra*. An estimated 70% of Yemen's imports are for local consumption. Although Puntland is a major source of *B. sacra*, precise details as to the size and form of trade are lacking due to the difficult security situation and poor access and infrastructure (Aden, 2013).

Table 4. Yemen 2011-2013 imports of HS 130190 (natural gum, resin, gum-resin, excluding gum arabic)

Year	Total import Qty (kg)	Total import Trade Value (US$)	Qty (kg) imported from Somalia	Trade Value (US$) from Somalia
2011	359,284	$583,987	225,614	$451,853
2012	459,424	$712,130	303,227	$469,847
2013	778,044	$820,838	334,358	$432,155
3-year total	1,596,752	$2,116,955.00	863,199	$1,353,855.00
Annual average	532,250	$705,652	287,733	451,285

Source: UN COMTRADE Database. Copyright © United Nations 2015

Table 5 shows that in 2013, Somalia ranked sixth in terms of trade value for supply of 'gums and resins' (olibanum, myrrh and dragon's blood) to China. China's 8-digit tariff code HS13019020 includes *Boswellia spp.*, *Commiphora* spp., *Daemonorops spp.*, and *Dracaena* spp., among other gums and resins. It is not known what portion of China's imports of HS13019020 are comprised of *B. sacra* resin. China is believed to be importing frankincense more for the manufacture of incense sticks than for traditional medicines as was previously supposed. China is reportedly the single largest importer of "beyo" type frankincense (*B. sacra*) and myrrh (Chikamai & Casadei, 2005).

Table 5. China 2013 imports of HS 13019020 (Olibanum, Myrrh, and Dragon's blood)

Exporter	Quantity (kg)	Trade Value (US$)
Ethiopia	1,165,395	3,417,396
Sudan	295,896	893,201
Singapore	4,078	731,088
Indonesia	2,922	608,000
Kenya	97,506	213,127
Somalia	37,998	117,239
Nepal, FDR	82,810	107,104
India	34,846	91,577
Total	1,721,451	6,178,732

Source: China Trade Data

6.3. Parts and derivatives in trade

Customs tariff codes used for *B. sacra* articles of commerce are shown in Table 6. All codes shown are general codes with the exception of Omani Customs (OC) and Saudi Customs (SC), both of which have assigned a specific tariff code for 'frankincense' HS1301907000, although not species-specific for differentiating imports of different *Boswellia* species.

Table 6. HS tariff codes used for 'Natural Gums & Resins' including Boswellia species

Traded form	BTI	CCC	CCCCS	CROSS	OC & SC	SMOTI
Dried resin	1301.90.0000	1301.90.2200	1301.9020	1301.90.9090	1301.90.7000	1301.9032
Essential oil	3301.29.41			3301.29.5050; 3301.29.5150		
Incense sticks	3307.41.0000			3307.41.0000		
Tincture	3003.90.0000.V999					

Legend:
BTI: Binding Tariff Information rulings of the European Commission Taxation and Customs Union
CCC: Standard Classification of Commodities of the Republic of China (Taiwan)
CCCCS: Commodity Classification for China Customs Statistics (PRC)
CROSS: Customs Rulings Online Search System (U.S. Customs & Border Protection)
OC: Oman Customs, Sultanate of Oman, Directorate General of Customs
SC: Saudi Customs, Kingdom of Saudi Arabia Central Department of Statistics & Information
SMOTI: Somaliland Ministry of Trade and Investment

Somaliland Ministry of Trade and Investment states "*The main quality aspects of gums and resins in Somaliland are measured according to traditional grading systems used in trade with the Arabic peninsula. These classifications depend on the size and colour of the gum resin. In some cases certain customers, mainly from European markets, who are buying gums and resins, demand certain grades and provide the specifications for these grades*" (Soloviev & Abdi, 2013). Table 7 shows the 6 different grades of "beyo" frankincense used in Somaliland, once cleaned and sorted. The raw product unsorted is called "marbuush‟.

Table 7. Somaliland grades of "*beyo*" frankincense

Grade Serial Number	Grade Name	Description	Average Selling Price (US$) of batches Sep-Nov 2013
1	Fusuus caddaan	White pieces (2mm-12mm)	2.56 – 4.20
2	Fusuus cassaan	Red-brown pieces (2mm-12mm)	2.44
3	Jidhiidh	Mixture of gum and bark	2.60

Grade Serial Number	Grade Name	Description	Average Selling Price (US$) of batches Sep-Nov 2013
4	Foox	Bark with little gum	3.00
5	Budo	Powder (<2mm)	No data
6	Qolof	Bark	0.70 – 1.20

Sources: (1) Republic of Somaliland Ministry of Trade and Investment; (2) Aden, 2013

6.4. Illegal trade

In Somaliland, according to DeCarlo & Ali (2014), "*Illegal harvesting is rampant. Youth with few opportunities are reported to sneak into these remote areas during the harvesting season and take the resin before the legitimate harvesters reach it […] illegal harvesters also collect resin by making additional cuts onto the bark after the 5-month legal harvesting season has ended. Desperate and irresponsible harvesters are reported as making too many cuts on the trees to drain resin as well as cutting in ways that can and does kill the trees*" (DeCarlo & Ali, 2014). Most of the illegally exported "beyo" reportedly first goes to Aden (Yemen) and Djibouti. In the past, the reason for trading on the illegal market was that it is more profitable and practical (Farah, 1994; Hall, 2005).

6.5. Actual or potential trade impacts

Gum harvesting and trading in Somalia is of significant economic importance for local livelihoods and economies and for international trade. Continued significant trade coupled with loss of habitat can be considered a threat to the species as well as to rural livelihoods. In Somalia, an estimated 10,000 persons are involved in gums & resins production and trade as a source of income (Lehoux & Chakib, 2012). In places like Oman and Yemen there has been major decline in the number of people involved in frankincense harvesting as better job opportunities emerge due to economic development.

7. Legal instruments

7.1. National

Prior to the collapse of the central Somalia government in 1991, the frankincense trade was government-controlled. *Boswellia sacra* is not covered by endangered-species legislation in any country in the Range States except Oman (Thulin, 1998) but some trees are protected inside some forest reserves and conservation areas. One of the most important of these conservation areas is the 4500km^2 Jabal Samhan Natural Reserve (JSNR), with an estimated 60% of the two most important *B. sacra* habitats (Hojari/Nejdi) within the JSNR. Although Farah (2008) points out that there were no active management plans for JSNR, the fact that the reserve was established in 1997 by Sultan Qaboos by Royal Decree 48/97 could be a stimulus to sustainable conservation and management of *B. sacra* in the conservation area. In Oman, Despite the fact that the Ministerial Notice no. 25/96 has placed a ban on the export of *B. sacra* seeds (Fisher, et al., 1998) some harvesters collect *B. sacra* fruits seeds for sale and export (Farah, 2008).

7.2. International

The species is not yet included in the CITES Appendices; thus its exploitation is not subject to CITES regulations.

8. Species management

8.1. Management measures

Most studies on population dynamics of commercial *Boswellia* species is focused on the species *B. papyrifera.* Many of the lessons learned may have relevance to *B. sacra* as well. The potentially negative implications, either ecological or economical, of the decline of populations in Oman have prompted the planning of a conservation program that has recently started with the mapping and monitoring of the populations. DNA sequencing of wild stands of *B. sacra* have been undertaken and ex situ and in situ conservation activities begun in various parts of Dhofar (Farah, 2008).

In 2009 the Oman Environment Society concerned about the rapid decline in the occurrence of *B. sacra* launched a five-year project to assess the status of the Frankincense population and to measure the impact of tapping on the health of Frankincense trees (Environment Society of Oman, 2013). The study identified gravel mining as by far the largest threat to tree survival in the region, a conclusion also reached by Farah (2008). Termite damage, urbanisation and inappropriate harvesting techniques were the other reasons reported for the rapid decline in tree numbers. The study set out a series of recommendations for sustainable harvesting and suggested that harvesting should be for only 3 years followed by a one to two rest period. Moreover they recommended legislation to limit gravel mining in the region (Times of Oman, 2013).

8.2. Population monitoring

No quantitative monitoring of *B. sacra* populations is known. Nevertheless, there is real potential of selecting some of the many photographs taken in well-known populations in Oman and using relocation and re-photography to get retrospective "time-depth" for monitoring, just as Duncan et al. (2006) were able to do with the Giant Quiver tree (*Aloe pillansii*) in South Africa (Duncan, et al., 2006).

8.3. Control measures

8.3.1. International

None known.

8.3.2. Domestic

None known.

8.4. Cultivation and propagation

A large *Boswellia sacra* plantation (of about 10 000 trees) was established at Ambarsare, north-east of Gardo in Somalia by the frankincense cooperative there using from cuttings obtained from *B. sacra* trees in the Karkar mountains (Thulin and Warfa, 1987). The current status of this plantation is unknown. More recently, preliminary research to establish in vitro plant tissue culture for *B. sacra* has been carried out (Haq, et al., 2014).

8.5. Habitat conservation

Experiments in Oman at Wadi Doka have clearly shown that if damaged trees are fenced off from herbivores they recover rapidly in terms of biomass and young plant regrowth. This 850 hectare frankincense park and 1,263 hectare buffer zone along with the remains of the caravan oasis of Shisr/ubar and the affiliated ports of Khor Rori and Al-Baleed have been designated a UNESCO world heritage site (Raffaeli, et al., 2008). Declaration of the 4500 km^2 Jabal Samhan Natural Reserve (JSNR) and its status as a conservation area with Arabia's largest population of Arabian leopard (*Panthera pardus* ssp. *nimr*), also enables *B. sacra* habitat to be maintained and if a management plan is implemented, restored.

9. Information on similar species

A comprehensive GC-MS analysis of *B. sacra, B. serrata, B. frereana and B. papyrifera* indicated that the main chemical components identified in *B. sacra* oil were: α-pinene (15.1%), myrcene, (8.2%) limonene and α cedrene (6.1%) (Hamm, et al., 2005). Using Thin-layer chromatography (TLC), Paul et al. (2012) have shown that samples of olibanum from *Boswellia papyrifera*, *Boswellia serrata* and *Boswellia sacra* can be clearly distinguished from one another (Paul, et al., 2012).

10. Experts consulted

Consultations were held with Earth Oils (www.eartholis.com), Enfleurage (www.enfleurage.com), Beymol (www.beymol.com), Maydi Frankincense Ltd (www.maydifrankincense.com), Neals Yard Remedies (www.Nealsyardremedies.com), Fairwild Foundation (www.fairwild.org)

11. References

Abdi, A., 2013. Developing a National Brand for Somali Gums and Resins. PREP II Programme for the Republic of SOMALILAND Support to Fisheries and Gums & Resins Value Chains., Hargeisa, Somaliland: SOFRECO.

Aden, A., 2013. Grading and classification system used for export of gums and resins in Somaliland, Hargeisa, Somaliland: SOFRECO.

Aden, A., 2014. Value Chain Development Project – Somaliland Gums & Resins Markets in Yemen, s.l.: SOFRECO.

Al Kitani, S. & Khan, S., 2013. Evaluation of Knowledge and Practices of Omani population in Sur region about the beneficial uses of frankincense - a commonly used natural plant product. Sch. Acad. J. Pharm, 2(3), pp. 168-72.

Alaamri, M., 2012. Boswellia sacra in Dhofar Mountains, Sultanate of Oman: Economic Value and Environmental Role. Journal of Life Sciences, Volume 6, pp. 632-36.

Al-Harrasi, A. et al., 2013. Antiglycation and Antioxidant Activities and HPTLC Analysis of Boswellia sacra Oleogum Resin: The Sacred Frankincense. Tropical Journal of Pharmaceutical Research, 12(4), pp. 597-602.

Ali, M., 2015. Is the production of frankincense in Somaliland under threat?. [Online]
Available at: http://lubanaromatics.com/production-frankincense-somaliland-threat/
[Accessed 1 6 2015].

Al-Saidi, S. et al., 2012. Composition and Antibacterial Activity of the Essential Oils of Four Commercial Grades of Omani Luban, the Oleo-Gum Resin of Boswellia sacra Flueck. Chemistry & Biodiversity, 9(3), pp. 615-24.

Basar, S., 2005. Phytochemical investigations on Boswellia species. Comparative studies on the essential oils, pyrolysates and boswellic acids of Boswellia carterii Birdw., Boswellia serrata Roxb., Boswellia frereana Birdw., Boswellia neglecta S. Moore and Boswellia rivae. s.l.:Thesis.

Beyomol – Neo Trading, 2010. Presentation on the aromatic gums market in Somaliland, Hargeisa, Republic of Somaliland: Beyomol Company.

Birdwood, G., 1870. On the Genus Boswellia, with Descriptions and Figures of three new Species. Transactions of the Linnean Society of London, 27(2), pp. 111-48.

Candlelight for Health, Education & Environment, 2006. Impact of Civil War on Natural Resources: A Case Study for Somaliland, Hegiras, Somaliland: Candlelight for Health, Education & Environment.

Chikamai, B. & Casadei, E., 2005. Production and Marketing of Gum Resins: Frankincense, Myrrh and Opoponax., Nairobi, Kenya: Network for Natural Gums and Resins in Africa (NGARA).

Coppi, A., Cecchi, L., Selvi, F. & Raffaelli, M., 2010. The Frankincense tree (Boswellia sacra, Burseraceae) from Oman: ITS and ISSR analyses of genetic diversity and implications for conservation.. Genetic resources and crop evolution, 57(7), pp. 1041-52.

Dalsen Consultants, 2013. Baseline survey report., s.l.: Africa Development Solutions, Care International in Somalia and Ministry of Environment, Puntland..

DeCarlo, A. & Ali, S., 2014. Sustainable Sourcing of Phytochemicals as a Development Tool: The Case of Somaliland's Frankincense Industry, s.l.: IEDS.

Directorate General for Health and Consumers, n.d.. Cosmetic Ingredients and Substances (CosIng®) Database. [Online].

Duncan, J. et al., 2006. Long-term population changes in the Giant Quiver Tree, Aloe pillansii in the Richtersveld, South Africa. Plant Ecology , Volume 185, pp. 73-84.

El-Nagerabi, S., Elshafie, A. & Alkhanjari, S., 2014. Endophytic fungi associated with endogenous Boswellia sacra. Biodiversitas: Journal of Biological Diversity, 15(1), pp. 24-30.

Environment Society of Oman, 2013. Project Frankincense. [Online]
Available at: http://www.eso.org.om/index/list3.php?categoryId=335&Extension=gif
[Accessed 1 6 2015].

Farah, A., 1994. The milk of the Boswellia forests: frankincense production among the pastoral Somali. Oxfordshire: Cab Direct.

Farah, M., 2008. Non-Timber Forest Product (NTFP) Extraction In Arid Environments: Land-Use Change, Frankincense Production And The Sustainability Of Boswellia Sacra In Dhofar (Oman), s.l.: University of Arizona.

Fisher, M. et al., 1998. Diversity and conservation. In: S. Ghazanfar & M. Fisher, eds. Vegetation of the Arabian Peninsula. Netherlands: Kluver, pp. 265-302.

Flueckiger, F., 1867. Lehrbuch der Pharmakognosie des Pflanzenreiches. Naturgeschichte der wichtigeren Arzneistoffe vegetabilischen Ursprunges [cited in Thulin & Warfa, 1987]. Berlin: s.n.

Frankincense co-operative, n.d.. Frankincense / Olibanum. [Online]
Available at: http://www.frankincensemyrrh.co.uk/frankincense.php
[Accessed 1 6 2015].

Giuliani, C., Bini, L. & Lippi, M., 2012. Two structures and functions in the nectary of Frankincense tree (Boswellia sacra Flueck.). Flora-Morphology, Distribution, Functional Ecology of Plants, 207(1), pp. 74-9.

Hall, A., 2005. Viability of a Sustainable Frankincense Market in Somaliland: A Historical and Economical Analysis., s.l.: Somaliland Cyberspace.

Hamm, S., Bleton, J., Connan, J. & Tchapla, A., 2005. A chemical investigation by headspace SPME and GC–MS of volatile and semi-volatile terpenes in various olibanum samples. Phytochemistry, 66(12), pp. 1499-1514.

Haq, Q. et al., 2014. Conservation of Omani frankincense (Boswellia sacra, Burseraceae) through plant tissue culture approach. Journal of Science, 4(10), pp. 632-6.

Hepper, F., 1969. Arabian and African frankincense trees [cited in Thulin & Warfa, 1987]. The Journal of Egyptian Archaeology, pp. 66-72.

Hildebrandt, A. & Eltahir, E., 2006. Forest on the edge: seasonal cloud forest in Oman creates its own ecological niche. Geophysical Research Letters, 33(11), pp. 1-4.

Intermediate Technology Consultants (ITC) – Eastern Africa, 2006. Promotion of Employment Through Training (PETT) Project. Review and Synthesis of Local Economic Development (LED) Materials: Somaliland., s.l.: The European Union's 5th Rehabilitation Programme for Somalia/Somaliland.

Lehoux, H. & Chakib, A., 2012. Non Wood Forest Products Subregional Report 2012 – Eastern Africa., s.l.: Food and Agriculture Organization, FOPP.

Lippi, M., Giuliani, C., Gonnelli, T. & Bini, L., 2011. Floral color changes in Boswellia sacra Flueck.(Burseraceae): A dialogue between plant and pollinator. Flora-Morphology, Distribution, Functional Ecology of Plants, 206(9), pp. 821-6.

Miller, A. & Morris, M., 1988. Plants of Dhofar. s.l.:Government of Oman.

Morris, M., 2012. The aloe and the frankincense tree in southern Arabia: different approaches to their use. Herbal Medicine in Yemen: Traditional Knowledge and Practice, and Their Value for Today's World, Volume 69, p. 103.

Paul, M., Brüning, G., Bergmann, J. & Jauch, J., 2012. A Thin-layer Chromatography Method for the Identification of Three Different Olibanum Resins (Boswellia serrata, Boswellia papyrifera and Boswellia carterii, respectively, Boswellia sacra). Phytochemical Analysis, 23(2), pp. 184-189.

PROTA4U, n.d.. Boswellia sacra Flueck.. [Online]
Available at:
http://www.prota4u.org/protav8.asp?h=M4&t=Boswellia,sacra&p=Boswellia+sacra#Synonyms
[Accessed 1 6 2015].

Rabinowitz, D., Cairns, S. & Dillon, T., 1986. Seven forms of rarity and their frequency in flora of the British Isles. In: M. Soule, ed. Conservation Biology, the Science and Scarcity of Diversity. Sunderland, Massachusetts: Sinauer, p. 182–204.

Raffaeli, M., Mostis, S. & Tradelli, M., 2003. The Frankincense Tree (Boswellia sacra Flueck., Burseraceae) in Dhofar,. Webbia, 58(1), pp. 133-49.

Raffaeli, M., Mostis, S. & Tradelli, M., 2006. Boswellia sacra Flueck. (Burseraceae) in the Hasik area (Eastern Dhofar, Oman). Webbia, 61(2), pp. 245-51.

Raffaeli, M., Mostis, S. & Tradelli, M., 2008. Preserving and restoring the frankincense tree (Boswellia sacra) at Wadi Doka: A work in progress. In: A. Lombardi, ed. A port in Arabia between Rome and the Indian Ocean. Khor Rori report 2. Roma: Bretschneider, pp. 715-26.

Royal Oman Police, Directorate General of Customs, 2015. Customs statistics: Exports. [Online]
Available at: http://www.customs.gov.om/english/tradeStat.asp
[Accessed 1 6 2015].

Schulz, B. et al., 2002. Endophytic fungi: a source of novel biologically active secondary metabolites. Mycological Research, 106(9), pp. 996-1004.

Soloviev, P., 2013. Manual on Good Tapping and Harvesting Practices for Gums & Resins produced in Somaliland. s.l.:Somaliland Ministry of Trade & Investment.

Soloviev, P. & Abdi, A., 2013. Directory for Somaliland gums, resins and essential oils., Hargeisa: SOFRECO.

Strumia, F. et al., 2007. Notes on some insects associated to frankincense tree (Boswellia sacra fluckiger 1867 Burseraceae) in Dhofar (Sultanate of Oman). Atti Soc. tosc. Sci. nat., Mem., Serie B, Volume 114, pp. 135-9.

The Plant List Version 1.1, 2013. Boswellia sacra Flueck.. [Online]
Available at: http://www.theplantlist.org/tpl1.1/record/kew-2680579
[Accessed 31 August 2015].

Thulin, M., 1998. Boswellia sacra. The IUCN Red List of Threatened Species. [Online]
Available at: http://www.iucnredlist.org/details/34533/0
[Accessed 1 6 2015].

Thulin, M. & Warfa, A., 1987. The frankincense trees (Boswellia spp., Burseraceae) of northern Somalia and southern Arabia. Kew Bulletin, pp. 487-500.

Times of Oman, 2013. Frankincense trees under threat in Oman. [Online]
Available at: http://timesofoman.com/article/30368/HI/Frankincense-trees-under-threat-in-Oman
[Accessed 1 6 2015].

USDA, ARS, National Genetic Resources Program, n.d. Boswellia sacra Flueck.. [Online]
Available at: http://www.ars-grin.gov./cgi-bin/npgs/html/taxon.pl?310550
[Accessed 31 August 2015].

Van Vuuren, S., Kamatou, G. & Viljoen, A., 2010. Volatile composition and antimicrobial activity of twenty commercial frankincense essential oil samples. South African Journal of Botany, Volume 76, pp. 686-91.

Boswellia_serrata v3 final clean.docx

Recvd. 25.10.2015

Reviewed schp #

Boswellia serrata

A. Summary of findings

Boswellia serrata is a multiple-use tree species used for fodder, timber and is tapped for an oleo-resin known internationally as Indian frankincense or Indian olibanum. *B. serrata* oleo-resin is one of the few non-coniferous sources of turpentine (Anon., 1916), which historically came from *Pistacia terebinthus* (Anacardiaceae), but is usually commercially derived from conifers (*Larix* and *Pinus* species). Turpentine from *B. serrata* is considered to be of better quality than turpentine from chir pine (*Pinus roxburghii*) and is used to make paints and varnishes (Sunnichan, et al., 2005). The main commercial use of *B. serrata* oleo-resin is medicinal, including in Unani and Ayurvedic herbal medicines and in western biomedicine. *B. serrata* is an important source of boswellic acid used in the pharmaceutical industry, where beta-boswellic acid, keto-beta-boswellic acid, and acetyl-keto-beta-boswellic acid (AKBA) have been used to treat cancer cells (for example in brain tumours). The most important medical uses for *B. serrata* are to treat asthma, Crohn's disease, osteoarthritis, and rheumatoid arthritis (Basch, 2004; Gupta, et al., 2011; Gupta, et al., 1998).

India is the only producer of *B. serrata* oleo-resin, mainly from the states of Madhya Pradesh, Andhra Pradesh, Gujarat and Jharkhand (Yogi, Bhattacharya, & Jaiswal, 2014). The Indian Trade Classification (ITC) has a specific 8-digit export tariff code for 'Olibanum or Frankincense' (HS 13019032), which enables quantification of export value and volume of presumably what is mainly *B. serrata* oleo-gum resin. In 2012-2013 and 2013-2014, the main destination for Indian frankincense was Republic of Trinidad and Tobago followed by Mexico. Other major importers of Indian olibanum include Germany, China, and USA. India exported 104.93 tonnes of frankincense in 2012-2013 and 120.89 tonnes in 2013-2014. In addition, based on analyses from an different trade database (www.zauba.com), India exported about 5,986 kg of frankincense essential oil with a reported trade value of 17,129,381 Indian Rupees (INR) (=about US$ 268,746) in 2014. The main importers in terms of value and volume were Canada, UK, USA and Australia. Also in 2014, India exported frankincense incense products (incense cones, dhoops, granules, sticks) of a reported customs value of INR 8,813,776 (=about US$ 138,284) (Zauba Technologies & Data Services Pvt Ltd.).

Oleo-resin yields from *B. serrata* are small compared to resin yields from co-occurring tree species such as *Sterulia urens* and for optimum oleo-resin yields, *B. serrata* trees with a girth greater than 86 cm need to be tapped (Mishra, et al., 2012). Smaller *B. serrata* trees (below a girth of 38cm) do not produce ole-resin, presumably because resin ducts form in larger, older trees (Mishra, et al., 2012). In their study of oleo-resin production from 152 *B. serrata* trees during the main tapping season (April – May), Mishra et al. (2012) recorded oleo-resin production from 0.834 to 4.657 g per tree in *B. serrata* trees ranging from 38.1cm to 104.1cm. The 2014 export of 120.89 metric tonnes of *B. serrata* resin is therefore likely to represent oleo-resin production hundreds of thousands of *B. serrata* trees. Although Mishra et al. (2012) suggest that no attempts have yet been made to develop a sustainable harvest method of gum from wild *B. serrata* trees, traditional tapping methods used by tribal people, when carried out correctly do not damage mature trees. The biggest concerns regarding sustainable harvest are not tapping impacts on the trees. Instead, the main concerns are habitat loss through clearing *B. serrata* woodlands for farming, poor recruitment of young *B. serrata* trees into the population due to grazing and browsing by livestock and reduced seed production due to tapping. Even untapped *B. serrata* trees produce relatively few fruits. Open pollinated *B. serrata* only have 10% seed set, probably due to the limited availability nutrients during the flowering period when leaves are absent (Sunnichan, et al., 2005). From rubber trees (*Hevea brasiliensis*) to other sources of frankincense (such as *Boswellia papyrifera* (Rijkers, et al., 2006), tapping is known to reduce seed set. So in *B. serrata* woodlands where harvesting occurs, multiple factors (poor seed set, plus grazing and browsing of young trees, coupled to lopping and tapping of larger trees) all compound each other. If unchecked, it is highly likely this will lead to the long-term population decline that has already been well documented for *B. papyrifera* in Ethiopia, Eritrea and Sudan decades (Abiyu, et al., 2010; Abtew, et al., 2011; Abtew, et al., 2012; Groenendijk, et al., 2012; Ogbazghi, et al., 2006; Tolera, et al., 2013).

Like *B. papyrifera* in north-eastern Africa, B. serrata woodlands still cover a wide geographic area of India. Therefore, while *B. serrata* is listed in the Indian Red Data Book as Rare (R), a study carried out in Jawahar Sagar Sanctuary found it to be in common distribution in the study area, assigning a threat status of Least Concern (LC) (Joshi & Shringi, 2014). In Madhya Pradesh and Orissa, however, *B. serrata* populations were considered Vulnerable (VU) (Biswal & Nair, 2008; Chaubey, et al., 2015). *B. serrata* was also ranked as a Vulnerable (VU) in Madhya Pradesh during a Conservation Assessment and Management Plan (CAMP) 2003 workshop and was given a threat status of Endangered (EN) in Rajasthan at a CAMP 2007 workshop in Jaipur (Ved, et al., 2013). *B. serrata* is listed as Critically Endangered Possibly Extinct [CR(PE)] in the National Red List of Sri Lanka (MOE, 2012). In summary, therefore, *B. serrata* is suggested for inclusion in CITES Appendix II based on the criteria in Res. Conf. 9.24.

B. Assessment on fulfilling the Conf. 9.24 Criteria for this species

Based on the criteria in Res. Conf. 9.24 for inclusion of *Boswellia serrata* in CITES Appendix II based on Art. IV 2(a), there is evidence for adding *B. serrata* to Appendix II, despite the fact that *B. serrata* occurs over a large geographic range in a diversity of habitats. Exports of oleo-resin from *B. serrata* are significant, despite small oleo-resin yields per tree. And in *B. serrata* woodlands where harvesting occurs, multiple factors (poor seed set, plus grazing and browsing of young trees, coupled to lopping and tapping of larger trees) all compound each other. If unchecked, it is highly likely this will lead to the long-term population decline that has already been well documented for *B. papyrifera* in north-eastern Africa. The most likely proponents this proposal would be India, as the only exporting country and Germany, as an importing country in Europe.

C. Supporting statement

1. Taxonomy

1.1. Class

Angiospermae

1.2. Order

Sapindales

1.3. Family

Burseraceae

1.4. Genus and species

Boswellia serrata Roxb. ex Colebr. (The Plant List, Version 1.1, 2013).

1.5. Scientific synonyms

Boswellia balsamifera Spreng., *B. glabra* Roxb., *B. thurifera* Roxb. ex Fleming, *Chloroxylon dupada* Buch.-Ham. (The Plant List, Version 1.1, 2013). Additionally, The Plant List also includes *Libnotus asciaticus* Stackh, and *Libanus thuriferus* Colebr. as unresolved names.

The species epithet "serrata" stems from *serra* (a saw) referring to the toothed leaf-margins.

1.6. Common names including trade names of the oleo-resin

English: Boswellia, Indian frankincense, Indian olibanum, Indian olibanum-tree, Shallaki (Health Canada, 2015); Sanskrit: Kunduru, Śallaki; Assamese: Sallaki; Bengali: Luban, Salai, Salgai; Gujrati: Shaledum, Saleda, Saladi, Gugal, Saledhi; Hindi: Salai, Labana; Kannada: Adimar, Chitta, Gugula, Dhupa adimar, Chilakdhupa (Sultana et al., 2013), Madimar, Chilakdupa, Tallaki, Maddi; Kashmiri: Kunturukkam, Samprani; Marathi: Salai cha dink; Punjabi: Salai Gonda; Tamil: Parangi Sambrani; Telugu: Parangi sambrani, Anduga, Kondagugi tamu; Urdu: Kundur (Ayurvedic Pharmacopoeia Committee, 2004).

2. <u>Overview:</u>

See Section A.

3. <u>Species characteristics</u>

3.1. Distribution

Boswellia serrata formerly occurred in Sri Lanka, where it is presumed to be extinct (MOE, 2014) but is widespread in India. In India, *B. serrata* occurs in the states of Andhra Pradesh (especially near Adilabad), Assam, Bihar, Gujarat, Jharkhand, Karnataka, Madhya Pradesh (Khandwa-Nimar division), Maharashtra (particularly in Khandesh and Nagpur-Wardha regions), Odisha, Punjab, Rajasthan (Aravalli hills), Tamil Nadu, and Uttar Pradesh, West Bengal and in peninsular India (Vindhyan and Satpura hills of the Deccan Plateau) (USDA, ARS, National Genetic Resources Program, 2009; Ayurvedic Pharmacopoeia Committee, 2004; Natural Remedies Pvt. Ltd., n.d.; Yogi, et al., 2014; Gupta, et al., 2005; Tewari, 2010; Murthy, 2015; Sultana, et al., 2013).

3.2. Habitat

Boswellia serrata grows at altitudes up to 1,150 m in regions with annual temperatures between 0-45 °C and annual rainfall between 500-2,000 mm, in dry tropical deciduous forests, including teak forests, on slopes, ridges, and flat terrain. Height is dependent on soil depth and soil fertility. *B. serrata* is typically be found on hilltops, where it can be a dominant species (with a basal cover of 8.9 m2 per ha (Singh & Singh, 1991)) and rocky ridges, growing in nutrient poor shallow soils over limestone, sandstone, gneiss, quartzite or schist. *B. serrata* is a characteristic tree one of four forest types occurring in Alwar district, Rajasthan, the other three forest types being *Anogeissus pendula* forest, mixed *Anogeissus butea* and mixed *Acacia zizyphus* forest (Tomar, et al., 2013). *B. serrata* is frost hardy, fire and drought resistant. Alongside *B. serrata*, the vegetation is characterized by *Anogeissus latifolia*, *Acacia catechu*, and *Terminalia tomentosa*, amongst others (Orwa, et al., 2009).

3.3. Biological characteristics

During flowering and fruiting the trees remain leafless. Its white inflorescence appears in form of a terminal raceme with up to 90 bisexual flowers between January and April. Of the fresh pollen about 85% is viable (Sultana, et al., 2013). Predominant pollinators are the Indian honeybee (*Apis cerana* var. *indica*) and the giant Asian honeybee (*Apis dorsata*). *B. serrata* is self-incompatible. In cross-pollinated flowers normal germination occurs, resulting in fruit- and seed-setting. Fruit set appears to be low (10% under open conditions, 20% after manual cross-pollination), which has been linked to limited nutrient availability (Sunnichan, et al., 2005).

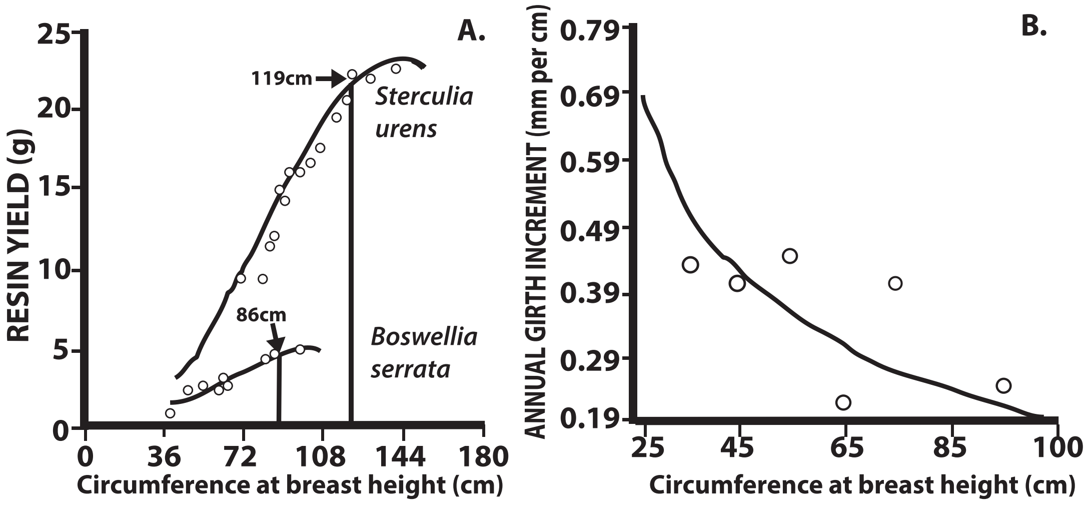


Figure 1. Resin yields and growth. A. Resin yields from *Boswellia serrata* trees are much lower than from co-occurring *Sterculia urens* trees. Small B. serrata less than 38 cm girth to do produce resin and Mishra et al. (2012) suggested that tappers should focus on harvesters from trees >86 cm in girth (redrawn from Mishra et al. (2012)). B. Annual growth increments of *B. serrata* showing the faster growth of smaller trees (redrawn from Singh and Singh, 1991).

Reproduction is primarily from seed, although some trees coppice, including from the roots. Seed viability is poor. Storage time is limited to 6-9 months under dry conditions. Seed weight is between 13,400 and 25,600 seeds/kg (Orwa, et al., 2009). Oleo-resin yields from *B. serrata* are small compared to resin yields from co-occurring tree species such as *Sterulia urens* and for optimum oleo-resin yields*, B. serrata* trees with a girth greater than 86 cm need to be tapped (Mishra, et al., 2012). Smaller *B. serrata* trees (below a girth of 38cm) do not produce ole-resin, presumably because resin ducts form in larger, older trees (Mishra et al., 2012). In their study of oleo-resin production from 152 *B. serrata* trees during the main tapping season (April – May), Mishra et al. (2012) recorded oleo-resin production from 0.834 to 4.657 g per tree in *B. serrata* trees ranging from 38.1cm to 104.1cm. The 2014 export of 120.89 metric tonnes of *B. serrata* resin is therefore likely to represent oleo-resin production hundreds of thousands of *B. serrata* trees.

3.4. Morphological characteristics

Boswellia serrata grows to a height of up to 15 m. It is deciduous and has a spreading crown with drooping branches. It normally has a short bole (up to 5 m, sometimes longer) with a girth of 1.2-1.8 m. The bark is greyish-green to ashy or reddish, very thin, outer layer peeling off in thin, papery flakes. Leaves are very variable in size, 20-45 cm, alternate and imparipinnate, predominantly at the end of branches. Leaflets opposite, 2.5-8 cm x 0.8-1.5 cm, sessile and lanceolate. White flowers in axillary racemes, 10-20 cm long. Fruits trigonous drupes, three-valved. Seeds compressed and pendulous (Orwa, et al., 2009).

The oleo-resin occurs in transparent, yellow brown fragrant tears around 5 cm long 2 cm thick. The tears are brittle and translucent with a waxy surface; The resin burns easily and produces a characteristic, resinous balsamic odor and taste (Sultana, et al., 2013).

3.5. Role of the species in its ecosystem

Boswellia serrata is among the most important of trees for the critically endangered Forest Owlet (*Heteroglaux blewitti*), which nests in the cavities of the tree. The Forest Owlet has an extremely small and fragmented population. Tribals are known to collect *B. serrata* gum at the owlet site of Khaknar, Madhya Pradesh (Jathar & Patil, 2011). *Boswellia serrata* trees also occur in the habitat of the endangered Bengal tiger (*Panthera tigris tigris*), for example in the Sariska Tiger Reserve in the Aravalli hill range of Rajasthan (Dular, 2015). *B. serrata* also provides an important habitat for endophytic fungi. In a recent study of endophytic fungi on *B. serrata* in Karnataka, Sunayana & Prakash (2012) recorded 17 genera of fungi on healthy *B. serrate* trees, most of which were mitosporic fungi (70.58%). Some bee species, including the giant Asian honeybee (*Apis dorsata)* and stingless bees (*Trigona* species) collect resin from the bark. In the case of stingless bees, this is for hive construction (Anon., n.d.). The drastic decline in the population of the giant Asian honeybee (*Apis dorsata*) and Indian honeybee (*A. cerana* var. *indica*) may have an impact on the propagation of *B. serrata* in the region (Sunnichan, et al., 2005).

4. <u>Status and trends</u>

4.1. Habitat trends

Vegetation in habitats with *Boswellia. serrata* dominance is impacted by anthropogenic and developmental activities. It has been observed that with increased disturbance by infrastructure, habitation, cutting, lopping and grazing, amongst others, distribution of trees changed from clumped to uniform with lower stem density (Sagar, et al., 2003). It is more than likely that impacts such as grazing, fires and tree cutting, and accompanying micro-climatic and soil changes are having as much or a greater impact on regeneration of *B. serrata* populations as does actual removal of plant parts (Shahabuddin & Prasad, 2004). Many of India's dry deciduous forests have been degraded to thorny scrub. Remaining forests are highly threatened by urbanization, cash crop farming, firewood collection and overgrazing. Large areas have been lost to urbanization, industry (mining and hydro-electric power production) and population movements (resettlement camps) (WWF, 2015a; WWF, 2015b).

4.2. Population size

Total population size across its entire range of distribution has not been assessed, but based on data in the regional surveys summarized below, the *Boswellia serrata* population is still very large. In their study of dry-deciduous forest located in the Manhan range of East Mirzapur Forest Division, Uttar Pradesh, Singh and Singh (1991) found that *B. serrata* was a dominant species on hill-tops, together with Acacia catechu. Out of a total tree basal cover of 10.36 m2 per ha, *B. serrata* represented 8.9 m2 per ha (and an Importance Value Index (IVI) of 185 (Singh and Singh, 1991). In a more recent study carried out in the Kawal Wildlife Sanctuary, Adilabad District, state of Telangana, surveying the ecological dominance of trees above 30 cm girth at breast height, found *B. serrata* to have a Relative Density (RD_1) of 1.84, Relative Frequency (RF) of 2.92, Relative Dominance (RD_2) of 3.71, and Importance Value Index (IVI) of 8.47; the IVI being the sum of the RF, RD and RD, indicating the second to lowest dominance (Murthy, 2015). In a quantitative analysis of vegetation of Rampara Forest, Saurashtra region, Gujarat, *B. serrata* exhibited maximum mean basal cover but its IVI was the lowest of all species surveyed due to low RD_1 and RF values (Panchal & Pandey, 2004). In an ecological survey conducted in tropical deciduous forest areas of Chhotanagpur plateau, Bokaro district, state of Jharkhand, *B. serrata* was determined to be among the most important species with a RD_1 of 3.44, RD_2 of 4.93, RF of 5.49, and IVI of 13.86 (Narayan & Anshumali, 2015).

In a structure, species composition, and soil properties study of 25 plots in the Aravally Range, Rajasthan dry tropical forest, 50 tree species were identified wherein *B. serrata* was found in all 25 of the sampled plots. A total of 207 individuals were counted; total basal area of 3.60 m2, maximum diameter at the breast height of 67.2 cm, maximum height of 13 m), and an Importance Value of 2.72, making it the 4th most important species in the study area (Kumar, et al., 2011).

Table 1, based on Rabinowitz et al. (1986), summarizes the geographic distribution (Section 3.1), habitat specificity (Section 3.2) and population size (Section 4.2) of *B. serrata* across its range (Rabinowitz, et al., 1986), showing *B. serrata* as a locally abundant species found in several habitats over a large geographic area.

Table 1. The Rabinowitz matrix approach (Rabinowitz, et al., 1986) can be applied at a variety of scales, from local through to a national or international scale, leading to a single choice out of 8 boxes (A-H) that is then ranked. In this report, we highlight the section of this matrix relevant to *B. serrata* from the perspective of an **international** scale.

GEOGRAPHIC DISTRIBUTION		**LARGE**		**SMALL**	
HABITAT SPECIFICITY		**Wide**	**Narrow**	**Wide**	**Narrow**
POPULATION SIZE	**Large & dominant somewhere**	A. Locally abundant, several habitats over large geographic area	C. Locally abundant in a specific habitat over large geographic area	E. Locally abundant, several habitats over small geographic area	G. Locally abundant in a specific habitat over small geographic area
	Small & non-dominant	B. Constantly sparse in several habitats over a large geographic area	D. Constantly sparse in a specific habitat over a large geographic area	F. Constantly sparse in several habitats over a small geographic area	H. Constantly sparse in a specific habitat over a small geographic area

4.3. Population structure

No comprehensive information is available that is representative of the entire range of distribution. In a study of disturbance impact on forest diversity, structure and regeneration in the Vindhyan dry tropical forest of India, low density and relatively poor regeneration was shown for *B. serrata* (Sagar & Singh, Structure, diversity, and regeneration of tropical dry deciduous forest of northern India, 2005). A survey in the Sariska Tiger Reserve in Rajasthan found *B. serrata* and a host of other resin producing plants such as *Commiphora wightii, Acacia catechu and Acacia nilotica* growing in the reserve (Dular, 2015).

A study carried out in the Kawal Wildlife Sanctuary, Adilabad District, state of Telangana, found *Tectona grandis* to be the dominant species, with *B. serrata* only present at higher altitudes. Other typical associates were *Anogeissus latifolia*, *Bombax ceiba*, *Diospyros melanoxylon*, *Mitragyna parviflora*, etc. (Murthy, 2015).

In a quantitative analysis of vegetation of Rampara Forest of Saurashtra region of Gujarat, population structures of tree species indicated a characteristic pattern at one of the studied sites represented by *Bauhinia racemosa* and *B. serrata*. However, another studied site with a population structure represented by *Prosopis cineraria, Butea monosperma and B. serrata* illustrated a non-characteristic pattern indicating that reproduction had occurred in the past but in recent years has stopped (Panchal & Pandey, 2004).

In an ecological survey conducted in tropical deciduous forest areas of Chhotanagpur plateau, Bokaro district, state of Jharkhand, *B. serrata* showed a relatively high density of specimen with small diameter vs. large diameter (ratio of ~3:1) implying good regeneration, with species such as *Shorea robusta*, *Butea monosperma*, *Acacia catechu*, *Diospyros melanoxylon*, and *Lagerstroemia parviflora* dominating the overall composition (Narayan & Anshumali, 2015).

In a structure, species composition, and soil properties study of 25 plots in the Aravally Range, Rajasthan dry tropical forest, *B. serrata* was found amongst the species with the largest stems and stem diameter at breast height, along with *Tectona grandis*, *Butea monosperma, Anogeissus latifolia, Wrightia tinctoria, Miliusa tomentosa.* etc. (Kumar, et al., 2011).

4.4. Population trends

Surprisingly, there appears to be scant, mostly anecdotal, information on the ecological sustainability of extraction of *B. serrata* and other non- timber forest products in India. Unlike *B. papyrifera*, however, where quantitative studies showed that *B. papyrifera* populations in three African Range States have been in decline for decades (Abiyu, et al., 2010; Abtew et al., 2011, 2012; Groenendijk et al, 2012; Ogbazghi et al, 2006; Tolera et al, 2013), there is no comparable quantitative evidence for *B. serrata*. Nevertheless, based on field observation of *B. serrata* populations in Maydha Pradesh, a similar situation applies to *B. serrata*, primarily due to grazing and browsing of small trees by livestock (Cunningham, A. B., pers. obs., 2009). Although Mishra et al. (2012) suggest that no attempts have yet been made to develop a sustainable harvest method of gum from wild *B. serrata* trees, traditional tapping methods used by tribal people, when carried out correctly, have a limited direct impact on mature *B. serrata* trees. The biggest long-term concerns about sustainable harvest are not tapping impacts on the trees. Instead, the main concerns are habitat loss through clearing *B. serrata* woodlands for farming, poor recruitment of young *B. serrata* trees into the population due to grazing and browsing by livestock and reduced seed production due to tapping. Even untapped *B. serrata* trees produce relatively few fruits. Open pollinated *B. serrata* only have 10% seed set, probably due to the limited availability nutrients during the flowering period when leaves are absent (Sunnichan, et al., 2005). From rubber trees (*Hevea brasiliensis*) to other sources of frankincense (such as *Boswellia papyrifera* (Rijkers, et al., 2006), tapping is known to reduce seed set. So in *B. serrata* woodlands where harvesting occurs, multiple factors (poor seed set, plus grazing and browsing of young trees, coupled to lopping and tapping of larger trees) all compound each other. If unchecked, it is highly likely this will lead to the long-term population decline that has already been well documented for *B. papyrifera* in Ethiopia, Eritrea and Sudan decades (Abiyu, et al., 2010; Abtew, et al., 2011; Abtew, et al., 2012; Groenendijk, et al., 2012; Ogbazghi, et al., 2006; Tolera, et al., 2013).

4.5. Geographic trends

B. serrata is considered to be amongst the commercially important species that are likely to become extinct in Sheopur forest division in Madhya Pradesh (Bhattacharya and Hayat 2003, cited in Shahabuddin & Prasad, 2004).

5. <u>Threats</u>

Boswellia serrata has not yet been assessed for the IUCN Red List. Researchers at the State Forest Research Institute (Jabalpur, Madhya Pradesh) assigned a conservation value of Vulnerable (VU), with the geographic focus of this assessment as just one district of the state (Chaubey, et al., 2015). The Environmental Information System (ENVIS) Centre at the Wildlife Institute of India lists *B. serrata* as a species of high conservation priority in Orissa with a threat status of Vulnerable (VU) (Biswal & Nair, 2008). *B. serrata* was ranked as a Vulnerable (VU) species in Madhya Pradesh through a Conservation Assessment and Management Plan (CAMP) 2003 workshop process in Bhopal and was given a threat status of Endangered (EN) in Rajasthan at a CAMP 2007 workshop in Jaipur (Ved, et al., 2013). Although *B. serrata* is listed in the Indian Red Data Book as Rare (R), a study carried out in Jawahar Sagar Sanctuary found it to be in common distribution in the study area, whereby a threat status of Least Concern (LC) was assigned (Joshi & Shringi, 2014). *B. serrata* is listed as Critically Endangered Possibly Extinct [CR(PE)] in the National Red List of Sri Lanka (MOE, 2012).

Primary threats are unsustainable tapping practices, cash crop plantations, excessive fuelwood collection, overgrazing, and development projects such as dams, mining, and resettlement of displaced people. Along with the aforementioned decline in pollinators, this has led to a steady and drastic decline in *B. serrata* populations.

The invasion of *Lantana camara* is another reported threat to the survival of *Boswellia* and many other species of trees growing in dry woodland areas of Northern India. The presence of Lantana shrubs as a dense understorey causes depletion of native trees (Sharma & Raghubanshi, 2007).

6. <u>Utilization and trade</u>

6.1. National utilization

Almost all uses are from wild *B. serrata* populations. Table 2 provides a summary of the types and extent of known uses of *B. serrata* plant parts and plant products in India.

Table 2. A summary of *B. serrata* harvest methods and uses in India

Plant part or plant product	**Uses**
Bark	Used as cordage (Orwa, et al., 2009).
Boswellic acids	Isolated boswellic acids used for pharmaceutical therapeutic applications (Du, et al., 2015)
Exudate (oleogum resin)	Collected by local people as one source of income from NTFPs (Dular, 2015).
Exudate (oleogum resin)	Indian herbal extraction companies produce standardized and non-standardized *B. serrata* extracts for the export market, mainly Japan, Singapore, UAE and USA (Indfrag pers. comm. 2015).
Exudate (oleogum resin)	The only non-coniferous source of turpentine and resin in India (reportedly used as a substitute for imported 'Canada balsam' oleoresin from the bark of *Abies balsamea*) (Haryana State Medicinal Plants Board, 2013).
Exudate (oleogum resin)	Active ingredient of traditional Ayurvedic medicinal formulations for treatment of asthma and arthritis (Ayurvedic Pharmacopoeia Committee, 2004) and of traditional Unani medicinal formulations for the treatment of renal disorders (Ahmed, et al., 2014).
Extracted gum	Used as a binding agent in pharmaceutical tablet formulations (Chaudhari, et al., 2011).
Fodder	As a substitute fodder for buffaloes (Orwa, et al., 2009).
Green leaf twigs	Utilized as fodder in the Sariska Tiger Reserve situated in the Aravalli hill range (Dular, 2015).
Tree	Reported new use in West Bengal as a lac host (Orwa, et al., 2009).
Wood	Used for fuel; charcoal made from it is used for iron smelting (Orwa, et al., 2009).
Wood	Wood fibre mixed with 25–40% long fibred bamboo pulp to make paper (Mahesh, et al.,

Plant part or plant product	Uses
	2015)
	Used to produce local furniture, storage boxes, packing cases, cement barrels, matches, plywood and veneers (Orwa, et al., 2009).

Leafy branches of *B. serrata* are utilized as fodder in the Sariska Tiger Reserve in Rajasthan and the exudate is collected by local people (inside and outside the reserve) as one source of income from NTFPs (Dular, 2015) Outside of India, *B. serrata* gum resin is widely used by traditional healers in Pakistan and the Middle East as well as in counties where the Ayurvedic and Unani systems of medicine are recognized and practiced. Dietary supplementation with *B. serrata* is being used for controlling blood parameters in patients with type 2 diabetes (Ahangarpour, et al., 2014). *Boswellia serrata* is also used topically for boils, wound healing, acne, bacterial and fungal infections, scars, varicose veins and boils. It is used also used in beauty care to smooth wrinkles and as a facial toner. The most important medical uses for *B. serrata*, however, backed by detailed scientific evidence, are chronic therapy for asthma, Crohn's disease, osteoarthritis, and rheumatoid arthritis (Basch, 2004).

The oleo-gum resin is obtained by incision or produced by spontaneous exudation from the stem and branches (United States Pharmacopeial Convention, 2015). The gum-resin is collected mainly from wild *B. serrata* trees from November to April (National Medicinal Plants Board, 2009).

The National Medicinal Plants Board provides detailed guidelines for gum resin collection and post-harvest practices. For example, "*Only a few small longitudinal incisions should be made to collect the exudates and the exposed parts should be treated appropriately to avoid any fungal or bacterial infestation after the exudates has been collected" "Incisions, too close to the ground, easily approachable by the cattle and wild animals, should be avoided. The collection container should be designed in a way to prevent rain, bird droppings and any other such possible contaminations*" (National Medicinal Plants Board, 2009).

6.2. Legal trade

Older data from the State of Madhya Pradesh, Gwalior, Shivpuri, Ujjain and Khandwa forests, provides an interesting perspective on production, value and trade trends, in combination with more recent data in tables 4ff spanning almost 3 decades.

Table 3. Quantities of *Boswellia serrata* gum collected in Gwalior, Shivpuri, Ujjain and Khandwa forests of Madhya Pradesh, 1996-2003

Collection Year	Collection Rate (Rs per Qntl)	Quantity Collected (Qntls)	Sale Price 10^5 Rs.
1996-97	1550/-	4577	118.14
1997-98	1800/-	5919	165.46
1998-99	2000/-	4877	129.02
1999-2000	3000/-	5432	210.30
2000-01	3000/-	7036	185.79
2001-02	3000/-	5947	165.62
2002-03	2500 - 3000/-	5072	138.47

Source: http://www.mfpfederation.org/Website/content/salai.html

There is sufficient data available from India, the only known producing and exporting range state, to make a reasonable estimate of current total annual export trade volume of *B. serrata* oleoresin gum. This section will provide detailed export trade data to support an estimation of over 100 tonnes exported annually by India (Table 5). Additionally, based on a survey of 'mandis' (Indian herb trading markets), *B. serrata* gum is traded domestically in quantities of greater than 100 tonnes per year (Ved & Goraya, 2008).

Commercial exploitation of *B. serrate* resin ('salai gum') occurs mainly in the states of Madhya Pradesh, Andhra Pradesh, Gujarat, and Jharkhand (Yogi, et al., 2014). Table 4 shows annual local production quantities for two of the main producing states, Andhra Pradesh and Gujarat, for the agricultural years (Apr-Mar) of 2008-2009 through 2012-2013. Annual quantities of *B. serrata* gum collection from other states are not available.

Table 4. *Boswellia serrata* gum collected in Andhra Pradesh and Gujarat, Apr-Mar 2008-2009 to Apr-Mar 2012-2013

State	**Agricultural year (Apr-Mar) / Quantity *B. serrata* gum collected (MT)**				
	2008-09	**2009-10**	**2010-11**	**2011-12**	**2012-13**
Andhra Pradesh	7.9 MT	4.2 MT	4.4 MT	5.0 MT	5.5 MT
Gujarat	10.2 MT	26.7 MT	13.3 MT	20.3 MT	29.3 MT

Source: Yogi et al. (2014)

The average annual production of <u>all</u> gums and resins in Jharkhand is around 300 tonnes, mainly gum karaya (*Sterculia urens*) (about 17% of total), guggual salai (*B. serrata*), and babool (*Acacia nilotica*), among others. The collected quantity is sold through open tenders/auctions either in advance or after storage (Yogi, et al., 2014).

The Indian Trade Classification (ITC) has a specific 8-digit export tariff code for 'Olibanum or Frankincense' (HS 13019032), which enables quantification of export value and volume of presumably what is mainly *B. serrata* oleo-gum resin. In agricultural years (Apr-Mar) of 2012-2013 and 2013-2014, the main destination for Indian frankincense was Republic of Trinidad and Tobago followed by Mexico. Upon cross-checking Trinidad imports (of 6-digit HS130190: Natural gum, resin, gum resin, balsam) in the UN COMTRADE database, it appears that Trinidad is indeed a major importer of natural gums, and mainly from India. Other major importers of Indian olibanum include Germany, China, and USA. Table 4 shows that India exported 104.93 MT of frankincense in agricultural year (Apr-Mar) 2012-2013 and 120.89 MT in 2013-2014.

Table 5. India exports of frankincense (HS 13019032) 2012-2013 and 2013-2014

Country	**Values in US$ Million**			**Quantity in Metric Tons (MT)**		
	2012-2013	**2013-2014**	**%Growth**	**2012-2013**	**2013-2014**	**%Growth**
Trinidad	0.10	0.06	-35.82	44.00	31.10	-29.32
Mexico	0.02	0.02	4.73	26.00	26.00	0.00

Country	Values in US$ Million			Quantity in Metric Tons (MT)		
	2012-2013	2013-2014	%Growth	2012-2013	2013-2014	%Growth
Germany	0.01	0.09	710.71	3.06	20.60	573.17
China, PR		0.04		0.00	15.00	
France	0.01	0.02	106.76	3.50	5.30	51.43
Morocco	0.01	0.01	17.80	4.00	5.00	25.00
Lebanon	0.00	0.00	88.00	2.00	5.00	150.00
Mauritius	0.01	0.02	29.91	4.00	4.76	19.12
Malaysia	0.01	0.00	-88.98	3.12	2.00	-35.82
Sri Lanka, DSR		0.01		0.00	1.40	
UK	0.00	0.00	3.85	0.61	1.22	98.70
Italy		0.00		0.00	1.00	
USA	0.03	0.04	26.90	11.15	0.95	-91.48
Pakistan, IR		0.00		0.00	0.80	
Oman	0.00	0.00	-23.68	0.55	0.45	-18.18
Maldives		0.00		0.00	0.17	
New Zealand	0.00	0.00	50.00	0.14	0.10	-25.00
Hungary		0.00		0.00	0.03	
Belgium				0.00	0.01	
Australia	0.00			0.03	0.00	-83.33
Taiwan	0.00			0.01	0.00	
Netherlands	0.00			0.13	0.00	
Panama	0.00			1.50	0.00	
Reunion	0.00			0.10	0.00	
Singapore	0.00			1.00	0.00	
Congo, DR	0.00			0.03	0.00	
TOTAL	**0.22**	**0.32**	**45.74**	**104.93**	**120.89**	

Source: Govt. of India Department of Commerce EXPORT IMPORT DATA BANK Version 7.1 –TRADESTAT

Utilizing the Zauba.com trade database, in calendar year 2014, India exported about 5,986 kg of frankincense essential oil with a reported trade value of 17,129,381 Indian Rupees (INR) (=about US$ 268,746). The main importers in terms of value and volume were Canada, UK, USA, and Australia. Using the same database, in 2014, India exported frankincense incense products (incense cones, dhoops, granules, sticks) of a reported customs value of INR 8,813,776 (=about US$ 138,284) (Zauba Technologies & Data Services Pvt Ltd., n.d.). Quantification by weight is not possible because different shipments used different units of measurement such as dozens, kilograms, packages, and pieces. Main export destinations in 2014 were Argentina, USA, UK, and Germany.

6.3. Parts and derivatives in trade

Table 6 shows the various HS Codes, general and specific, that are used for *B. serrata* articles of commerce.

Table 6. HS Codes used for various B*. serrata* articles of commerce

Traded form	BTI	CCCCS	CROSS	ITC	OC & SC
Dried resin	1301.90.0000	1301.9020	1301.90.9090	1301.9032	1301.90.7000

Traded form	BTI	CCCCS	CROSS	ITC	OC & SC
Essential oil	3301.29.41		3301.29.5050; 3301.29.5150		
Extract	1302.19.7000				
Food supplement	2106.90.9260				
Incense sticks	3307.41.0000		3307.41.0000		

Legend:

BTI: Binding Tariff Information rulings of the European Commission Taxation and Customs Union

CCCCS: Commodity Classification for China Customs Statistics (PRC)

CROSS: Customs Rulings Online Search System (U.S. Customs & Border Protection)

ITC: Indian Trade Classification

OC: Oman Customs, Sultanate of Oman, Directorate General of Customs

SC: Saudi Customs, Kingdom of Saudi Arabia Central Department of Statistics & Information

Most all of the HS Codes shown in Table 5 are assigned as the result of rulings, for example by BTI (EU) or CROSS (US). Thus, they are not species-specific, but rather are determinations made by customs authorities as to which 'other' code to place an article that is Not Elsewhere Specified or Included (NESOI). The exceptions are codes specifically assigned to 'frankincense' (any *Boswellia* spp.) in the columns for Indian Trade Classification (ITC), Oman Customs (OC) and Saudi Customs (SC). The aforementioned zauba.com database revealed that individual Indian companies use several different general or 'other' tariff codes for export shipments of essential oil of frankincense including HS 33011990, HS 33012590, HS 33012911, HS 33012950, HS 33012990, HS 33013099, HS 33019079, HS 33019090, HS 33029012, and HS 33029019. These disparate are not shown in the table.

Parts and derivatives of *B. serrata*, including types of products in trade are listed in Table 7.

Table 7. Defined articles of commerce containing *Boswellia serrata*

Trade name(s) of article	Definition	Ref.
Boswellia serrata	The oleo-gum resin obtained by incision or produced by spontaneous exudation from the stem and branches of *Boswellia serrata* Roxb.	USP 38
Boswellia serrata Extract	Prepared from pulverized *Boswellia serrata* USP, using suitable solvents such as isopropanol, alcohol, methanol, hexanes, or mixtures of these solvents. The ratio of starting plant material to Extract is approximately 6:1.	USP 38
Boswellia serrata Extract	Extract of the whole plant, *Boswellia serrata*.	CosIng
Boswellia serrata Gum	Bark exudate of the *Boswellia serrata*.	CosIng
Boswellia serrata Gum Extract	Extract of the gum of the *Boswellia serrata*.	CosIng
Boswellia serrata Leaf Cell Extract	Extract of a culture of the leave cells of *Boswellia serrata*.	CosIng
Boswellia serrata Oil	Oil obtained from *Boswellia serrata*.	CosIng
Boswellia serrata Resin Extract	Extract of the resin of *Boswellia serrata*.	CosIng
Boswellia serrata Water	Aqueous solution of the steam distillate obtained from the olibanum *Boswellia serrata*.	CosIng
Saccharomyces/Boswellia serrata Gum Ferment Extract	Extract of the product obtained by the fermentation of *Boswellia serrata* gum by the microorganism, Saccharomyces.	CosIng

Legend:

CosIng Cosmetic Ingredients & Substances Database (European Commission)

USP 38 United States Pharmacopeia, Thirty-eighth Revision

6.4. Illegal trade

Material adulterated with *B. sacra* and *B. frereana*, imported from countries of the Gulf and Africa are reportedly sold in Indian markets under the same trade name used for *B. serrata* ('*kundur*'), as well as the oleo-gum resin of *Garuga pinnata* Roxb. (Gupta, et al., 2005).

6.5. Actual or potential trade impacts

Decline in supply of quality *B. serrata* material in the world market, while demand is increasing will shift demand pressure to African *Boswellia* spp. which themselves are exposed to various threats. While *B. sacra* may constitute a possible substitute for *B. serrata*, *B. frereana* is characterized by almost absence of boswellic acids, the lead compound in medicinal efficacy.

7. <u>Legal instruments</u>

7.1. National

In the 1960s in Madhya Pradesh, *B. serrata* trees were being damaged due to deep tapping injury which led local government to restrict gum collection. *B. serrata* gum was included under the category of nationalized Non Wood Forest Products and 'notified' as "specified forest produce" under the M.P Van Upaj (Vyapar Viniyaman) Act, 1969, resulting in only the State Government or an agent appointed by the State Government being allowed to collect it. Collection was carried out through Primary Forest Produce Cooperative Societies and the District Unions. In the 1980s the state government banned extraction of all gums, but the ban was lifted in 1995 and controlled extraction was permitted in certain identified districts. In 1997, the State Government lifted the ban in Gwalior, and Shivpuri, Ujjain Khandwa forest circles. Collection was also permitted in Narmada Sarovar submergence areas of Badwani and Jhabua forest divisions. In 2003 these restrictions were removed and *B. serrata* gum was removed from the list of specified produce (Yogi, et al., 2014).

Much of the *B. serrata* habitat lies in an area classified as Scheduled Tribe territory. These areas have poor physical and social infrastructure but special legislative arrangements (Dular, 2015).

7.2. International

None at present.

8. <u>Species management</u>

8.1. Management measures

In Uttar Pradesh the trunk diameter suitable for felling used to be >30cm with a 30-year rotation period. It is implied, however, that population increase, mining, thermal power generation etc. have triggered illegal felling, lopping etc. (Sagar & Singh, 2005).

According to Mishra et al. (2012), no attempts have yet been made to develop a sustainable harvest method of gum from wild *B. serrata* trees in the Indian subcontinent. In their study, a relationship between the girth size and gum yield was determined, concluding that for optimum yield of gum, a girth size of above 86 cm for *B. serrata* should be selected so that the gum tapping practices shall not affect the survival status of the species in the natural forest (Mishra, et al., 2012).

CAZRI (Jodhpur, Rajasthan) has developed a 'gum inducer' technique and carried out studies on dosage standardization of gum inducer, time of application, and viability of gum cultivation through plantation. Based on the CAZRI study, the best time for gum inducer injection treatment for *B. serrata* trees would be November-December (Tewari, 2010).

8.2. Population monitoring

No data available.

8.3. Control measures

8.3.1. International

None known.

8.3.2. Domestic

None known.

8.4. Cultivation and propagation

The vast majority of Indian *B. serrata* is wild harvested by local tribal people in India.

Some attempts at developing sustainable plantations been undertaken in recent years. A range of forest enrichment techniques are practised.

For example, in the context of a new project on conservation and development of guggal (*Commiphora wightii*) in Haryana State, the Haryana Forest Department also plans to establish a *Boswellia serrata* ('Salai Guggal') plantation in Mohindergarh, Rewari & Bhiwani Districts. While naturally occurring trees will be maintained, 100 ha of new *B. serrata* trees will be planted from cuttings and seeds in 3x3 m plots at 1,100 trees per ha (Haryana State Medicinal Plants Board, 2013).

Some regeneration is achieved from coppicing regimes and suckers. Propagation can be done from seed or cuttings. For the former, ripe fruits are collected from trees and sterile seeds eliminated by immersing them in water where they will float. Seeds are sown immediately after collection. Pre-treatment is by soaking in warm water for 24 hours. Seeds will germinate after 7-15 days and can be transplanted after 10-12 weeks. Root systems are delicate and transplanting is not well tolerated. For the latter, cuttings between 10 and 180 cm are buried in the ground at around 50 cm deep around two months before the rainy season. Success rate is up to 80% (Bedi, et al., 2011).

Khan (2015) experimented with various pre-treatments to improve *B. serrata* seed viability. Maximum germination was achieved with gibberellic and indoleacetic acid. Improvement of the germination rate was also achieved with mechanical scarification, the aforementioned hot water treatment, sulphuric acid, potassium nitrate and thiourea (Khan, 2015).

8.5. Habitat conservation

According to a biodiversity assessment report for the Wakal river basin in Rajastan, a conservation area is under development in Kumbhalgarh (GLOWS-FIU, 2008).

Where *Boswellia serrata* occurs in forest reserves and conservation areas, measures to protect the habitat of animals should also benefit *B. serrata*. However, tribals are known to collect *B. serrata* gum from protected sites (Jathar & Patil, 2011; Dular, 2015).

9. Information on similar species

There is potential for "look-a-like" problems. Material adulterated with *B. sacra* and *B. frereana*, imported from countries of the Gulf and Africa is being sold in Indian markets under the same trade name used for *B. serrata* ('Kundur'), as well as the oleo-gum resin of *Garuga pinnata* Roxb. (Gupta, et al., 2005). The extraction of boswellic acid from other species of *Boswellia* from Africa is now quite common and these are used in a wide range of standardized local medicines sold under the name of "*kundur*" and other proprietary Ayurvedic medicines. These products, however, have a different composition and color, which causes formulation problems for some manufacturers (Indfrag, pers. comm., 2015).

The gum is known as "*Salai guggal*", "*Loban dhoop*" or Indian frankincense. It contains 20-36% gum, 56-65% acid resin (up to 43% boswellic acids) and 4-8% essential oil. Further, the gum contains galacturonic acid, digitoxose, arabinose, galactose and xylose (Mishra, et al., 2012; Alam, et al., 2012). Pharmacopeial standards for *B. serrata* require the oleogum-resin to contain NLT 1.0% of the keto derivatives of b-boswellic acid (as the sum of 11-keto-b-boswellic acid and 3-acetyl-11-keto-b-boswellic acid). The extract made from it has a drug-to-extract ratio of about 6:1 (w/v) (United States Pharmacopeial Convention, 2015).

Differentiation of the species and thus evidence for adulteration is possible through application of modern analytical tools and methods. *Boswellia serrata* gum has a chemical composition similar to that of *Boswellia sacra,* however some chemical components distinguish them from each other. In the former a-thujene predominates over a-pinene. Moreover *B. serrata* contains compounds not found in *B. sacra* including methyl chavicol and methyl eugenol (Paul, 2012), p-anisaldehyde, elemicin and isocaryophyllene. *Boswellia serrata* does not contain caryophyllene oxide, a-humulene, b-caryophyllene, and bornyl acetate (Hamm, et al., 2005). Kamal et al. (2014) developed a high-performance liquid chromatographic method that simultaneously determines keto beta boswellic acid, acetyl keto beta boswellic acid, beta boswellic acid, and acetyl beta boswellic acid. This allows for complete identification and standardization of any *B. serrata* extract (Kamal, et al., 2014).

10. Experts consulted

Fairwild Foundation (www.fairwild.org); Indfrag Ltd (www.indfrag.ltd); Organic Herb Trading (www.organicherbtrading.co.uk)

11. References

Abiyu, A. et al., 2010. Incense Woodlands in Ethiopia and Eritrea: regeneration problems and restoration possibilities. In: F. Bongers & T. Tenningkeit, eds. *Degraded Forests in Eastern Africa. Management and Restoration..* London: Earthscan, pp. 133-152.

Abtew, A., Pretzsch, J., Mohamoud, T. & Adam, Y., 2011. *Population structure, density and natural regeneration of Boswellia papyrifera (Del.) Hochst in Dry woodlands of Nuba Mountains, South Kordofan State, Sudan.* Bonn, DITSL GmbH, p. 245.

Abtew, A., Pretzsch, J., Mohmoud, T. & Adam, Y., 2012. Commodity chain of Frankincense from the dry woodlands of Nuba Mountains, South Kordofan State, Sudan. *Small-scale Forestry,* 11(3), pp. 365-388.

Ahangarpour, A. et al., 2014. Effect of Boswellia serrata supplementation on blood. *lipid, hepatic enzymes and fructosamine levels in type2 diabetic patients,* 13(1), p. J Diabetes Metab Disord.

Ahmed, S. et al., 2014. Versatile pharmacological action and compound formulation of Kundur in Unani medicine: A review.. *IJP,* 2(1), pp. 627-31.

Alam, M., Khan, H., Samiullah, L. & & Siddique, K., 2012. A review on Phytochemical and Pharmacological studies of Kundur (Boswellia serrata Roxb ex Colebr.) - A Unani drug. *Journal of Applied Pharmaceutical Science,* 2(3), pp. 148-56.

Anon., 1916. Turpentine Oil and Rosin from Boswellia serrata [abstract only]. *Indian Forester ,* 42(5), pp. 271-2.

Anon., n.d. *Boswellia serrata.* [Online]
Available at:
http://indiabiodiversity.org/species/show/31115/?max=8&offset=0&classification=314523&taxon=29431&view=grid
[Accessed 1 6 2015].

Ayurvedic Pharmacopoeia Committee, 2004. Kunduru (exudate). In: *The Ayurvedic Pharmacopoeia of India, Part I, Volume IV.* New Delhi, India: Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry of Health & Family Welfare, Government of India, pp. 57-58.

Basch, E., 2004. Boswellia: An evidence-based systematic review by the natural standard research collaboration. *Journal of herbal pharmacotherapy,* 4(3), pp. 63-83.

Bedi, Y., Dutt, H. & Kaur, H., 2011. *Plants of Indian Systems of Medicine (Volume-I): Monographs on twenty commercially important medicinal plants: Boswellia serrata Roxb..* Saarbrücken: Lambert.

Biswal, A. & Nair, M., 2008. Threatened Plants of Orissa and Priority Species for Conservation. *Special Habitats and Threatened Plants of India. ENVIS Bulletin: Wildlife and Protected Areas,* 11(1), pp. 175-86.

Chaubey, O., Sharma, A. & Krishnamurthy, G., 2015. Ex-situ Conservation of Indigenous, Threatened and Ethno-Medicinal Diversity of Forest Species. *International Journal of Bio-Science and Bio-Technology,* 7(3), pp. 9-22.

Chaudhari, S. et al., 2011. Evaluation of binding properties of Boswellia serrata Roxb. gum in tablet formulation. *J Pharm Educ Res,* 2(1), pp. 61-5.

Dular, A., 2015. Plant diversity assessment of Sariska tiger reserve in Aravallis with emphasis on minor forest products. *Tropical Plant Research,* 2(1), pp. 30-5.

Du, Z. et al., 2015. Prospects of boswellic acids as potential pharmaceutics. *Planta Medica,* 81(4), pp. 259-71.

GLOWS-FIU, 2008. *Biodiversity Assessment Report: Wakal River Basin, India,* Miami: Global Water Sustainability Program, Florida International University.

Groenendijk, P. et al., 2012. Limitations to sustainable frankincense production: blocked regeneration, high adult mortality, and declining population. *Journal of Applied Ecology,* Volume 49, pp. 164-173.

Gupta, A., Tandon, N. & Sharma, M., 2005. Boswellia serrata Roxb. Ex Colebr. (Śallaki). In: *Quality Standards of Indian Medicinal Plants, Volume 2.* New Delhi, India: Indian Council of Medical Research, pp. 19-24.

Gupta, I. et al., 1998. Effects of Boswellia serrata gum resin in patients with bronchial asthma: results of a double-blind, placebo-controlled, 6-week clinical study. *Eur J Med Res ,* 3(11), pp. 511-4.

Gupta, P. et al., 2011. Pharmacognostical and Phytochemical evaluation of Oleo gum-resin of Shallaki (Boswellia serrata Roxb.). *Journal of Pharmaceutical and Biomedical Sciences,* 6(6), pp. 1-6.

Hamm, S., Bleton, J., Connan, J. & Tchapla, A., 2005. A chemical investigation by headspace SPME and GC–MS of volatile and semi-volatile terpenes in various olibanum samples. *Phytochemistry,* 66(12), pp. 1499-1514.

Haryana State Medicinal Plants Board, 2013. *Project on conservation and development of guggal (Commiphora wightii) in Haryana,* s.l.: Haryana Forest Department.

Health Canada, 2015. *Organism Boswellia serrata.* [Online]
Available at: http://webprod.hc-sc.gc.ca/nhpid-bdipsn/ingredReq.do?id=5947&lang=eng
[Accessed 1 6 2015].

Jathar, G. & Patil, D., 2011. *Reassessment of the status of forest owlet in its known distribution and evaluation of conservation status,* Pune, India.: Foundation for Ecological Conservation and Sustainable Development..

Joshi, S. & Shringi, S., 2014. Floristic Diversity with Special Reference to Rare and Threatened Plants of Jawahar Sagar Sanctuary Area near Kota Rajasthan. *Biological Forum – An International Journal,* 6(1), pp. 84-91.

Kamal, Y., Yusufoglu, H. & Alharthy, S., 2014. Unse of fingerprinting and marker compounds for the identification and standardization of Boswellia serrata gum extract. *IJBPAS,* 3(10), pp. 2290-303.

Khan, M., 2015. Studies On Seed Germination Of An Threatened Endangered Medicinal Plant Species Boswellia Serrata Roxb. *Weekly Science Research Journal,* 2(39), pp. 1-5.

Kumar, J., Patel, K. K. R. & Kumar Bhoi, R., 2011. Forest structure, diversity and soil properties in a dry tropical forest in Rajasthan, Western India. *Annals of Forest Research,* 54(1), pp. 89-98.

Mahesh, S., Kumar, P. & Ansari, S., 2015. A rapid and economical method for the maceration of wood fibres in Boswellia serrata Roxb.. *Tropical Plant Research,* 2(2), pp. 108-11.

Mishra, S., Behera, N. & Paramanik, T., 2012. Comparative assessment of gum yielding capacities of Boswellia serrata Roxb. and Sterculia urens Roxb. in relation to their girth sizes. *The Ecoscan,* 1(Special Issue), pp. 327-330.

MOE, 2012. *The National Red List 2012 of Sri Lanka; Conservation Status of the Fauna and Flora,* Colombo, Sri Lanka: Ministry of Environment.

Murthy, E., 2015. Ecology and phytosociology of the tropical dry deciduous forests of Kawal Wildlife Sanctuary, Telangana, India. *Journal of Threatened Taxa,* 7(3), pp. 6972-9.

Narayan, C. & Anshumali, J., 2015. Diversity indices and importance values of a tropical deciduous forest of Chhotanagpur plateau, India. *Journal of Biodiversity and Environmental Sciences,* 7(1), pp. 358-67.

National Medicinal Plants Board, 2009. *Standard for Good Field Collection Practices of Medicinal Plants,* New Delhi, India: NMPB, Department of AYUSH, Ministry of Health and Family Welfare, Government of India.

Natural Remedies Pvt. Ltd., n.d. *Boswellia serrata.* Bangalore: s.n.

Ogbazghi, W., Rijkers, T., Wessel, M. & Bongers, F., 2006. The distribution of the francincense tree Boswellia papyrifera in Eritrea: the role of environment and land use. *Journal of biogeography,* Volume 33, pp. 524-535.

Orwa, C. et al., 2009. *Agroforestree Database: a tree reference and selection guide version 4.0.* [Online]
Available at: http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp
[Accessed 1 6 2015].

Panchal, N. & Pandey, A., 2004. Analysis of vegetation of Rampara forest in Saurashtra region of Gujarat state of India. *Tropical Ecology,* 45(2), pp. 223-31.

Rabinowitz, D., Cairns, S. & Dillon, T., 1986. Seven forms of rarity and their frequency in flora of the British Isles. In: M. Soule, ed. *Conservation Biology, the Science and Scarcity of Diversity.* Sunderland, Massachusetts: Sinauer, p. 182–204.

Rijkers, T. O. W., Wessel, M. & Bongers, F., 2006. The effect of tapping for frankincense on sexual reproduction in Boswellia papyrifera. *Journal of Applied Ecology,* 43(6), pp. 1188-1195.

Sagar, R., Raghubanshi, A. & Singh, J., 2003. Tree species composition, dispersion and diversity along a disturbance gradient in a dry tropical forest region of India. *Forest Ecology and Management,* Volume 186, pp. 61-71.

Sagar, R. & Singh, J., 2005. Structure, diversity, and regeneration of tropical dry deciduous forest of northern India. *Biodiversity and Conservation,* Volume 14, pp. 935-59.

Shahabuddin, G. & Prasad, S., 2004. Assessing ecological sustainability of non-timber forest produce extraction: the Indian scenario.. *Conservation and Society,* 2(2), pp. 235-50.

Sharma, G. & Raghubanshi, A., 2007. Effect of Lantana camara L. cover on local depletion of tree population in the Vindhyan tropical dry deciduous forest of India. *Applied ecology and environmental research,* 5(1), pp. 109-21.

Singh, L. & Singh, J., 1991. Species structure dry matter dynamics and carbon flux of a dry tropical forest in India. *Annals of Botany ,* Volume 68, pp. 263-73.

Sultana, A., Ur Rahman, K., Padmaja, A. & Ur Rahman, S., 2013. Boswellia serrata Roxb. A traditional herb with versatile pharmacological activity: a review. *IJPSR,* 4(6), pp. 2106-17.

Sunnichan, V., Mohan Ram, H. & Shivanna, K., 2005. Reproductive biology of Boswellia serrata, the source of salai guggul, an important gum-resin.. *Botanical Journal of the Linnean Society,* 147(1), pp. 73-82.

Tewari, J., 2010. *Tree gum exudate technique developed by CAZRI,* Jodhpur, Rajasthan: Central Arid Zone Research Institute (CAZRI).

The Plant List, Version 1.1, 2013. *Boswellia serrata Roxb. ex Colebr..* [Online]
Available at: http://www.theplantlist.org/tpl1.1/record/kew-2680580
[Accessed 1 June 2015].

Tolera, M. et al., 2013. Frankincense tree recruitment failed over the past half century. *Forest Ecology and Management,* Volume 304, pp. 65-72.

Tomar, V. et al., 2013. A satellite-based biodiversity dynamics capability in tropical forest. *The Electronic Journal of Geotechnical Engineering,* Volume 18, pp. 1171-80.

United States Pharmacopeial Convention, 2015. *United States Pharmacopeia, Thirty-Eighth Revision (USP 38).* Rockville, MD: United States Pharmacopeial Convention.

USDA, ARS, National Genetic Resources Program, 2009. *Boswellia serrata Roxb. ex Colebr..* [Online]
Available at: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?7458
[Accessed 1 6 2015].

Ved, D. & Goraya, G., 2008. *Demand and supply of medicinal plants in India,* Bangalore, India: National Medicinal Plants Board, New Delhi, Foundation for Revitalisation of Local Health Traditions.

Ved, D. et al., 2013. Medicinal Plants Species of Conservation Concern identified for Andhra Pradesh, Arunachal Pradesh, Madhya Pradesh & Rajasthan. *ENVIS Newsletter on Medicinal Plants,* 6(1, 2, 3 & 4).

WWF, 2015a. *Tropical and subtropical dry broadleaf forests. Southern Asia: India.* [Online]
Available at: https://www.worldwildlife.org/ecoregions/im0209
[Accessed 1 6 2015].

WWF, 2015b. *Tropical and subtropical dry broadleaf forests. Southern Asia: Northwest India.* [Online]
Available at: http://www.worldwildlife.org/ecoregions/im0206
[Accessed 1 6 2015].

Yogi, R., Bhattacharya, A. & Jaiswal, A., 2014. *Lac, Plant Resins and Gums Statistics at a Glance 2013,* Ranchi (Jharkhand), India: ICAR-Indian Institute of Natural Resins and Gums, Bulletin (Technical) No. 06/2014, 38 pp.

Zauba Technologies & Data Services Pvt Ltd., n.d. *Detailed Export Data of Boswellia serrata.* [Online]
Available at: https://www.zauba.com/export-boswellia-serrata-hs-code.html
[Accessed 1 6 2015].

Questionnaire on Decision 18.205 on *Boswellia* trees

1. At its 18th meeting (CoP18, Geneva, 2019), the Conference of the Parties adopted Decisions 18.205 to 18.208 on *Boswellia* trees.
2. Decision 18.205 directs the Secretariat to issue a Notification requesting the following information from Parties (and relevant stakeholders):
a) biological data on *Boswellia* species, including population size, distribution, status and population trends, identification information, and its role in the ecosystem in which it occurs;
b) available information about harvest and exploitation levels, trade names, stakeholders close to the harvest of the species and supply chain characteristics for domestic consumption and international trade;
c) information on threats to these species, especially as it pertains to the underlying causes of poor regeneration capability and the impact of harvest on these species;
d) information on any initiatives to artificially propagate these species or produce plantations of them;
e) existing regulations and ownership structures pertaining to the species, their habitat, drivers of habitat trends and management measures in place or under development, including sustainable harvest practices; and
f) suggestions for meetings or other venues that might provide opportunities to collaborate or share information regarding harvest and management of these species.
2. The Secretariat hereby invites Parties and relevant stakeholders to complete the questionnaire included in the Annex to this Notification and submit it to the Secretariat (martin.hitziger@cites.org) by 25 March 2020.
3. The completed questionnaires submitted in response to this Notification will be taken into consideration by the Secretariat in its implementation.

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party: New Zealand	
1b.	Institution: New Zealand CITES Management Authority, Department of Conservation, 18-32 Manners Street, Wellington 6011, New Zealand	
1c.	Contact information of the representative who responded to the questionnaire:	Name: Anastacia Kirk
		Phone: +64 27 403 9269
		Email: cites@doc.govt.nz
		Other: akirk@doc.govt.nz

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

New Zealand is not a range, importing, exporting or re-exporting state for *Boswellia* spp live specimens. Climatic conditions would not support viable specimens and specimens are unlikely to survive outside of a controlled environment. Enquiry with a New Zealand university botany department and botanical institution have indicated that there are no known species of *Boswellia* spp which are being grown within New Zealand. Importation of this genus as seed, live plants or seedlings is prohibited under New Zealand's Biosecurity Act.

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
• N/A	☐	☐	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• N/A	☐	☐	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2d.	For each species occurring in your country, please provide its habitat trends. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• N/A	☐	☐	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2e.	Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed. N/A
2f.	Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed. Climatic conditions unsuitable for this species in New Zealand.
2g.	Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats. N/A

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	N/A	

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use? N/A
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)?
N/A	
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors.
N/A	
3d.	What volume is exported (approximate annual export)?
None.	
3e.	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations.
N/A	
3f.	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations.
N/A	
3g.	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries. No known activity occurring in New Zealand.

<table>
<tr><td colspan="3">3h. What are the challenges to artificially propagate/cultivate Boswellia species in your country?

The genus does not have clearance to be imported into New Zealand as either seed or live plants under the Biosecurity Act. In addition New Zealand’s climate and growing conditions are unsuitable for this species.</td></tr>
<tr><td>3i.</td><td colspan="2">Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.</td></tr>
<tr><td></td><td>File/attachment</td><td>Comments (if any)</td></tr>
<tr><td></td><td>N/A</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

Section 4: Supply chains and international trade (paragraph a), b) and f) of Decision 18.205)

4a.	Who are the predominant legal or customary owners / custodians of *Boswellia*? Government-owned ☐ Local communities ☐ Individual ownership ☐ Community-based or individual land tenure ☐ Please describe the land ownership structure where *Boswellia* spp. occur, including harvest rights.
4b.	If known, please specify who are the main harvesters of *Boswellia* specimens? Individual collectors ☐ Collector associations ☐ Private companies ☐ Other ☐ Please provide further details on the types of harvesters.
4c.	Is there any in-country processing capacity for *Boswellia* specimens? Please describe.
4d.	Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones.
4e.	What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)?

4f.	Which are the main known importing countries of *Boswellia* specimens sourced from your country?
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported.
4h.	What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)?
4i.	What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen.
4j.	Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries.
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded.

4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade.
4m.	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206.

4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a.	Please describe any regulations or management measures in place or in preparation concerning i. The conservation of *Boswellia* populations and/or habitats? ii. The sustainable harvest of *Boswellia* specimens? iii. The export of *Boswellia* specimens? iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.

5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 6. Additional remarks or information

6a.	Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

Thank you very much for your responses!

New Zealand response (submitted by New Zealand CITES Management Authority/New Zealand CITES Scientific Authority [delete as required])

Contact details: New Zealand CITES Management and Scientific Authorities

Department of Conservation, 18-32 Manners Street, Wellington 6011, New Zealand

Email: cites@doc.govt.nz

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party: Slovakia	
1b.	Institution: Ministry of Environment of the Slovak republic, CITES Management Authority	
1c.	Contact information of the representative who responded to the questionnaire:	Name: Silvia Rusnakova
		Phone: +421 917 240 178
		Email: silvia.rusnakova@enviro.gov.sk
		Other:

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

Not native in Slovakia

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
•	☐	☐	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
•	☐	☐	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2d. For each species occurring in your country, please provide its habitat trends. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
•	☐	☐	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2e. Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.

2f. Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.

2g. Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use?
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)?
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors.
3d.	What volume is exported (approximate annual export)?
3e.	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations.
3f.	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations.
3g.	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries.

3h.	What are the challenges to artificially propagate/cultivate *Boswellia* species in your country?	
3i.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 4: Supply chains and international trade (paragraph a), b) and f) of Decision 18.205)

4a.	Who are the predominant legal or customary owners / custodians of *Boswellia*? Government-owned ☐ Local communities ☐ Individual ownership ☐ Community-based or individual land tenure ☐ Please describe the land ownership structure where *Boswellia* spp. occur, including harvest rights.
4b.	If known, please specify who are the main harvesters of *Boswellia* specimens? Individual collectors ☐ Collector associations ☐ Private companies ☐ Other ☐ Please provide further details on the types of harvesters.
4c.	Is there any in-country processing capacity for *Boswellia* specimens? Please describe.
4d.	Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones.
4e.	What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)?

4f.	Which are the main known importing countries of *Boswellia* specimens sourced from your country?
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported.

Regarding international trade, in general, information about *Boswellia* imported is difficult to find out, as this information is too concrete. The customs HS code system does not contain HS code for products containing *Boswellia*. These species occur in several types of products (see below), but are not needed to be mentioned when imported (e.g. we have several imports of essential oils from India, one import from Oman, but without adding any other information. So it is not possible to find out, if such a product contains *Boswellia* or not).

Nevertheless, for time period from 1.1.2018 to 19.3.2020 I have found 2 imports with indication of *Boswellia/*Frankincense*.* The countries of export are Switzerland (with country of origin Somalia) and India.

In national trade (online offer) I have found *Boswellia sacra* and *Boswellia serrata*. As countries of origin were mentioned Erithrea, Oman and India.

4h. What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)?

In international trade - Essential oil

In national trade (online offer) I have found dietary supplements (many kinds) for humans and also animals (dogs), resin, extract from resin, powder, essential oil, aromatic stick, soap, hemorrhoid gel, live plant

4i. What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen.

1. Essential oil deterpenated – 0,3 kg (country of origin Somalia – country of export Switzerland)
2. Essential oil – frankincense oil – 0,3 kg (country of origin and export – India)

4j. Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries.

-

4k. If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded.

Based on results of the short survey of the online national trade offer in Slovakia, I found following names: olibanum, Shallaki, Salai, Hougari, Frankincense, Boswellia resin.		
4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade.	
4m.	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206.	
4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a.	Please describe any regulations or management measures in place or in preparation concerning i. The conservation of *Boswellia* populations and/or habitats? ii. The sustainable harvest of *Boswellia* specimens? iii. The export of *Boswellia* specimens? iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.	
5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 6. Additional remarks or information

6a. Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

As Slovakia is Party, in which *Boswellia* spp. does not naturally occur, the only relevant questions for us are 4g – 4k. Slovakia, as the EU Member State, is Party, in which trade in this genus occurs. In Slovakia are traded also specimens imported via other EU Member State. So I have included also information from our national market.

Thank you very much for your responses!

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party: CITES Scientific Authority	
1b.	Institution: Department of Wildlife Sciences, University of Juba	
1c.	Contact information of the representative who responded to the questionnaire:	Name: Thomas Francis Lado, PhD
		Phone:+211926086097; +211916011765
		Email: jsuliman.lado@gmail.com; lokweh@outlook.com
		Other:

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country: *Boswellia papyrifera*

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
• *Boswellia papyrifera*	☐	☐	☐		☒
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• *Boswellia papyrifera*	☐	☐	☒		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2d. For each species occurring in your country, please provide its habitat trends. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• *Boswellia papyrifera*	☐	☐	☒		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2e. Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.

• *Boswellia papyrifera*
It is a common savanna tree that occurs on rocks or hill slopes in high rainfall savanna, in Bahr El Ghazal, Upper Nile and Equatoria typically on hilly areas with shallow soils of low fertility.

use for furniture
and fodder

Boswellia papyrifera in Sudan

Boswellia
Frankincense is an ancient product more than 4000 years and today,
remains important article commerce on the international market. It is traditionally used as incense in religious or social ceremonies. However, it is in the cosmetic and pharmaceutical industries that the commodity holds great potential for development.

However, there is high rate of ecosystem degradation in this region and, therefore, the populations of Boswellia and Commiphora species in the natural vegetation are declining rapidly [19]. The decline in commercially important tree species with a subsequent deterioration of rural livelihood opportunities has been attributed to ecosystem degradation caused by drought, excessive fuelwood harvesting and overgrazing, as well as to land conversion, improper resin tapping methods and insect damage.

Tribal leaders and local
community members indicated that natural mortality, intensive tapping, continuous tapping without resting period, mis-tapping (deep tapping), and insect attack are the major causes for the decline of the population of the species. There is no supervision of production areas and no management and protection activities being carried out. The local community blames the outsiders/ migrant frankincense producers for the death of Boswellia trees that since they are not permanent residents in the area they tend to maximize yield from trees by making many tapping spots. On the other hand migrant tappers (outsiders) blame the locals for improper tapping and using improper tapping tools.

The species is
plays significant role for economic development and desertification control (Stiles, 1988).

can provide plant cover and protect the soil and provide shade. It also plays an important role in desertification control since it acts as defense line against desert creeping southwards.

2f.	Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.
	Boswellia papyrifera is declining rapidly. There are pockets of the species under general protection in protected areas especially in the mountain zone of the country. It is a common savanna tree that occurs on rocks or hill slopes in high rainfall savanna, in Bahr El Ghazal, Upper Nile and Equatoria typically on hilly areas with shallow soils of low fertility.
2g.	Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.
	Main threats comprise ecosystem degradation, poor natural regeneration, drought, excessive fuelwood harvesting and overgrazing, land conversion, improper resin harvesting methods and insect damage.

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
1.	Adam, A. A. & El Tayeb, A. M. (2008). A comparative study of natural regeneration of B. papyrifera and other tree species in Jebel MArra Darfur Sudan. Research Journal of Agriculture and Biological Sciences 4: 94-102.	
2.	Coppen J.J.W. (1995) Flavors and fragrances of plant origin. Food and Agricultural Organization of the United Nations (FAO). Rome	
3.	Mohammed, M. H. (2012). The status of the world forest genetic resources. Country Report Sudan.	
4.	Stiles D. (1988) Arid and plants for economic development and desertification control. Desertification Control Bulletin 17: 18-21.	

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use?
Boswellia papyrifera.	
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)?
Frankincense/ incense, timber, furniture and fodder.	
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors.
Un known.	
3d.	What volume is exported (approximate annual export)?
Un known.	
3e.	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations.
It is severely affected.	
3f.	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations.
It does.	
3g.	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries.
In the Sudan but not in South Sudan.	

3h.	What are the challenges to artificially propagate/cultivate *Boswellia* species in your country? Lack of funds, political instability and lack of steps to address the matter.	
3i.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
1.	Adam, A. A. & El Tayeb, A. M. (2008). A comparative study of natural regeneration of B. papyrifera and other tree species in Jebel MArra Darfur Sudan. Research Journal of Agriculture and Biological Sciences 4: 94-102.	
2.	Stiles D. (1988) Arid and plants for economic development and desertification control. Desertification Control Bulletin 17: 18-21.	

Section 4: Supply chains and international trade (paragraph a), b) and f) of Decision 18.205)

4a. Who are the predominant legal or customary owners / custodians of *Boswellia*?

Government-owned ☒ Local communities ☐ Individual ownership ☐ Community-based or individual land tenure ☐

Please describe the land ownership structure where *Boswellia* spp. occur, including harvest rights.

Local communities for areas outsides protected areas, and Government for protected areas.

4b. If known, please specify who are the main harvesters of *Boswellia* specimens?

Individual collectors ☒ Collector associations ☐ Private companies ☐ Other ☒

Please provide further details on the types of harvesters.

Other mainly individuals.

4c. Is there any in-country processing capacity for *Boswellia* specimens? Please describe.

No.

4d. Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones.

No data.

4e. What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)?

No clear information.

4f.	Which are the main known importing countries of *Boswellia* specimens sourced from your country?
No information.	
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported.
~~Na~~	
4h.	What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)?
Na	
4i.	What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen.
Unknown.	
4j.	Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries.
Not known	
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded.

4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade.
4m.	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206.

Ministry of Forestry and Environment, Juba, South Sudan.

Ministry of Wildlife Conservation and Tourism, Juba, South Sudan.
University of Juba

Sudan National Forest Corporation (FNC), Khartoum, Sudan.

University of Juba, South Sudan

University of Bahri, Sudan.

University of Zalingi, Sudan

4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Adam, A. A. & El Tayeb, A. M. (2008). A comparative study of natural regeneration of B. papyrifera and other tree species in Jebel MArra Darfur Sudan. Research Journal of Agriculture and Biological Sciences 4: 94-102.	
	Mohammed, M. H. (2012). The status of the world forest genetic resources. Country Report Sudan.	

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a. Please describe any regulations or management measures in place or in preparation concerning

i. The conservation of *Boswellia* populations and/or habitats?

No specific regulation pertaining to that.

ii. The sustainable harvest of *Boswellia* specimens?

No specific regulation pertaining to that.

iii. The export of *Boswellia* specimens?

No specific regulation pertaining to that.

iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.

No specific regulation pertaining to that.

5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 6. Additional remarks or information

6a.	Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

Thank you very much for your responses!

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party: Switzerland	
1b.	Institution: Management Authority of Switzerland and Lichtenstein	
1c.	Contact information of the representative who responded to the questionnaire:	Name: Ursula Moser
		Phone: +41 58 463 8399
		Email: ursula.moser@blv.admin.ch
		Other:

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
•	☐	☐	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
•	☐	☐	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2d.	For each species occurring in your country, please provide its habitat trends. Add rows if needed.					
	Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
•		☐	☐	☐		☐
•		☐	☐	☐		☐
•		☐	☐	☐		☐
2e.	Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.					
2f.	Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.					
2g.	Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.					

<table>
<tr><td>2h.</td><td colspan="2">Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.</td></tr>
<tr><td></td><td>File/attachment</td><td>Comments (if any)</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use?
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)?
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors.
3d.	What volume is exported (approximate annual export)?
3e.	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations.
3f.	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations.
3g.	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries.

<table>
<tr><td colspan="3">3h. What are the challenges to artificially propagate/cultivate Boswellia species in your country?</td></tr>
<tr><td>3i.</td><td colspan="2">Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.</td></tr>
<tr><td></td><td>File/attachment</td><td>Comments (if any)</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

Section 4: Supply chains and international trade (paragraph a), b) and f) of Decision 18.205)

4a.	Who are the predominant legal or customary owners / custodians of *Boswellia*? Government-owned ☐ Local communities ☐ Individual ownership ☐ Community-based or individual land tenure ☐ Please describe the land ownership structure where *Boswellia* spp. occur, including harvest rights.
4b.	If known, please specify who are the main harvesters of *Boswellia* specimens? Individual collectors ☐ Collector associations ☐ Private companies ☐ Other ☐ Please provide further details on the types of harvesters.
4c.	Is there any in-country processing capacity for *Boswellia* specimens? Please describe.
4d.	Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones.
4e.	What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)?

4f.	Which are the main known importing countries of *Boswellia* specimens sourced from your country?
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported. *Boswellia serrata* most of the exports are from EU but the origin is normally India, *Boswellia sacra* most exported from EU but the origin is the African / Arabian region
4h.	What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)? The analyze covers only the year 2018. 1. Incense 51% of all imports 2. Cosmetics 9% 3. Medicine 18% 4. Essential oils 5% 5. Food supplements 17%
4i.	What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen. The analyze covers only the year 2018. 1. Incense 666 kg 2. Cosmetics 259 kg 3. Medicine 118 kg 4. Essential oils 880 kg 5. Food supplements 872 kg
4j.	Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries. The analyze covers only the year 2018. 1. Incense 3672 kg 3. Medicine 2277 kg 4. Essential oils 72 kg 5. Food supplements 396 kg
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded. Indian Frankincense for *Boswellia serrata*
4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade.

4m.	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206.	
4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a.	Please describe any regulations or management measures in place or in preparation concerning i. The conservation of *Boswellia* populations and/or habitats? ii. The sustainable harvest of *Boswellia* specimens? iii. The export of *Boswellia* specimens? iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.	
5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 6. Additional remarks or information

6a.	Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

Thank you very much for your responses!

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party: The United States of America	
1b.	Institution: U.S. Fish and Wildlife Service, Division of Scientific Authority	
1c.	Contact information of the representative who responded to the questionnaire:	Name: Patricia S. De Angelis
		Phone: 703-358-1753
		Email: Patricia_DeAngelis@fws.gov
		Other:

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

Summary/Overview: The United States is not a range country for these species. The United States imports raw materials of *Boswellia* spp. and produces value-added products that are sold domestically as well as exported. Our response below refers to information that was included in document CoP18 Doc. 66 on *Trade in* Boswellia *spp. (Burseraceae)*, and includes additional analysis from our files, input from U.S. industry, and information obtained after the CoP18 document was submitted.

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

In CoP18 Doc. 66 we provided a table of *Boswellia* species and their range (alphabetized by species name). In case it is useful, we provide a list of range countries and the associated species (see Section 6 of the present response).

See also Coppen (1995) (p. 83) for botanical/local names and Brendler et a. (2018) for folk taxonomy.

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
•	☐	☐	☐		☐

See Section 6 for a compilation of IUCN Red List Assessment categorizations. We note that several species (5-6) were recently provisionally reassessed against the Red List criteria (in 2017 and 2018), and we look forward to the review and confirmation so that assessments can be added to the IUCN Red List online database. Information received in response to this Notification might inform the reassessment of remaining species that have not been assessed since 2004 or, in some cases, since 1998.

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
•	☐	☐	☐		☐

2d. For each species occurring in your country, please provide its habitat trends. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
•	☐	☐	☐		☐

2e.	Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.

Pls refer to paras 8, 9, 11 in document CoP18 Doc. 66 for ecological and economic value (role in ecosystem).

Additional information on commodity value:

Market prices for frankincense perfumery oils (European market)

Essential Oil	Origin	2014 (ITC 2014)	2016 (ITC 2016)
Conventional	Somalia/France	$250/kg (~$114/pound)	$270/kg (~$122/pound)
	India (*B. serrata*)	$120/kg (~$55/pound)	-
Organic	Somalia/France	$560/kg(~$255/pound)	$525/kg (~$239/pound)
	India (*B. serrata*)	$ 78/kg (~$35/pound)	-

See also:

- Adhikari 2004 – community resource management in resource dependent rural areas (in Nepal but has concepts that may be applicable to frankincense) Alemu et al. 2012 (Sudan) – see bibliography for more sources of economic value to local communities
- Bantihun & Tesema 2018 (Ethiopia) – see bibliography for more sources of economic value to local communities
- Brendler *et al*. 2018 – information on contributions to local economies
- Coppen 1995 – for 'historical' (25yr old) market characteristics and values
- Eshete 2002 (Ethiopia) – see Table 10 for market value
- Tilahun et al. 2012 (Ethiopia) – mechanisms to incentivize rural demands for conservation

2f.	Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.

Pls refer to para 5 and Annex 1 in document CoP18 Doc. 66, for a compilation of population information, threats, and distribution.

The following publications should be reviewed for additional information on species biology:

- Eshete 2002 – may contain information on the existence of natural seed banks, which has implications both for natural regeneration as well as conservation of germplasm
- Mies *et al*. 2000 – review for information on Yemeni frankincense populations

2g.	Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.

The species in this genus have many intrinsic biological traits (including poor regeneration and high adult mortality) that make them vulnerable to overexploitation (paras 6, 23-26 CoP18 Doc 66).

The main threats are habitat destruction, insect damage, and overexploitation leading to shifting harvest (paras 28-30 and Annex 1). From the information we reviewed, it is not clear that low regeneration is the *result* of harvest (there was at least one study that showed equally poor regeneration in a tapped vs. untapped population), but rather it would appear that low regeneration is a function of the harsh environmental conditions in which these species are found, combined with the impacts of harvest.

See also these publications:

- IUCN Red List assessments provided in Section 6 below as a source of threat information.
- Adam & El-Tayeb 2008 – conducted population studies (as summarized in para 6, CoP18 Doc. 66); may have information on seedling establishment rates (data as opposed to qualitative);
- Bongers *et al*. 2019
- Mengistu 2011 – measured carbon gain in response to tapping and noted greater carbon gain at higher altitudes despite a shorter growing season; suspected that this phenomenon is the result of higher light levels (implies that tapping may differentially affect species depending on their altitude and light levels)
- Mahesh *et al*. 2018 – suggest poor seed vigor, viability, and regeneration may be a result of fragmentation and isolation of populations of the dioecious species
- Vaishnav *et al*. 2019 – genetic work suggesting limited gene flow and "total absence of natural regeneration"

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.

	File/attachment	Comments (if any)
	CoP18 Doc. 66	See: https://cites.org/sites/default/files/eng/cop/18/doc/E-CoP18-066.pdf
	Adam & El-Tayeb 2008 Alemu *et al*. 2012 Bantihun & Tesema 2018 Brendler *et al*. 2018 Coppen 1995 Eshete 2002 ITC 2014 ITC 2016 Mengistu 2011	Fully cited in CoP18 Doc. 66
	Adhikari 2004	Adhikari, B. S. (2004). Household characteristics and forest dependence: evidence from common property forest management in Nepal. *Ecological Economics* 48(2):245-257.
	Da Silva & Da Silva 2018	Da Silva, S. & A. Da Silva. 2018. Pstat: An R Package to Assess Population Differentiation in Phenotypic Traits. *The R Journal* 10(1):447-454. https://journal.r-project.org/archive/2018/RJ-2018-010/RJ-2018-010.pdf
	Mahesh *et al*. 2018	Mahesh *et al*. 2018. Comparison between QST and ϕST indices in an endangered *Boswellia serrata* Roxb: Implications for conservation. Not clear if this was published. Pre-print available at: https://www.biorxiv.org/content/biorxiv/early/2018/10/14/442723.full.pdf
	Mies *et al*. 2000	Mies, BA, JJ Lavaranos, & GJ James. 2000. Frankincense on Soqotra Island. Cactus and Succulent Journal 72:265-278. *Available from ResearchGate.*
	Tilahun *et al*. 2011	Tilahun M, R Olschewski, C Kleinn, & K Gebrehiwot. 2007. Economic analysis of closing degraded *Boswellia papyrifera* dry forest from human interventions: a study from Tigray, Northern Ethiopia. *Forest Policy and Economics* 9:996–1005.
	Vaishnav *et al*. 2019	Vaishnav, A., S. Mahesh, and P. Kumar. 2019. Assessment of genetic structure of the endangered forest species *Boswellia serrata* Roxb. population in central India. *Journal of Tropical Forest Science* 31(2): 200–210 (2019). https://info.frim.gov.my/infocenter_applications/jtfsonline/jtfs/v31n2/200-210.pdf

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a. Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use?

Pls refer to paras 8 and 10-12 in document CoP18 Doc. 66 for information from published references pertaining to harvested species.

Global information indicates that international trade is dominated by four species (with most trade in *Boswellia frereana, B. papyrifera, B. sacra,* and *B. serrata*), with smaller amounts of trade in another three species (*B. neglecta, B. ogadensis , B. ovalifoliolata,* and *B. rivae*). The main commodities in trade appear to be resin, essential oils and alcohol extracts, with smaller trade in bark, wood products, and possibly, live plants. International trade originating from range countries includes raw materials (e.g., resin and essential oils); some finished products are produced in range countries (such as incense, food flavoring, and traditional medicines), but many value-added products are produced by non-range countries (perfumes, cosmetics, and dietary supplements).

As noted in CoP18 Doc. 66, para 25, trade seems to be shifting to other species as it becomes more difficult to obtain in some areas; these shifts may be difficult to detect as it is not clear whether parts and derivatives of *Boswellia* species can be positively identified to the species level.

See also Brendler *et al*. 2018 – summary of harvested items and methods (Table 4)

3b. For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)?

Pls refer to paras 8-12, as well as para 14 on general international trade patterns in CoP18 Doc. 66.

3c. For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors.

Pls refer to para 10 in document CoP18 Doc. 66 for information from published references pertaining to both production potential and some harvest data. These global data include some regional and country-level data, and current and older data that could be evaluated together with additional input Parties may provide through this Notification.

- There has been some research on sustainable production but the parameters and methodologies vary (DeCarlo & Ali 2004; Groenendijk *et al*. 2012; Hassan Alaamri 2012; Paramanik *et al*. 2012).
- Important to note that 'production potential' is different from sustainable harvest volume (with the latter figure being presumably lower).
- Older harvest and trade data provide useful baseline information that can be used to compare and view the changing supply and demand for this commodity (both in terms of volumes and source country) (e.g., Coppen 1995).

See also

- Brendler *et al*. 2018 – 1996-2002 Indian *Boswellia serrata* gum collection data and analysis (Tables 2 & Table); and production potential information (in the last two paragraphs of Brendler *et al*.'s section 3.7)
- Tolera *et al*. 2013 – provide important observations on resin yield over time (both in terms of seasons and in terms of years of consecutive harvest)
- CBI 2018 – information on the European market for *Boswellia*
- IDB & FAO 2018 – gross production volume in Somalia, 1986-2017 (Table 1.3), showing no production until 2013-2017 period (none from 1986-2012), due to high-value international demand

3d. What volume is exported (approximate annual export)?

Pls refer to para 16 in document CoP18 Doc. 66.

See also additional sources of trade data:

- The Indian Institute of Natural Resins & Gums (ICAR) (https://iinrg.icar.gov.in/) - publishes annual statistics
- Zauba (https://www.zauba.com/) – maintains import/export data
- Brendler *et al*. 2018 – for additional sources of trade information (see material and Methods); 2015-2017 Indian olibanum exports, both tonnage and values (Table 1); as well as a detailed analysis of global trade data for *Boswellia serrata* (Brendler *et a*l.'s section 3.7)

3e.	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations.	
Pls see paras 23-26 in document CoP18 Doc. 66, and refer to citations therein for additional information.		
3f.	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations.	
See above.		
3g.	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries.	
Pls refer to paras 4 and 7 in document CoP18 Doc. 66, for some information on age to produce resin and generation times.		
3h.	What are the challenges to artificially propagate/cultivate *Boswellia* species in your country?	
Pls refer to para 7 in document Cop18 Doc. 66 for some basic cultivation information, as well as refer to the citations for publications that describe difficulties		
3i.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Brendler *et al*. 2018 DeCarlo & Ali 2004 Groenendijk *et al*. 2012 Hassan Alaamri 2012 Paramanik *et al*. 2012	Fully cited in CoP18 Doc 66
	CBI 2018	CBI (The Centre for the Promotion of Imports). 2018. Exporting frankincense to Europe. Netherlands Ministry of Foreign Affairs. At: https://www.cbi.eu/market-information/natural-ingredients-health-products/frankincense/
	IDB & FAO 2018	IDB & FAO. 2018. SOMALIA: Rebuilding Resilient and Sustainable Agriculture. FAO & World Bank. At: http://www.fao.org/3/I8841EN/i8841en.pdf
	Tolera *et al*. 2013	Tolera, M., D. Menger, U. Sass-Klaassen, F.J. Sterck, P. Copini, & F. Bongers. 2013. Resin secretory structures of *Boswellia papyrifera* and implications for frankincense yield. *Annals of Botany* 111(1):61-18.

Section 4: Supply chains and international trade (paragraph a), b) and f) of Decision 18.205)

4a. Who are the predominant legal or customary owners / custodians of *Boswellia*?

Government-owned ☐ Local communities ☐ Individual ownership ☐ Community-based or individual land tenure ☐

Please describe the land ownership structure where *Boswellia* spp. occur, including harvest rights.

Not applicable to the United States; we have no domestic *Boswellia* species.

4b. If known, please specify who are the main harvesters of *Boswellia* specimens?

Individual collectors ☐ Collector associations ☐ Private companies ☐ Other ☐

Please provide further details on the types of harvesters.

Not directly applicable, but see:

- Eshete 2002 (Ethiopia) –Table 8 for information on the numbers or tappers and processers involved in *Boswellia* resin production

4c. Is there any in-country processing capacity for *Boswellia* specimens? Please describe.

Not applicable.

4d. Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones.

Not applicable.

4e. What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)?

Not applicable for United States.
According to Brendler *et al*. (2018), India is the only country known to be both producing and exporting frankincense, exporting about 100 metric tons annually and producing more than 100 metric tons annually for domestic consumption. Please see para 14 in CoP18 Doc. 66 for global trade characteristics.

4f. Which are the main known importing countries of *Boswellia* specimens sourced from your country?

Pls refer to section 3.d of this response for the names of databases that will include such information.

4g. Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported.

- *Boswellia sacra* from France (under synonym *B. carteri*) (George Bouboulis, Director, International Trade & Regulatory Affairs, Personal Care Products Council, March 12, 2020)
- *Boswellia serrata* mainly from India (Brendler *et al*. 2018; pers. comm., Bouboulis 2020; pers. comm. Michael McGuffin, President, American Herbal Products Association, March 16, 2020; pers. comm., Josef A. Brinckmann, Research Fellow, Traditional Medicinals, March 3, 2020); data from Zauba provide additional information on raw material sellers that are based in various other countries, but that appear to be sourcing the material from India.

4h. What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)?

- *Boswellia sacra*: We continue to gather information on these imports and will provide an update at the next meeting of the Plants Committee.
- *Boswellia serrata*: oleoresin gum and essential oil (Brendler *et al*. 2018)
- *Boswellia serrata*: extract, variously described as powder, granules, 65%, or water soluble (ZAUBA 2012-2019)

The following requires further discussion and analysis, but these terms appear to describe specimens in trade:

- *Boswellia* raw materials = extract, essential oil
- *Boswellia* products = granules, incense cones, logs or dhoops (see Brendler *et al*., 2018)

4i.	What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen.

Brendler *et al*. (2018) provide a detailed analysis and discussion of global trade in *Boswellia serrata*, reporting that the United States imported just over 3 metric tons in 2015-2016 and 4 metric tons in 2016-2017. We do not have import figures for *B. sacra*, but will provide any updates at the next meeting of the Plants Committee.

See para 15 in CoP18 Doc. 66 regarding difficulties of characteristics calculating international trade in *Boswellia* parts and derivatives, such as imprecise customs codes.

4j.	Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries.

The primary market for *Boswellia* products in the United States is for dietary supplements* (Meins *et al*. 2016; McCutcheon 2018). *Boswellia serrata* essential oil and oleoresin gum are imported from India for use in dietary supplements (Brendler *et al*. 2018). *Boswellia carteri* (syn. *B. sacra*) and *Boswellia serrata* are imported for use in personal care products.

The United States produces value-added finished products from imported material that are sold domesticallyas well as exported. We continue to gather information on volumes and destination markets and will provide an update at the next meeting of the Plants Committee.

*Note that the United States regulates plant-derived consumptive products as dietary supplements; the U.S. Food and Drug Administration regulates dietary supplements under the Good Manufacturing Practices, codified in U.S. regulations 21 CFR 111.

4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded.

The U.S. legal labelling requirements are also dictated by law and differ depending on whether the material will be consumed. Under U.S. law, the use of common names for botanical ingredients in **dietary supplements labeling** must follow the guidance included in the publication Herbs of Commerce (21 CFR Part 101 Food Labeling; AHPA 1991 & 2000), and **cosmetic labeling** must follow the International Cosmetic Ingredient (INCI) Dictionary and Handbook (21 CFR Part 701).

- Accordingly, for dietary supplements marketed in the United States, U.S. law dictates that the common name “frankincense” may only legally be used on labels of products containing *Boswellia sacra* as a component ingredient, as recorded in Herbs of Commerce 2nd edition (AHPA 2000).
- Similarly, for cosmetic ingredients, *Boswellia carteri, Boswellia frereana, Boswellia sacra,* and *Boswellia serrata* are included in the naming guidelines for product labels under the International Nomenclature of Cosmetic Ingredients (INCI) system that is followed by the fragrance, cosmetic, and personal care products industries in many major markets, including the United States of America, Canada, [1] Europe,[2] China,[3] Japan,[4] and many other countries. Various ingredients include absolute, oil, gum, extract, resin extract, leaf cell extract, and gum extract.

The INCI names (for cosmetic ingredients) related to *Boswellia* are listed below. Note that just because there is an INCI name does not mean the ingredient is currently in use (pers. comm. Bouboulis 2020).

Boswellia Carterii Bark Powder	Boswellia Sacra Resin Oil
Boswellia Carterii Gum Extract	Boswellia Sacra Resin Water
Boswellia Carterii Gum Water	Boswellia Serrata Extract
Boswellia Carterii Oil	Boswellia Serrata Gum
Boswellia Carterii Resin Extract	Boswellia Serrata Gum Extract

[1]Health Canada INCO Compliance and Enforcement Policy: http://www.hc-sc.gc.ca/cps-spc/legislation/pol/compliance-inci-conformite-eng.php
[2] European Commission *Health and Consumers*: http://ec.europa.eu/consumers/sectors/cosmetics/cosing/ingredients/index_en.htm
[3] Chemical Inspection & Regulation Service (China): http://www.cirs-reach.com/Cosmetic_Inventory/International_Nomenclature_of_Cosmetic_Ingredients_INCI.html
[4] Japan Cosmetic Industry Associations Application for Japanese Labeling Name: http://www.jcia.org/n/en/jcia/e/

Boswellia Frereana Resin Boswellia Frereana Resin Oil Boswellia Neglecta Resin Oil Boswellia Papyrifera Resin Oil Boswellia Papyrifera/Sacra/Serrata Resin Extract Boswellia Sacra Gum/Resin Extract	Boswellia Serrata Leaf Cell Extract Boswellia Serrata Oil Boswellia Serrata Resin Extract Boswellia Serrata Water Olibanum

4l. If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade.

For products on the U.S. market, see legal labelling requirements described under Section 4k, legally requiring the species names be used on the product labels.

For live plants, variation in leaf shape, number and size of leaflets can be used to distinguish among the East African species: *B. papyrifera, B. rivae, B. neglecta,* and *B. microphylla*; a confounding issue is, trees are deciduous (Abiyu et al. 2010) and spend much of the year leafless (Mugah et al. 1997). For specimens in trade, it is not clear to what degree chemical variation can distinguish *Boswellia* commodities to the species level. In addition, there is a potential for adulteration using other, lesser-valued *Boswellia* species (McCutcheon 2018).

See these publications for information on diagnostic characteristics:

- Brendler *et al*. 2018 – chemical
- Mathe *et al*. 2004 – chemical
- Miens *et al*. 2016 – chemical
- Mugah *et al*. 1997 - morphological
- Thulin & Warfa 1987 - morphological

4m. If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206.

- The research and team of experts mentioned in Information Document CoP18 Inf. 53
- The Network for Natural Gums and Resins in Africa Network for Natural Gums and Resins in Africa (NGARA): A regional network of sub-Saharan Africa gum and resin-producing countries that includes 14 *Boswellia* range states: Burkina Faso, Chad, Eritrea, Ethiopia, Kenya, Mali, Mauritania, Niger, Nigeria, Senegal, Somalia, Sudan, Tanzania and Uganda.
- Country expert/India: Dr. Ghaza Shahabuddin - atghazalafarzin@yahoo.com - Centre for Ecology, Development and Research (CEDAR)

4n. Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.

	File/attachment	Comments (if any)
	Brendler *et al*. 2018 McCutcheon 2018 Miens *et al*. 2016 Mugah *et al*. 1997 Thulin & Warfa 1987	Fully cited in CoP18 Doc. 66
	AHPA 1992 & 2000	AHPA (American Herbal Products Association). 1992 & 2000. Herbs of Commerce. First Edition & Second Edition. American Herbal Products Association: Silver Spring, MD.
	Mathe *et al*. 2004	Mathe C, G Culioli, P Archier & C Vieillescazes. 2004. High-performance liquid chromatographic analysis of triterpenoids in commercial frankincense. *Chromatographia* 60(9/10):493-499.

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a. Please describe any regulations or management measures in place or in preparation concerning

i. The conservation of *Boswellia* populations and/or habitats?

See para 7 in document CoP18 Doc. 66 in reference to species found in protected areas.

See also:

- Brendler *et al*. 2018 (India) summarizes history of regulations that have pertained to *Boswellia* in India (from Yogi et al. 2014)
- Botanic Garden Conservation International *GlobalTreeSearch* for *ex situ* collections

ii. The sustainable harvest of *Boswellia* specimens?

Pls see para 9 in CoP18 Doc. 66 for published references that describe the traditional harvest methods, where sustainable harvest has been characterized by seasonal harvest with periods of no harvest appear to be key to sustainability.

See para 30 in CoP18 Doc. 66 on Overtapping for what *not* to do.

See also:

- Sommerlatte n.d. – (Kenya/home to *B. neglecta, B. rivae*) has a FairWild certified harvest program (see also film and research safari)
- Ebuen 2016 (Oman/*Boswellia sacra*) - a multi-year project to determine sustainable harvest rates
- Murali 1995 (India) – impact of harvest by Soliga tribe in Biligiri Rangaswamy Temple Wildlife Sanctuary on regeneration, population structure

iii. The export of *Boswellia* specimens?

Not applicable.

iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.

Please see:

- Smuel *et al*. 2013 – seed regions in Yemen (implications for restoration and management)
- The genetics references mentioned in Section 2 of this response.

5b. Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.

	File/attachment	**Comments (if any)**
	Brendler *et al*. 2018 Ebuen 2016 Sommerlatte n.d.	Fully cited in CoP18 Doc 66
	Smuel *et al*. 2013	Smuel, L, P. Madera, D. Volarik, B. Vrskovy, and H. Habrova. First Proposal of Seed Regions for Frankincense Trees (Boswellia Spp.) On Socotra Island. *Journal of Landscape Ecology* 6(3):35-45. *Available from ResearchGate.*
	Murali 1995	Murali, KS, U. Shankar, RU Shaanker, KN Ganeshaiah, & KS Bawa. 1995. Extraction of non-timber forest products in the Forests of Biligiri Rangan Hills, India: Impact of NTFP extraction on regeneration, Population structure, and species composition. *Economic Botany* 50(3) pp. 252-269. At: see article

Section 6. Additional remarks or information

6a. Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

IUCN Red List Categorizations (by species)

Boswellia ameero:

VU 1998: Oldfield, S., Lusty, C. and MacKinven, A. (compilers). 1998. The World List of Threatened Trees. World Conservation Press, Cambridge, UK.

VU 2004: Miller, A. 2004a. *Boswellia ameero*. *The IUCN Red List of Threatened Species* 2004: e.T30414A9546504. http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T30414A9546504.en. Downloaded on 28 November 2018.

VU 2017: IUCN Red List assessment carried out at the 18th Annual Sharjah International Conservation Forum for CMEP (Centre for Middle Eastern Plants) (February 2017; RBG, Edinburgh; unpublished).

***Boswellia bullata*:**

VU 2004: Miller, A. 2004b. *Boswellia bullata*. *The IUCN Red List of Threatened Species* 2004: e.T44812A10950015. http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T44812A10950015.en. Downloaded on 28 November 2018.

EN 2017: unpublished, CMEP 2017 (as above)

***Boswellia dioscorides*:**

VA 2004: Miller, A. 2004c. *Boswellia dioscoridis*. *The IUCN Red List of Threatened Species* 2004: e.T44813A10950138. http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T44813A10950138.en. Downloaded on 28 November 2018.

LC 2017: unpublished, CMEP 2017 (as above)

***Boswellia elongata*:**

VU 1998: Oldfield, S., Lusty, C. and MacKinven, A. (compilers). 1998. The World List of Threatened Trees. World Conservation Press, Cambridge, UK.

VU 2004: Miller, A. 2004d. *Boswellia elongata*. *The IUCN Red List of Threatened Species* 2004: e.T30415A9546667. http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T30415A9546667.en. Downloaded on 28 November 2018.

VU 2017: unpublished, CMEP 2017 (as above)

***Boswellia nana*:**

E 1998: Walter, K.S. and Gillett, H.J. [eds] (1998). *1997 IUCN Red List of Threatened Plants*. Compiled by the World Conservation Monitoring Centre. IUCN - The World Conservation Union, Gland, Switzerland and Cambridge, UK. lxiv + 862pp

VU 2004: Miller, A. 2004e. *Boswellia nana*. *The IUCN Red List of Threatened Species* 2004: e.T44814A10950258. http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T44814A10950258.en. Downloaded on 28 November 2018.

VU 2017: unpublished, CMEP 2017 (as above)

Boswellia ogadensis

VU 1998a: Oldfield, S., Lusty, C. and MacKinven, A. (compilers). 1998. The World List of Threatened Trees. World Conservation Press, Cambridge, UK.

E 1998b: Walter, K.S. and Gillett, H.J. [eds] (1998). *1997 IUCN Red List of Threatened Plants*. Compiled by the World Conservation Monitoring Centre. IUCN - The World Conservation Union, Gland, Switzerland and Cambridge, UK. lxiv + 862pp

CR 2005: Vivero, J.L., Kelbessa, E. & Demissew, S. (2005). The Red List of Endemic Trees & Shrubs of Ethiopia and Eritrea. Fauna and Flora International, Global Trees Campaign, IUCN.

CR 2018: Alemu, S., Alemu, S., Atnafu, H., Awas, T., Belay, B., Demissew, S., Luke, W.R.Q., Mekbib, E., Nemomissa, S. & Bahdon, J. 2018a. *Boswellia ogadensis*. *The IUCN Red List of Threatened Species* 2018: e.T34385A128140745. http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T44814A10950258.en. Downloaded on 29 November 2018.

Boswellia ovalifoliolata

I 1998: Walter, K.S. and Gillett, H.J. [eds] (1998). *1997 IUCN Red List of Threatened Plants*. Compiled by the World Conservation Monitoring Centre. IUCN - The World Conservation Union, Gland, Switzerland and Cambridge, UK. lxiv + 862pp

VU 2015: Saha, D., Ved, D., Ravikumar, K. & Haridasan, K. 2015. *Boswellia ovalifoliolata*. *The IUCN Red List of Threatened Species* 2015: e.T50126567A50131280. http://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T50126567A50131280.en. Downloaded on 29 November 2018.

Boswellia pirottae

LR/nt 1998a: Oldfield, S., Lusty, C. and MacKinven, A. (compilers). 1998. The World List of Threatened Trees. World Conservation Press, Cambridge, UK.

R 1998b: Walter, K.S. and Gillett, H.J. [eds] (1998). *1997 IUCN Red List of Threatened Plants*. Compiled by the World Conservation Monitoring Centre. IUCN - The World Conservation Union, Gland, Switzerland and Cambridge, UK. lxiv + 862pp

VU 2005: Vivero, J.L., Kelbessa, E. & Demissew, S. (2005). The Red List of Endemic Trees & Shrubs of Ethiopia and Eritrea. Fauna and Flora International, Global Trees Campaign, IUCN.

VU 2018: Awas, T., Belay, B., Demissew, S., Nemomissa, S., Mekbib, E., Atnafu, H., Alemu, S. & Alemu, S. 2018. *Boswellia pirottae*. *The IUCN Red List of Threatened Species* 2018: e.T34394A128137387. http://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T50126567A50131280.en. Downloaded on 29 November 2018.

Boswellia popoviana

VU 1998: Oldfield, S., Lusty, C. and MacKinven, A. (compilers). 1998. The World List of Threatened Trees. World Conservation Press, Cambridge, UK.

VU 2004: Miller, A. 2004f. *Boswellia popoviana*. *The IUCN Red List of Threatened Species* 2004: e.T37866A10082448. http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T37866A10082448.en. Downloaded on 29 November 2018.

VU 2017: unpublished, CMEP 2017 (as above)

Boswellia rivae

LC 2018: Alemu, S., Alemu, S., Atnafu, H., Awas, T., Bahdon, J., Belay, B., Demissew, S., Luke, W.R.Q., Mekbib, E., Musili, P. & Nemomissa, S. 2018b. *Boswellia rivae*. *The IUCN Red List of Threatened Species* 2018: e.T128044164A128044176. http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T37866A10082448.en. Downloaded on 29 November 2018.

Boswellia sacra

NT 1998a: Oldfield, S., Lusty, C. and MacKinven, A. (compilers). 1998. The World List of Threatened Trees. World Conservation Press, Cambridge, UK.

NT 1998c: Thulin, M. 1998. *Boswellia sacra*. *The IUCN Red List of Threatened Species* 1998: e.T34533A9874201. http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T34533A9874201.en. Downloaded on 29 November 2018.

Boswellia serrata

CR 2012/Sri Lanka: MOE (Ministry of the Environment). 2012. The National Red List 2012 of Sri Lanka; Conservation Status of the Fauna and Flora. Ministry of Environment, Colombo, Sri Lanka. viii + 476pp. [*B. serrata* Critically Endangered-Possibly Extinct]

R 2016/India: Modi, R. K., and P. Mathad. 2016. Floristic diversity with reference to rare and threatened plants from the forest of Yadgir District, Karnataka, India. International Journal of Scientific Research in Science, Engineering and Technology 2(4): 2394–4099

Boswellia socotrana

VU 1998: Oldfield, S., Lusty, C. and MacKinven, A. (compilers). 1998. The World List of Threatened Trees. World Conservation Press, Cambridge, UK.

VU 2004: Miller, A. 2004g. *Boswellia socotrana*. *The IUCN Red List of Threatened Species* 2004: e.T30416A9546843. http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T30416A9546843.en. Downloaded on 29 November 2018.

Thank you very much for your responses!

You're welcome!

Additional information from the American Herbal Products Association (AHPA) pertaining to the use of *Boswellia* in the U.S. dietary supplements industry (received March 28, 2020)

AHPA process for obtaining information

AHPA's membership consists of over 300 companies in the herbal products industry, including several who serve as ingredient suppliers. In response to your request for information we contacted only those ingredient suppliers known to provide ingredients derived from *Boswellia* to the U.S. market. Four such companies provided responses to at least some of the questions posed in Section 4 of the Questionnaire; these responses are consolidated below. Although we did not complete an exhaustive market survey it's our understanding that these four companies represent among them the largest portion of the *Boswellia* supply for finished dietary supplement products sold in the U.S.

Interest limited just to *Boswellia serrata* from India

All four AHPA member respondents reported they sell ingredients derived from *Boswellia serrata* and do not use any other species in the genus for any commercial purpose. All reported their supply to be obtained in India, mainly from the State of Madhya Pradesh.

Though probably apparent, none of the respondents reported harvest of U.S. domestic *Boswellia*, since the genus is not known to be present in the U.S.

Question 4a. Predominant legal or customary owners / custodians

Respondents reported the *Boswellia serrata* trees from which resin is produced are government owned or owned by local communities or through community-based land tenure. Government ownership is reported to be predominant in Madhya Pradesh though the trees are also owned by the tribal families and inherited and gifted to a bride and groom during marriage. Thus, individual tribal collectors of *B. serrata* have inherited or been assigned by their communities a certain number of trees which they tap, harvest, and maintain. Under existing Indian government acts, only tribal populations living in the forest areas can tap and collect the gum and non-tribal outsiders do not have access to these activities.

One respondent to AHPA's request for information in this matter reported that it obtains *Boswellia serrata* gum resin both from wild populations and from artificially propagated plantations, some of which are as much as 20 years old.

Question 4b. Main harvesters of *Boswellia* specimens

Respondents reported that harvest of *Boswellia serrata* resin is done by individual collectors and by collector associations (tribal societies). One noted this practice has gone on for many centuries in the rural communities in which the trees are found, another that a large number of tribal populations depend on *Boswellia* harvest for their livelihood, and a third reported that harvest practice is passed down within individual families over several generations.

One respondent to AHPA's request for information in this matter stated that after tapping and collection, the harvested gum resin is aggregated by local tribal traders who in turn supply the material to licensed larger vendors. This respondent also stated that these vendors work in coordination with harvesters and forest authorities to provide capacity building in the form of training of activities such as sampling and testing, identification, harvesting techniques, storage, supply capabilities, etc.

Question 4c. In-country processing capacity
To the best of AHPA's knowledge there is no processing of ingredients derived from *Boswellia* spp. within the U.S. The only domestic manufacturing operations known are finished product production in forms such as capsules and tablets that contain *Boswellia* ingredients.

Respondents to AHPA's request for information in this matter reported that there is some limited processing in locales in India near where *Boswellia serrata* resin is harvested, which may be limited just to collectors themselves drying and processing the collected resin in the area of collection. Further processing in the form of manufacturing extracts of the resin, usually standardized to specific levels of boswellic acid, is reported to occur elsewhere in India.

Question 4d. U.S. companies that process and / or trade in *Boswellia* specimens
As stated in 4c, AHPA is not aware of any companies that process *Boswellia* ingredients in the U.S.

Of possible related interest, a search for the term "Boswellia serrata" on March 28, 2020 at the Dietary Supplement Label Database maintained by the Office of Dietary Supplements and the National Library of Medicine (http://www.dsld.nlm.nih.gov/dsld/) identified 525 (five hundred twenty-five) individual products as containing this ingredient. While this website is useful for identifying supplement products in the U.S. market, there are several considerations to keep in mind:

1. The database counts each separate package size and form individually. For example, a product identified as "CVS Health Triple Strength Glucosamine Chondroitin With MSM" makes up four entries, including packages of 40, 80, 100 and 120 caplets.

2. There are numerous duplicate entries in the database. For example, a product identified as "Solgar #7" makes up eight entries, including packages of 3, 7 (listed twice), 30 (listed twice), 60 and 90 (listed twice) vegetable capsules.

3. Though the database provides some indication of the breadth of products in the U.S. market that contain *Boswellia serrata* as an ingredient, some of the listed product may contain only a very small amount of this ingredient. The most

common amount labeled on most listed products though is 100 mg of an ingredient, usually identified as gum resin or an extract of the gum resin.

Of possibly additional use in trying to estimate the prominence of *Boswellia serrata* as an ingredient in U.S.-marketed supplement products, the same search at the Dietary Supplement Label Database identifies only six products that identify *Boswellia serrata* in the product name. These products may therefore include *Boswellia* as the primary ingredient.

A search of this database for the term “Boswellia” on the same date identified 620 (six hundred twenty) individual products recorded as containing this ingredient. Logically, this includes the 525 products identified with “Boswellia serrata” as the search term. A review of a representative portion of the labels of the other products returned by this search found these to label the relevant ingredient as “Boswellia” and identified no products that claimed to contain any other species of *Boswellia*. It therefore appears that only *B. serrata* is currently marketed in the U.S. as a dietary supplement ingredient.

Of additional interest, a Market Report published in October 2019[1] provides sales data that indicates that herbal supplement sales in the U.S. increased by 9.4% overall in 2018. The greatest growth was reported in the direct sales channel (+11.8%), followed by the mass market channel (+7.6%) and the natural and health food channel (+6.9%). This report ranks Boswellia (*B. serrata*) as the 28th highest volume botanical in 2018 in the mass channel, but records the 2018 sales of $9.63 million as a 34.2% reduction from the prior year – thus, in a year that herbal supplement sales increased overall in this channel the market for Boswellia was significantly reduced. Regarding the other two channels, Boswellia did not appear in the top 40 selling herbal supplements in the natural channel, and no such detailed data is provided in this article for the direct sales channel.

[1 Smith T. et al. October 2019. Herbal supplement sales in the US increase by 9.4% in 2018. *HerbalGram* 123:62-73.]

Question 4e. Main *Boswellia* specimens exported
To the best of AHPA’s knowledge there is at most very limited export of *Boswellia* from the U.S. and any export is probably limited just to sales of finished products that contain *B. serrata* as an ingredient.

Question 4f. Main importing countries for U.S. *Boswellia* exports
As noted at 4e, exports of *Boswellia* from the U.S. is likely very limited. AHPA has no information as to the identity of the countries to which these exports are provided.

Question 4g. *Boswellia* species imported
To the best of AHPA’s knowledge and based on the information provided by the four respondents to AHPA’s request for information in this matter, only *B. serrata* is

imported for use as an ingredient in dietary supplement products, and is generally imported in the form of an extract of the gum resin. AHPA has been informed that imports are likely exclusively, and are at least primarily exports of India.
AHPA was informed by one respondent that the crude gum (usually called frankincense or olibanum or gum luban) of various other species of *Boswellia* (e.g., *B. carterii*; *B. papyrifera*; etc.) may be imported into the U.S. from India, Africa and the Middle East, for use as incense or in cosmetics. AHPA has no additional information on imports of any *Boswellia* species for such commercial uses.

Question 4h. Main *Boswellia* specimens imported
It is AHPA's understanding that the only *Boswellia* specimens imported into the U.S. for use as dietary supplement ingredients consist of the gum resin and gum resin extract of *B. serrata*.

As noted immediately above, AHPA was informed by one respondent that the crude gum (usually called frankincense or olibanum or gum luban) of various other species of *Boswellia* (e.g., *B. carterii*; *B. papyrifera*; etc.) may be imported into the U.S. from India, Africa and the Middle East, for use as incense or in cosmetics.

Question 4i. Approximate U.S. import volume of *Boswellia* specimens
Based on data provided by respondents, approximately 100 metric tons of *Boswellia serrata* gum resin extract was imported into the U.S. from India over the last several years, with ~88 metric tons imported in 2017 and ~126 metric tons imported in 2018 (last year for which data is available).

AHPA has no information on the volume of imports from India or elsewhere of any other article derived from this or any other species of *Boswellia*.

Question 4j. Re-export of *Boswellia* specimens from the U.S.
As stated elsewhere, it is AHPA's understanding that any re-export from the U.S. of *Boswellia* is likely limited only to export of finished dietary supplements that contain *Boswellia serrata* gum resin extract as an ingredient. AHPA has no data to approximate the quantity of any such exports.

Question 4k. Common trade / product names in international commerce
Boswellia serrata gum resin extract is sold under several trade names, including BosPure® (Arjuna Natural LLC); Casperome® (Indena S.p.A.); AprèsFlex® and 5-LOXIN® (PLT Health Solutions); Boswellin® (Sabinsa Corp.); and WokVel® (Verdure Sciences), among others.

Question 4l. Tools to identify *Boswellia* specimens in trade
Boswellia serrata specimens are identified *in situ* taxonomically and morphologically. Identification of articles in trade, such as gum resin extract, are identified with various chromatographic analyses (e.g., HPLC and HPTLC) and DNA fingerprinting may also be

available. Extracts that are standardized to specific levels of boswellic acid can be analyzed with reference standards available from Sigma-Aldrich (MilliporeSigma; Merck Group).

Question 4m. Stakeholder groups

One respondent to AHPA's request for information in this matter identified two stakeholder groups that may be able to aid the Secretariat in the implementation of Decision 18.206 as the National Medicinal Plants Board (NMPB) India, and the National Biodiversity Authority (NBA) India.

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party: Hilary Sommerlatte		
1b.	Institution: Arbor Oils of Africa		
1c.	Contact information of the representative who responded to the questionnaire:	Name:Hilary Sommerlatte	
		Phone: +254 714053917	
		Email: info@oilsafrica.com	
		Other: hilary@oilsafrica.com	

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

Boswellia neglecta, Boswellia rivae, Boswellia microphylla

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
• *Boswellia neglecta*	☒	☐	☐		☐
• *Boswellia rivae*	☐	☐	☐		☒
• *Boswellia microphylla*	☐	☐	☐		☒

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• *Boswellia neglecta*	☐	☐	☐		☒
• *Boswellia rivae*	☐	☐	☐		☒
• *Boswellia microphylla*	☐	☐	☐		☒

2d.	For each species occurring in your country, please provide its habitat trends. Add rows if needed.						
	Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
	• *Boswellia neglecta*	☐	☐	☐		☒
	• *Boswellia rivae*	☐	☐	☐		☒
	• *Boswellia microphylla*	☐	☐	☐		☒

2e. Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.

Habitat**:** *Boswellia neglecta* is often found in woodlands on the rocky larva slopes at the base of mountainous areas. (personal observations) It also occurs on red sandy well drained soils 200 - 1,350m above sea level and 250–600mm rainfall. (Beentje 1994).

Boswellia sp. role in ecosystem: After the rains the leaves fall to the ground and provide fodder for wild life and livestock. Sweat bees make their hives in the hollows in the trunk and use the resin to make propolis. Hornbills will also use hollows in the trunk to nest. (Sommerlatte interviews with collectors, Hassan *et al*. 2011)

Because most of the grasses and herbs are grazed down by the livestock or dried out in the drought periods, the *Burseraceae* species, are vital in holding the soil with their root systems, and protecting it from erosion.

2f. Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.

Boswellia neglecta is widespread in East Africa. In Kenya,it occurs in the dry *Acacia-Commiphora* bushland K1,2,34,7 between 200-1350m (Distribution map, Beentje 1994) and where it occurs it is usually the dominant species (Sommerlatte observations).

Population status - variable according to different reports done on population studies. Luvanda *et al.* 2014 reported that in Wajir county the area covered by Boswellia trees was 278,040 hectares and made up 45% of the composition of the total number of gum producing trees , (*Commiphora holtziana* 18%, *C.myrrha* 7%, *C.candidula* 30%, *Acacia Senegal* 0%.) Densities of *B. neglecta* ranged from 25 trees /hectare to 203 tree/hectare . Muga *et al.* 2014 recorded *B. neglecta* densities in Baragoi, Samburu district, as 175/hectare and in Garbatula, Isiolo District as 662/hectare.

Luvanda *et al.* 2014 maintained that all the gums and resin species in Wajir district were characterized by poor regeneration. However one area Khorof Harar should high populations of 30%, of young trees.

Boswellia neglecta trees are well adapted to varying climatic changes as they have a capacity to form two growth rings per year,which coincide with the two wet seasons. This suggests the tree can respond quickly when moisture becomes available to tide it over drought periods. (Mokria 2016)

Note* (*Commiphora candidula* is a synonym for *Commiphora incisa*, a very abundant *Commiphora* tree, (Beentje 1994) which is not harvested for resins (Sommerlatte).

Boswellia microphylla is limited to Mandera and Wajir districts in Kenya. In one area, Wajir Bo population densities were measured as 144 trees/hectare. (Luvanda *et al.* 2014).

Boswellia rivae is limited to Mandera district. (Luvanda *et al*. 2014,). It can regenerate by rooting at the areas where the horizontal branches touch the ground, giving rise to new trees (Kagombe 2002)

Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.

2g. The main threats to all dryland species, including *Boswellia*, in pastoralist areas in Kenya are increasing livestock and human populations and droughts which have a negative effect on regeneration (Luvanda *et al.* 2014; Hassan *et al.* 2011). However having said that, Luvanda *et al.* 2014 reported that around the densely

populated town of Wajir where there was massive vegetation degradation, population densities of *Boswellia neglecta* were measured as 88 trees/hectare

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Beentje H.(1994) Kenya Trees and Shrubs National Museums Kenya.	not attached
	Hassan B.A., Glover E.K. Luukkanen O., Chikamai B., Jamnadass R., Liyama M., Kanninen M. 2011. The role of *Boswellia* and *Commiphora* species in rural livelihood security and climate change adaptation in the Horn of Africa: Case Study North-Eastern Kenya. Journal of Social Forestry. 4(1):86-112	not attached.
	Luvanda A.M., Choge S.K., Chikamai B.N. 2014. An Assessment of the Distribution of Natural Growing Boswellia species in Wajir County, Kenya Octa. Journal of Environmental Research Vol. 2(3):197-202	not attached.
	Muga, M.O., Mutunga, C., Peter, E., Oriwo V., and Chikamai, B.N., 2014. Sustainable Wild Harvesting Protocol for Gums and Resins in Isiolo and Samburu Districts. A Study for CETRAD	file attached.
	Mokria M., Tolera M., Sterk F.J., Gebrekirstos A., Bongers B., Decuper M., Sass-Klaassen U., 2017. The Frankincense Tree *Boswellia neglecta* reveals high potential for restoration of of woodlands in the Horn of Africa. Forest Ecology and Management Vol.385:16-24	not attached.
	Kagombe J.K., 2002. Field Appraisal on the state of knowledge of *Boswellia* species and Commercialisation of Frankincense in Kenya: Report of Field Visit to North East province, Kenya KEFRI	file attached.

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use? *Boswellia neglecta* *Boswellia microphylla* *Boswellia rivae*
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)? Incense, bark dyes, tanning & hide processing, worship rituals, chewing gum, (Hassan 2011) circumcision ceremonies (Sommerlatte interviews Samburu)
3c	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors. *Boswellia neglecta* Hassan (2011) on resin trade and harvest in Wajir district states that *Boswellia neglecta* as compared to the myrrh resins (*Commiphora myrrha* and *Commiphora holtziana)* has more cultural value than economic. *B. neglecta* resins fetch a low price. Across northern Kenya the market for *Boswellia neglecta* remains underdeveloped. Kagombe (2002) Interviewed 7 traders and buyers of resins who all stated that the price for *Boswellia neglecta* was low as there was not a high market demand as compared to the myrrh species, *Commiphora myrrha* and *Commiphora holtziana*. Arbor Oils of Africa , which is certified organic, buys *Boswellia neglecta* and *Commiphora confusa* frankincense resins from collectors in Samburu district. Purchase records have been kept since 2007 and quantities of resins purchased per annum range from 1114kg (2009) to 17,950kg (2018) for *Commiphora confusa* frankincense resins and 75kg (2013) to 21,817kg (2018) for *Boswellia neglecta* resins. Sommerlatte made a conservative estimate, on the volume of harvested material available for *Boswellia neglecta* in the Mathews Range and Ndoto mountains where the resins are harvested. The *B. neglecta* areas on the mountain slopes are estimated to be 50,000 hectares and is a dense woodland of estimated 400 trees/hectare of which an estimated 60% are *B. neglecta* trees giving 240/hectare. Estimated number of mature resin producing trees 30%, = 72/hectare. Estimated average resin production per tree 0.08kg. The Mathews Range collection area of 50,000 hectares would give an estimated potential total yield of 288 MT. Luvanda *et al.* 2014 calculated for *B. neglecta* in Wajir county: The mean yield/per tree/per year as 80g and a mean population density of 142 trees/hectare which can produce 11kg/ha/year naturally (not tapped). The county can produce 1,800MT of frankincense per year assuming that 60% of the trees can yield resin. Harvesting and trade figures of *Boswellia rivae* and *Boswellia microphylla* resins not mentioned in the publications sourced

3d.	What volume is exported (approximate annual export)? No comprehensive national figures available.
3e.	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations. The harvesting method of *Boswellia neglecta* has no negative effect on the sustainability of *Boswellia* popualtions as there is no tapping of the trees. Harvesting of *Boswellia neglecta* resins is collection by natural exudation.The resins drip down, dry and are usually collected from the ground. (Hassan 2011, Kagombe 2002) Samburu collectors interviewed on Ol Donyo Mara mountain, confirmed the above citations. They were adamant that tapping could not induce the trees to produce resin, it was only due to the activity of a borer beetle larvae, which stimulated the tree to produce resin. (Sommerlatte trip with artists Ackroyd & Harvey in the making of *Into Blue* which was commissioned by the University of Cambridge for the official opening of The David Attenborough Building, Cambridge, England 2016) Market demand for *Boswellia neglecta* resins is low and therefore collection of resins is way below the potential harvest. Consequently export of *Boswellia neglecta* resins would have a minimal effect on the sustainability of *Boswellia* populations (See section 3c). Harvesting and trade figures of *Boswellia rivae* and *Boswellia microphylla* resins not mentioned in the publications sourced
3f.	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations. Harvest and export of *Boswellia neglecta* resins would have a minimal effect on the regeneration capacity of *Boswellia* populations as the market demand for Boswellia resins

	is low and therefore harvesting is way below the potential and therefore populations are not visited by the collectors frequently. (See section c). As the trees are not tapped, there is no added stress to the trees, from collector damage. Germination is higher and regeneration is better in areas that are closed to tapping or that have not been tapped. Ogbazghi (2001). Overharvested populations are characterized by a lack of young and sapling size classes Mengistu (2011) The main threats to the regeneration capacity of *Boswellia* populations is livestock grazing. Groenendijk, P. et al (2012) Harvesting methods and trade figures of Boswellia rivae and Boswellia microphylla resins not mentioned in the publications sourced.
3g.	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries. None so far

3h.	What are the challenges to artificially propagate/cultivate *Boswellia* species in your country? In their Gum Resins Value Chain Desk Study in Wajir by Mercy Corps done in 2017, which focused on the myrrh producing species and gum Arabic: - "The majority of respondents still consider that there is substantial cover of the gum and resin yielding trees in the locality and in their own opinion there is no need to domesticate them. Other reasons for not planting gum and resin trees include lack of knowledge on methods of propagation; lack of financial capital; scarcity of water; and tendency of opoponax producing trees to grow less well in the homestead, as they prefer rocky and rough terrain."
3i.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.

	File/attachment	Comments (if any)
	Hassan B.A. et al (2011) The role of Boswellia and Commiphora species in rural livelihood security and climate change adaptation in the Horn of Africa: A Case Study North-eastern Kenya. Journal of Social Forestry. 4(1):86-112	not attached.
	Kagombe J.K et al (2002) Field Appraisal on the state of knowledge of Boswellia species and Commercialisation of Frankincense in Kenya: Report of Field Visit to North East province, Kenya KEFRI	not attached.
	Luvanda A.M., Choge S.K., Chikamai B.N. 2014. An Assessment of the Distribution of Natural Growing Boswellia species in Wajir County, Kenya Octa. Journal of Environmental Research Vol. 2(3): 197-202	not attached.
	Groenendijk, P. et al (2012) Limitations to sustainable frankincense production: blocked regeneration, high adult mortality and declining populations. Journal of Applied Ecology 49, 164–173	not attached.
	Mercy Corps – Value Chain Research- Wajir, Gum Resins Value Chain Desk Study	file attached.
	Ogbazghi, W. 2001 The distribution and regeneration of Boswellia papyrifera (Del.). Hochst. in Eritrea. PhD Thesis, Wageningen University and Research Centre, The Netherlands.	not attached.
	Mengistu, TM. 2011. Physiological ecology of the frankincense tree. PhD Thesis, Wageningen University and Research Centre, The Netherlands	not attached.

Section 4: Supply chains and international trade (paragraph a), b) and f) of Decision 18.205)

4a. Who are the predominant legal or customary owners / custodians of *Boswellia*?

Government-owned ☐ Local communities ☒ Individual ownership ☐ Community-based or individual land tenure ☐

Please describe the land ownership structure where *Boswellia* spp. occur, including harvest rights.

The collection areas are community land which according to the Kenya constitution Section 63 (1) is land held by communities identified on the basis of ethnicity and is lawfully held, managed or used by specific communities as community forests, grazing lands or shrines. The boundaries of the collection area are defined by the boundaries of the community land and the borders are clearly defined as dry riverbeds or mountains.
In Samburu district the community members have various committees such as water, grazing gum collection committees, and they determine the management and use of the land and its resources.
For example *Boswellia neglecta* resin is used in circumcision rites in the Samburu culture. The young recently circumcised men,(moran) will collect the *Boswellia neglecta* resin to put on the end of the arrows and use it to stun birds and from these they collect feathers to decorate head bands. The traditional *Boswellia neglecta* areas, used by the moran, are protected and no access is allowed for other *Boswellia* collection activities. For example Poron, which is on the edge of the Kaisut west of Marsabit)
(Sommerlatte interview Samburu collectors).

4b. If known, please specify who are the main harvesters of *Boswellia* specimens?

In Wajir county,collection and selling of gums and resins is currently considered the work of people who are less endowed with livestock wealth .Households with more than 50 heads of cattle are 24 times less likely to collect gums and resins as compared to households with no livestock. (Mercy Corps 2017)

In Samburu county 95% of collectors for Arbor Oils of Africa are Samburu women as gum/resin collection is not considered a male occupation unless they are herd poor. Arbor Oils of Africa has ca 2,000 registered collectors.

Please provide further details on the types of harvesters.

Individual collectors ☒ Collector associations ☒ Private companies ☒ Other ☐

4c.	Is there any in-country processing capacity for *Boswellia* specimens? Please describe. Arbor Oils of Africa Naro Moru processes the resins of *Boswellia neglecta* by steam distillation to extract the essential oils. Lubanchem Nanyuki processes the resins *Boswellia sacra* by steam distillation to extract the essential oils.
4d.	Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones. Arbor Oils of Africa, Naro Moru Lubanchem, Nairobi
4e.	What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)? *Boswellia neglecta*

4f.	Which are the main known importing countries of *Boswellia* specimens sourced from your country? Europe (essential oil)
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported. *Boswellia sacra* from Puntland by Lubanchem
4h.	What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)? *Boswellia sacra* resins from Puntland by Lubanchem
4i.	What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen. Figures from Lubanchem unavailable
4j.	Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries. *Boswellia sacra* essential oil from the resins, exported to America
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded.

	Boswellia neglecta – INCI name Black Frankincense *Boswellia rivae* – Ogaden type frankincense
4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade. *Boswellia neglecta* has a black tar like resin easily distinguishable from the white resins of *B. sacra* and *B. papyifera*. The essential oil is characterized by Terpinen-4-ol (up to 20%) (Asfaw et al. 2019)
4m.	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206. Kenya Forestry Research Insitute (KEFRI) Nairobi: meshackmuga@hotmail.com luvandaa@gmail.com Network for Natural Gums and Resins in Africa (NGARA). bnchikamai@gmail.com Centre for Training & Intergrated Research in ASAL Development (CETRAD) b.kiteme@africaonline.co.ke

4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Kenya constitution Section 63 (1)	not attached
	Mercy Corps – Value Chain Research-Wajir, Gum Resins Value Chain Desk Study done in 2017	attached

	Asfaw N.,Sommerlatte H.,Demissew S., (2019) Uncommon frankincense. Perfumer & Flavorist Vol 44: 46-55	not attached

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a. Please describe any regulations or management measures in place or in preparation concerning

i. The conservation of *Boswellia* populations and/or habitats?

Arbor Oils of Africa is certified organic and was also Fairwild certified in 2013 and 2014 until it became too expensive. Organic and Fairwild certification standards demand sustainable harvesting techniques with minimal damage by collectors to trees and habitats. The areas covered by certification for *Boswellia neglecta* are semi-protected areas within the Northern Rangeland Trust member conservancies in Samburu county and include Sera, Namunyak, Melbae, Kipsing and Westgate which are in total 895,250 hectares. The population densities within the conservancies, is low. (overview NRT maps) and the traditional land use is pastoralism. The NTR mandate includes providing a platform for developing sustainable enterprise and livelihoods either directly or indirectly related to conservation. NRT member community conservancies work to conserve wildlife and sustainably manage the grassland, forest, river and marine ecosystems upon which livelihoods depend. (nrt-kenya.org).

As mentioned in section 4a, the Samburu set aside special *Boswellia* growing areas, to be used only for collection of resins for circumcision rites. No collection of resins for commercial reasons is allowed in these traditionally protected areas. (Sommerlatte interviews with Samburu collectors)

ii. The sustainable harvest of *Boswellia* specimens?

No tapping is done on the *B. neglecta* trees for harvest (see explanation section 3e) and management measures include training of collectors to not harm trees in any way ie. natural exudations should be prised gently from the trees and branches or bark should not be cut.

The harvest seasons are in the dry months, which are February and July to November. Bark recovery takes place during the rainy season when livestock/wildlife have alternative fodder.

iii. The export of *Boswellia* specimens?

Since the demand for *Boswellia neglecta* resins and essential oils is low, the quantity of resins harvested in northern Kenya is currently below their potential (Hassan 2011, Kagombe 2002, Mercy Corps 2017 Luvanda et al 2014) and therefore no regulatory measures are in place at present, to limit the export of *Boswellia* specimens.

iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.

None

5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	website Northern Rangelands Trust. nrt-kenya.org	
	Hassan B.A. et al (2011) The role of Boswellia and Commiphora species in rural livelihood security and climate change adaptation in the Horn of Africa: A Case Study North-eastern Kenya. Journal of Social Forestry. 4(1):86-112	not attached
	Kagombe J.K., 2002. Field Appraisal on the state of knowledge of *Boswellia* species and Commercialisation of Frankincense in Kenya: Report of Field Visit to North East province, Kenya KEFRI	not attached
	Mercy Corps – Value Chain Research-Wajir, Gum Resins Value Chain Desk Study done in 2017	attached

Section 6. Additional remarks or information

6a.	Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.) - Trade of *Boswellia neglecta* resins is an important alternative source of livelihood for pastoralist communities, particularly women, who in most cases are marginalized with no income. - Current information from Wajir county in Kenya indicates that recurring droughts, livestock and human encroachment and not harvesting and trade are the main threats to *Boswellia neglecta* regeneration and populations. The above threats impact all dryland species in pastoralist areas. - There is a paucity of information regarding the population status and trends of *Boswellia neglecta* from other areas in Kenya. - Any trade restrictions or Cites listings may have a negative impact on *Boswellia neglecta* populations. If the trees are seen to have no value, they may be used as timber products or harvested illegally and unsustainably as is the case with *Osyris lanceolata* Regulation through using a Fairwild or FSC standard may be a better option.

Thank you very much for your responses!

SUSTAINABLE WILD HARVESTING PROTOCOLS FOR GUMS AND RESINS IN ISIOLO AND SAMBURU COUNTIES, KENYA

BY

Muga, M.O, Mutunga, C., Peter, E., Oriwo V., and Chikamai, B.N.

A study carried out for CETRAD
June 2014

EXECUTIVE SUMMARY

Gums and resins are commodities of commerce from Acacia, Commiphora and Boswelia spp found in at least 8 ASAL Counties in Kenya namely: Marsabit, Wajir, Garissa, Moyale, Mandera, Turkana, Samburu and Isiolo Kenya. They include gum arabic from *Acacia senegal or Acacia seyal*, Myrrh from *Commiphora myrrha*, Hagar from *Commiphora holtziana*, Frankincense from *Boswelia neglecta* and *Commiphora confusa.* Little effort has been made on their conservation and domestication in Kenya. There is also lack of national and regional standards/protocols for sustainable gums and resins production. Addressing this gap is critical in order to make the trade in gums and resins sustainable and more profitable and beneficial to the resource poor pastoral collectors.

CETRAD therefore contracted KEFRI to carry out a resource assessment and mapping of gums and resins and produce maps and protocols to aid sustainable wild harvesting and domestication of these resources in Isiolo and Samburu counties. These two counties have great potential for gums and resins production but have limited information on the inventory of these resources and their production potential.

Land Sat images (medium resolution) were acquired, processed and used to generate and identify relevant land cover classes and areas covered by the gums and resins resources mapped. Based on 49 sample plots (20m x 20m) in key gums and resins producing areas in these two counties, stocking density, tree height and diameters (dbh and crown) were determined for all the *Acacia senegal* and *Commiphora holtziana* trees in a plot. The potential gum production was estimated based on number of stems, crown cover and gum yield per tree. Results show that *C. holtziana* is found mainly in Garbatula (Isiolo County), has a stocking density of 156 stems ha^{-1}, mean DBH of 22.2 cm, height of 6.4 m, crown diameter of 7.8 m but has poor natural regeneration. *A. senegal* , found in both counties, has stocking density of 339 stems ha^{-1}, DBH of 7.8 cm, height of 4.7 m, and crown diameter of 5.6 m with no significant variation between counties. *Acacia senegal* is found mainly in Central, East, Oldonyiro and Garbatula divisions of Isiolo County and Baragoi, Nyiro and Waso, divisions of Samburu County. A few spots of *Acacia senegal* were also observed in Kirisia and Wamba divisions of Samburu County. The potential gum arabic production in Isiolo County is estimated at 178 $Kgha^{-1}$ and Samburu County at 151 $Kgha^{-1}$ (overall mean of 169.5 $Kgha^{-1}$) while the potential Hagar production is approximately 234 $Kgha^{-1}$. It is also estimated that the potential annual production of gum arabic is 835 MT in Isiolo County and 4145 MT for Samburu County. The annual potential production of hagar is estimated at **2,886.3 MT.**

Based on FairWild Standards/ criteria and FSC indicators for Non Timber Forest Products (NTFPS), traditional ecological knowledge, information obtained during resource assessment and mapping exercise, existing scientific information,

environmental factors; draft protocols for sustainable harvesting of the two species have been developed. Approval is to be gained from accredited certification bodies that these protocols are fully accepted under identified internationally recognized standards (organic and FSC). A template for developing protocols for sustainable wild harvesting for other indigenous species in Kenya and Eastern Africa has been develped based on the one designed for gums and resins species and FSC indicators.

It is concluded that *there is* reasonable quantity of *A. senegal* (Isiolo and Samburu Counties) and *Commiphora holtziana* (in Isiolo) for commercial exploitation. Populations of both *Acacia senegal and Commiphora holtziana* in a number of the sites surveyed, have low natural regeneration and their protection is critical. It is recommended that sustainable tapping methods be introduced and promoted to enhance sustainable production of gum arabic and hagar. Furthermore, several possible approaches for increasing the production and quality of gums and resins such as improving the management of natural stands, domestication of the species and certification should be employed in order to increase production and improve productivity. There should also be a funding mechanism for the selected sites.

LIST OF ABBREVIATIONS AND ACRONYMS

ACT*!*	Act Change Transform
ADS	Agricultural Development Strategy
AOP	Acacia Operation Project
ASALs	Arid and Semi Arid Lands
CBOs	Community Development Organizations
CETRAD	Centre for Training and Integrated Research for ASAL areas
CFA	Community Forest Association
ENNDA	Ewaso Ng'iro North Development Authority
FAO	Food and Agriculture Organization of the United Nations
FSC	Forest Stewardship Council
GARA	Gum Arabic and Resin Association of Kenya
GDP	Gross Domestic Product
GIS	Geographic Information System
GoK	Government of Kenya
KEFRI	Kenya Forestry Research Institute
KFS	Kenya Forestry Service
MDGs	Millennium Development Goals
NALEP	National Agriculture and Livestock Extension Programme
NGARA	Network for Natural Gums and Resins in Africa
NTFPs	Non Timber Forest Products
TORS	Terms of Reference

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

1.1 Overview of gums and resins sub-sector

Plant gums and resins from the drylands of Kenya are among key natural resources with potential to improve livelihoods of rural communities in terms of food security, income generation and foreign exchange earnings. These resources include gum arabic from *Acacia senega* or*Acacia seyal* and commercial gum resins such as myrrh from *Commiphora myrrha*, hagar from *Commiphora holtziana* and Frankincense from *Boswelia neglecta* S. Moore. Currently, gums and resins are produced in at least 8 ASAL Counties namely: Marsabit, Wajir, Garissa, Moyale, Mandera, Turkana and Samburu and Isiolo. There are also a number of other counties with these resources and therefore potential for production of gums and resins, these include among others: Mwingi, Meru North and Ijaara Districts.

Gums and resins have potential to generate wealth and uplift the living standards of the local communities in the dry lands. They are renewable resources that can be sustainably exploited for household income and still conserve biological diversity and ecosystem functions while increasing overall productivity of the land. They can also serve as raw materials for enterprise development thus providing opportunities for trade and employment generation. Gums (gum arabic) and resins (myrrh, hagar and frankincense), are articles of commerce both locally and internationally. The current annual world demand for gum arabic is about 100,000 MT against a current supply of about 70,000 MT which is projected to reach 150,000 MT by 2020 (Muller and Okoro, 2004). The annual world demand for gum resins is estimated at around 2500 MT. Globally the resource potential of gums and resins far exceeds current levels of production. In Kenya the potential for gum arabic production is 3,000 MT against an average production of 400-500 MT while for resins (myrrh, hagar and frankincense) the potential is 3500 MT against an average production of around 1000 MT. Apparently, the exports of gum arabic from Kenya are still very small relative to the resource potential. Annual exports have been only a few 100 tonnes which reached a peak of 460 MT in 1995 (Chikamai *et al,* 2010). The Export Promotion Council (EPC) trade statistics of 2011 indicate that, Kenya exported 96 MT of gum arabic valued at KShs. 14.4 Million.

Kenya is the third largest exporter of resins (myrrh, hagar and frankincense) after Ethiopia and Somalia. Export volumes of gum resins reached a peak of 3,299 MT valued at KShs. 340.4 Million and sold mainly to Pakistan, Vietnam, China, Hong Kong and India (Export Promotion Council, 2011). Profit margins for local traders and producers are quite low making them to rely on selling groceries, and hides and skins to break-even. This explains why investment by such local dealers in marketing infrastructure is low.

Between 2004 and 2011, two major regional projects (Acacia Operation Project and Acacia Gum project) were implemented with the aim to improve the gums and resins subsector and build capacity of producing communities. Kenya was one of the beneficiary countries. Results and important lessons have been documented. Some of the key achievements in this subsector include: Taxonomic, ecological and chemical characterization of gums and resins, characterization of soil physico-chemical properties of different varieties of *A. senegal*, preliminary resource assessment and mapping of gum and resin producing species in Kenya and the region, piloting of production and management of *Acacia senegal* trees and capacity building of extension agents and communities in some of the gum and resin producing counties in production, processing and marketing of gums and resins (Chikamai *et al*., 2010, Chikamai *et al*., 2007, Muga *et al* 2010, Chikamai, and Kagombe (2002), Chikamai, Gachathi, 1994, Chikamai, and Hall,, 1995, Chikamai, , 2001, FAO. 2005, Gachathi. 1994, Gachathi and Muga, 2009; Lelon *et al*., 2011).

Similarly, through these past initiatives, major barriers that inhibit realization of full potential for the gums and resins in the dry lands of Kenya have been identified and classified as ecological, climatic, socio-economic, technological, policy as well as institutional barriers. Specific constraints found to be associated with these barriers include: 1. lack of clear policy and strategies on the development of gums and resins, 2. poorly developed markets and marketing systems resulting in low prices at the producer level, 3. inadequate access to capital, 4. harsh and difficult terrain, animal and human damage to trees, famine and poverty, 5. poor production and post-harvest handling practices (limited primary value addition and storage facilities), 6. Land tenure issues and 7. Lack of adequate data on the resources (Wekesa *et al*, 2010). There has been little effort on conservation and domestication of gum and resins producing species and there is also lack of national and regional standards/protocols for sustainable production of gums and resins and for product classification and cerfication.

It is therefore critical that the existing gaps and constraints be addressed in order to make the trade in gums and resins sustainable and more profitable and beneficial to the resource poor pastoral collectors. This initiative is expected to lead to increased production and marketing of gums and gum resins through intervention of some of the above constraints and diversification of the sub-sector.

1.2 Background to the study

CETRAD contracted KEFRI to carry out a detailed assessment and mapping of gums and resins resources to establish the extent, distribution, population dynamics, and potential yield of gum resources by type in identified areas and produce resource maps and protocols for sustainable wild harvesting and domestication of these resources in Isiolo and Samburu counties. These two counties have great potential for gums and resins production but have limited information on the inventory of these resources and their production potential.

1.3 Broad Objectives

To carry out a detailed assessment and mapping of gums and resins resources in Isiolo and Samburu counties in order to establish the extent, distribution, population dynamics, tree size and potential gum yield by type in identified areas and produce resource maps and protocols for sustainable wild harvesting and domestication of these resources.

1.4 Specific Objectives

i. To carry out resource assessment and mapping of *Acacia senegal, Commiphora holtziana and Boswelia neglecta* in Isiolo and Samburu counties.
ii. To develop criteria and protocols/methodology for sustainable wild harvesting and commercial domestication of the three species.
iii. To provide detailed information to relevant government partners to develop regulations and licensing for sustainable wild harvesting of these resources in Kenya, in line with international certification standard requirements.
iv. To disseminate information generated to key stakeholders through appropriate information pathways

1.5 TORs

1. Three indigenous species assessed/ evaluated & mapped in selected sites in Isiolo and Samburu counties
2. Criteria and methodology for sustainable harvesting and commercial domestication of the two indigenous species developed.
3. Sustainable wild harvesting and domestication protocols designed for these species and approval gained from accredited certification bodies that these protocols are fully accepted under identified internationally recognized standards (organic and FSC)
4. The documented output is presented to key government partners for developing regulation mechanism and licensing system for gums and resins
5. Guidelines/ protocols on sustainable wild harvesting of the selected species published in an easily assimilated form (posters and livelihood briefs) and awareness created amongst rural communities on the livelihood opportunities of sustainable utilization of indigenous plant species.

6. A template for developing protocols for sustainable wild harvesting for other indigenous species in Kenya and Eastern Africa provided.

2. METHODOLOGY

2.1 Resource Assessment and Mapping

The main objective of resource inventory and mapping was to generate key data on the gums and resins resources to be used in estimating the potential of these resources for commercial production in the selected counties/ districts and to form a data base for future reference and use. The following procedure was used:

2.1.1 Resource Mapping

An expert on resource mapping spearheaded this activity. The process involved the following activities:

i. Land Sat images (of medium resolution) for the area were acquired, processed and used to generate and identify relevant land cover classes.

ii. The identified classes were subjected to further interpretation and areas covered by gums and resins resources (*A. senegal, Boswelia neglecta* and *Commiphora holtziana)* carefully mapped.

iii. Some sample points were pre-selected prior to the field visit and verified during the fieldwork. Additional points with the gum resources were also taken along the transect routes during the field visits.

iv. The sample points which were picked during the field visits were used to identify areas with occurrence of gums and resins resources and similar areas were identified on the images. Using Geovis GIS software, polygons of *Acacia senegal, Boswelia neglecta* and *Commiphora holtziana* trees were digitized and areas occupied by each resource were computed.

v. Based on the field measurements of stocking densities of each of the resources, polygons were delineated and further classified as Low, Medium and High densities. The findings of the field work and resource inventory were used to update the preliminary interpretation. The data was harmonized to establish the areas covered by each resource in each density class (low, medium and high density) in each Division. Resource maps were produced showing the location, distribution and densities of the resources.

2.2 Resource assessment

i. Information on geographic coordinates of the centroids of the polygons containing *Acacia senegal, Commiphora holtziana and Boswelia neglecta* were obtained from KEFRI's database. The points were marked on the provisional resource maps and also entered into a GPS.

ii. Consultations were carried out with local communities in each selected area prior to field work on the availability of the target resources and areas with more resources prioritized. The research team was accompanied by at least one indigenous resource person. At least 3 sample plots were selected in each administrative division for the resource inventory exercise. Areas that were relatively accessible by car were selected as transect routes. Along each transect route square sample plots of 0.04 ha (20 x 20 m) was established in areas with the gum resources.

iii. The study sites were as shown in Table 2-1 below.

Table 2-1: Summary of tree species, number of sample plots and number of tree individuals across the divisions in Isiolo and Samburu Counties

County	**Division**	**Species**	**No. of sample plots**	**No. of trees**	
				Mature	Juvenile
Isiolo	Central	*Acacia senegal*	4	64	39
	East	*Acacia senegal*	2	32	5
	Oldonyiro	*Acacia senegal*	2	27	7
Samburu	Kirisia	*Acacia senegal*	1	20	3
	Waso	*Acacia senegal*	7	76	45
		Commiphora confusa	1	4	0
		Commiphora holtiziana	1	4	0
		Boswelia neglecta	1	4	0
	Wamba	*Acacia senegal*	3	31	32
	Baragoi	*Acacia senegal*	3	34	46
		Commiphora confusa	1	6	0
		Boswelia neglecta	1	7	2
	Nyiro	*Acacia senegal*	3	40	37
		Commiphora holtiziana	2	10	0

i. Within each sampling plot, data was collected using data sheets (Annex 1) on:
- GPS
- Number of juvenile and mature gum producing species
- Local and botanical names of associated species

- Diameter at breast height (DBH) –determined at 1.3 m using a diameter tape
- Crown diameter-(determined measured by projecting the edges of the crown to the ground and measuring the length along one axis from edge to edge through the crown centre, the measurements from the two perpendicular directions were then averaged).
- Approximate tree height measured using telescopic measuring rod
- Terrain conditions
- Soil conditions
- Evidence of exploitation through tapping or harvesting

ii. The collected data was put in an excel data base, cleaned and synchronized to ensure that data from the mapping and inventory exercises corresponded to the correct mapping units (Division/County)

iii. Stocking density (stems per hectare) was calculated for each resource as follows:

Stocking Density (stems/ ha) = No. of trees in 0.04 ha sample plot x 25

iv. Stocking Density classes were then assigned based on the following criteria:

The stocking density was based on the optimal stocking density for a plantation of 625 stems per hectare and a spacing of 4 x 4-m. Based on this criterion, the stocking density for each resource was then classified into low, medium and high (Table 2-2).

Table 2-2: Density Classification (stems/ha)

Density	**Classification**
< 300	Low
300-500	Medium
> 500	High

The data was analyzed using SPSS Programme. The mean, standard deviation and coefficient of variation of stocking density, was calculated for the three diameter categories (low, medium and high) at the county levels. Significant differences in these parameters within the county were tested at 95 % confidence level using sample plot means.

vi. A correction factor was applied to account for the existence of other land uses such as farmlands, settlements or glades because the mapping units are not homogenous. The following correction factors were adopted for all the resources.

High Density -	75%
Medium Density-	50%
Low Density-	25%

vii. Assessment of area under the gum resources and gum yield was derived as follows:

❖ Estimated density of acacia gum resource for a given density class;

No. of stems = Mean Density x Area x correction factor (1)

❖ The gum yield was based on the formula:

Estimated Yield (MT) = (Number of Stems x Crown Cover x Yield)/1000000 (2)

Where: Crown Cover *Acacia senegal* = 10%
Crown Cover *Commiphora holtziana* = 20 %
Yield/stem=500 gm for *A. senegal*
Yield/ stem=1500gm for Gum resins

2.3 Population dynamics

This was determined based on the average number of mature stems and juvenile stems in the sample plots. The percentage of each category was determined. If the proportion of the juvenile trees in a plot or division or county was less than 30 % such a population was considered to be unhealthy with low natural regeneration. Frequency charts were also used to show the distribution of tree diameter classes in each sampling unit (Division and County).

2.4 Criteria and methodology for sustainable harvesting and domestication of the three gums and resins producing species

The criteria and methodology for sustainable harvesting and domestication of the three gums and resins producing species was based on FairWild standards/Criteria.

2.5 Designing of sustainable wild harvesting and domestication protocols

Indicators and verifiers from Forest Stewardship Council, Smart Wood non-timber forest products certification addendum were reviewed and domesticated for adoption for gums and resins. Based on these indicators, traditional ecological knowledge, information obtained during resource assessment and mapping exercise, existing information on harvesting and post-harvest handling and environmental factors, draft protocols for sustainable harvesting of the species were developed. Approval to be gained from accredited certification bodies that these protocols are fully accepted under identified internationally recognized standards (organic and FSC).

2.6 Designing of a template for developing protocols for sustainable wild harvesting for other indigenous species in Kenya and Eastern Africa

A template for developing protocols for sustainable wild harvesting for other indigenous species in Kenya and Eastern Africa was develped based on the one designed for gums and resins species and FSC indicators.

3. FINDINGS

3.1 Resource Mapping and Inventory of *Acacia senegal* in Isiolo and Samburu Counties

The study generated a lot of important information. The information obtained included data on site factors (e.g. soil type, terrain, current use of the resources and other vegetation in the neighbourhood), distribution of diameter classes, tree height, diameter and crown cover and their variations. The study shows that *Acacia senegal* is found mainly in Central, East and Oldonyiro divisions of Isiolo County and Baragoi, Nyiro and Waso Divisions of Samburu County. Some few plots of *Acacia senegal* were also observed in Kirisia and Wamba Divisions of Samburu County.

3.1.1 Site factors

The data on soil type, terrain, and species in the neighborhood of *Acacia senegal* are summarized in Table 3-1 and 3-2.

Table 3-1: Data on soil type, terrain and other tree species at the sampling plots in Isiolo County

Division	Stocking density (stems/ha)	Soil type	Terrain	Current use	Other species in the same habitat
Central	406	Gravelly sandy to gravelly clay	Sloping gently	Gums eaten raw, sold to traders	*Acacia tortilis, Acacia mellifera, Commiphora holtiziana, Commiphora africana, Boscia coriacea*
East	425	Gravelly clay	Flat to gentle slope	Gums eaten raw, sold to traders	*Acacia tortilis, Acacia mellifera,*
Oldonyiro	300	Gravelly to sandy loam	Sloping gently	Gums eaten raw, sold to traders	*Acacia tortilis, Commiphora confusa, Boscia coriacea*
Garbatula	294	Rocky and sandy loam	Flat to gently sloping	Gum collected for sale	*C. holtziana, C. confusa, C. africana, B. neglecta, B. coriacea, A. tortilis, Cordia*

					senensis, Borcia coreasea, Premna resinosa

Table 3-2: Data on soil type, terrain and other tree species at the sampling plots in Samburu County

Division	Mean Stocking density (stems/ha)	Soil type	Terrain	Current use	Other species in the same habitat
Baragoi	283	Gravelly to rocky	Sloping steeply	Gums eaten raw, sold to traders	*A. tortilis, C. holtiziana, C. confusa, Boswelia neglecta, Delonix regia*
Kirisia	500	Gravelly	Gently sloping	Gums eaten raw, sold to traders	*A. tortilis, A. mellifera, C.africana*
Nyiro	250	Sandy to gravelly to rocky	Flat to steep slope	Gums eaten raw, sold to traders	*A.tortilis, A. recifiens, Cordia sinensis, C. holtiziana, C. africana, Grewia bicolor*
Wamba	258	Gravelly loamy	Gently sloping	Gums eaten raw, sold to traders	*Acacia tortilis, Acacia mellifera, Commiphora africana*
Waso	496	Sandy loam to Gravelly sandy	Gently sloping	Gums eaten raw, sold to traders	*A. tortilis, A. mellifera, A. recifiens, C. holtiziana, C. africana, C. confusa, Boscia coriacea, Grewia bicolor*

3.1.2 Variations in tree diameter, height, crown diameter and stocking density for *Acacia senegal* in Isiolo and Samburu counties

The data obtained for diameter, height, crown diameter and stocking density for *Acacia senegal* is summarized in Tables 3-3.

Table 3-3: Diameter classes for *Acacia senegal* across the divisions in Isiolo and Samburu Counties

County	Division	Diameter class			
		0-4.9 cm	5-9.9 cm	10-14.9 cm	15-19.9 cm
Isiolo	Central	39	64	0	0
	East	5	18	12	2
	Oldonyiro	7	24	0	0
	Sub-total	**51**	**106**	**12**	**2**
	%	**29.8**	**62.0**	**7.0**	**1.2**
Samburu	Kirisia	3	15	4	1
	Waso	43	64	12	0
	Wamba	32	18	13	0
	Baragoi	46	33	1	0
	Nyiro	37	24	7	9
	Sub-total	**161**	**154**	**37**	**10**
	%	**44.5**	**42.5**	**10.2**	**2.8**
Overall	**Total**	**212**	**260**	**49**	**12**
	%	**39.8**	**48.8**	**9.2**	**2.3**

The results indicate that most of the trees were in the diameter classes 5-9.9 cm and 0-4.9 cm (91.8 %) and very few in the diameter class 15-19.9 cm (1.2 %), Table 3-3. The proportion of Juvenile trees (<5 cm diameter), is more than 30 % in all the divisions except East and Oldonyiro divisions of Isiolo and Kirisia and Waso divisions in Samburu County, Figures 7 and 8. This indicates that the populations of *Acacia senegal* in Central Division (Isiolo) and Wamba, Baragoi and Nyiro (Samburu) are generally healthy and that there is reasonable natural regeneration for this species in these areas. The mean height of *A. senegal* in Isiolo County was 4.9 m ranging from 3.6 to 7.4 m; mean diameter at breast height was 7.6 cm ranging from 5.9 to 11.4 cm; mean crown diameter was 5.2 m ranging from 4.1 to 6.4 m (Table 3-4). These results were similar to those in Samburu County. The mean height of *A. senegal* in Samburu County was 4.5 m ranging from 2.9 to 7.0 m; mean diameter at breast height was 7.9 cm ranging from 5.4 to 10.0 cm; mean crown diameter was 5.1 m ranging from 3.7 to 8.3 m (Table 3-5).

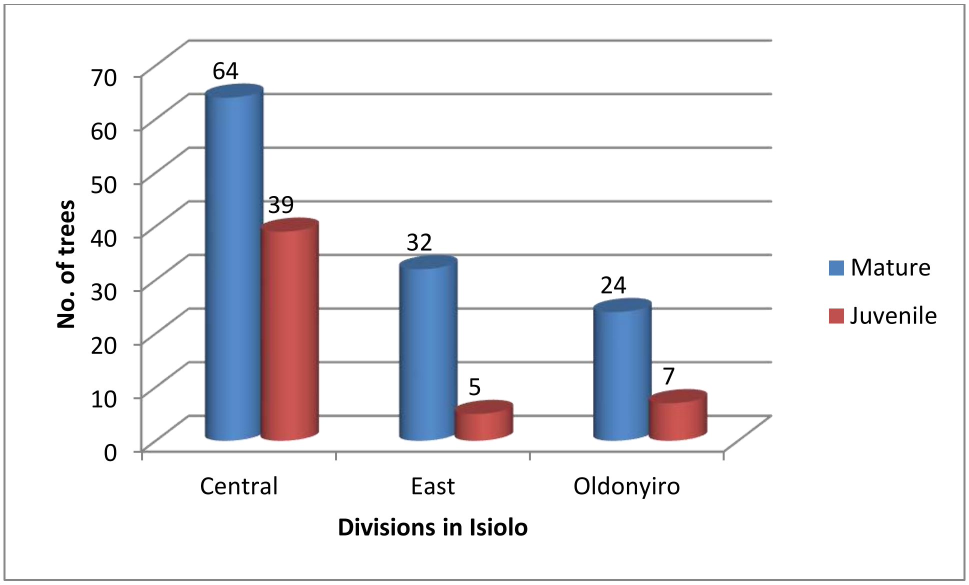


Figure 3-1: Distribution of *Acacia senegal* mature and juvenile tree in Isiolo divisions sampled in the study

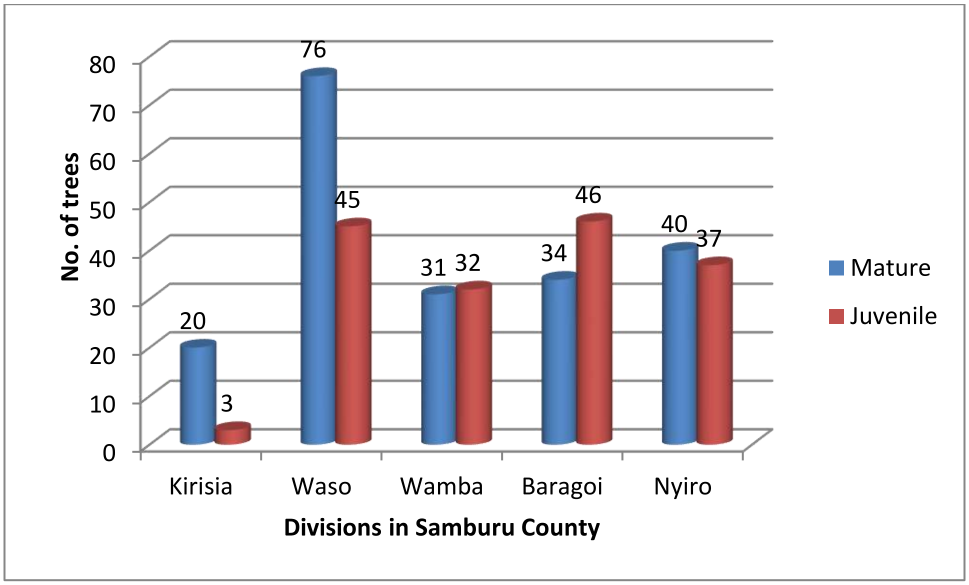


Figure 3-2: Distribution of Acacia Senegal mature and juvenile tree in Samburu divisions sampled in the study

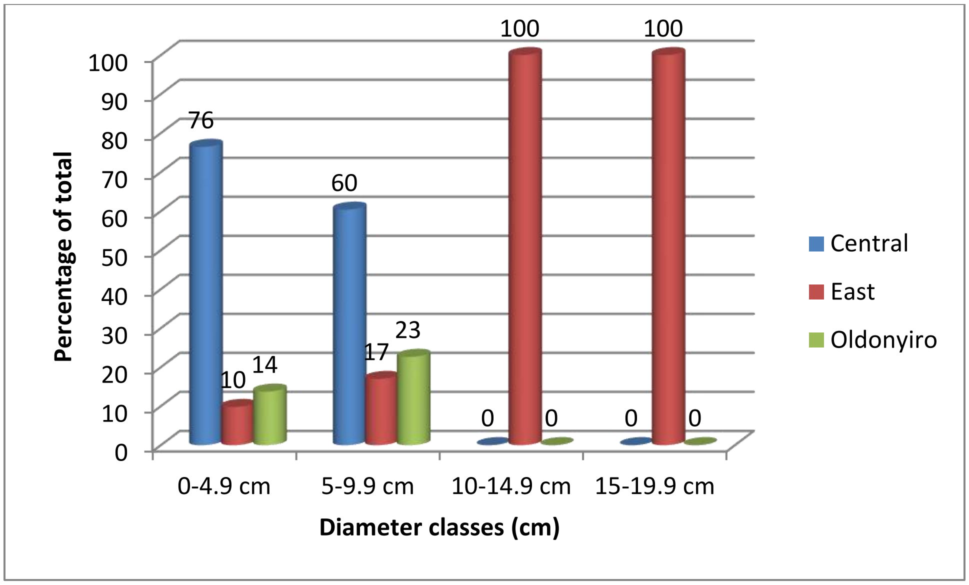


Figure 3-3: Distribution of Diameter classes for *A. senegal* among the divisions in Isiolo County

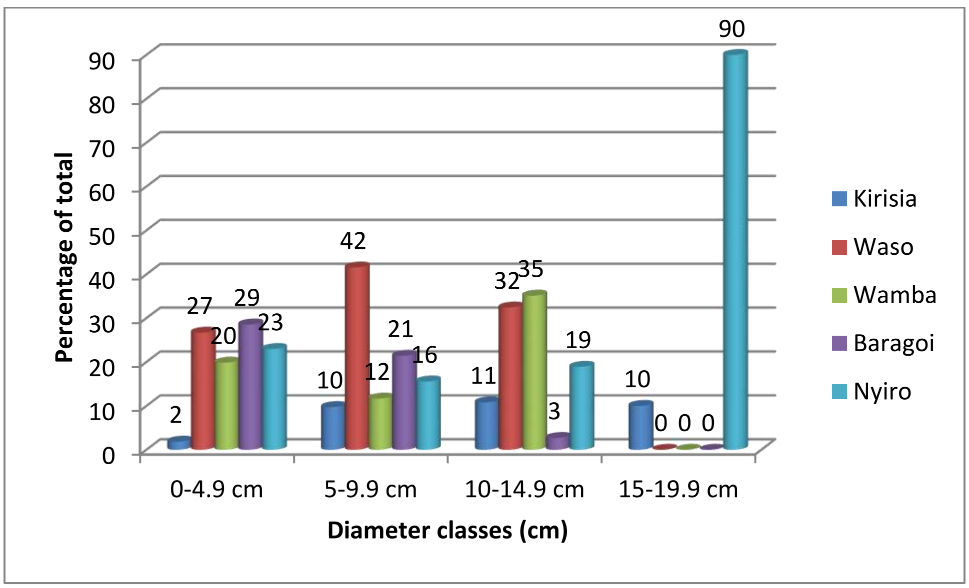


Figure 3-4: Distribution of Diameter classes for *A. senegal* among the divisions in Samburu County

There was no significant difference ($P<0.05$) in mean height, dbh and crown diameter between the divisions.

Table 3-4: Variation in height, diameter and crown diameter in Isiolo County

Parameter	Division	No. of trees	Mean	Std. Deviation	CV (%)
Height (m)	Central	64	4.3	0.777	18.1
	East	32	6.5	1.691	26.0
	Oldonyiro	24	3.9	0.45	11.5
	Total	**120**	**4.9**	**0.973**	19.9
DBH (cm)	Central	64	6.7	1.212	18.1
	East	32	9.7	3.153	32.5
	Oldonyiro	24	6.1	1.044	17.1
	Total	**120**	**7.5**	**1.803**	24.0
Crown Diameter (m)	Central	64	4.9	1.556	31.8
	East	32	6.3	0.92	14.6
	Oldonyiro	24	4.5	0.868	19.3
	Total	**120**	**5.2**	**1.115**	21.4

Table 3-5: Variation in height, diameter and crown diameter in Samburu County

Parameter	Division	No. of trees	Mean	Std. Deviation	CV (%)
Height (m)	Kirisia	20	4.4	1.135	25.8
	Waso	76	5.1	0.819	16.1
	Wamba	31	5	0.707	14.1
	Baragoi	34	3.2	0.549	17.2
	Nyiro	40	4.4	1.328	30.2
	Total	**201**	**4.4**	**0.908**	20.6
DBH (cm)	Kirisia	20	8.3	3.084	37.2
	Waso	76	8.2	1.984	24.2

	Wamba	31	8.6	2.972	34.6
	Baragoi	34	6.8	1.508	22.2
	Nyiro	40	9.8	4.398	44.9
	Total	**201**	**8.3**	**2.789**	33.6
Crown Diameter (m)	Kirisia	20	4.9	1.182	24.1
	Waso	76	5	1.205	24.1
	Wamba	31	5.3	0.957	18.1
	Baragoi	34	4.4	0.946	21.5
	Nyiro	40	5.6	1.851	33.1
	Total	**201**	**5**	**1.228**	24.6

Stocking density

The mean stocking density for *Acacia senegal* from Isiolo County was 356 stems ha^{-1} ranging from 150 to 675 stems ha^{-1} while that from Samburu County was 302 stems ha^{-1} ranging from 100 to 550 stems ha^{-1}. This indicates low to high stocking density. The observed low density in some sites could probably be as result of cutting of the trees for fencing. There was no significant difference ($P<0.05$) in stocking density of *Acacia senegal* among the divisions in each county and between the two counties. East Division had the highest mean stocking density (425 stems ha^{-1}) while Garbatula Division had the lowest stocking density (294 stems ha^{-1}) in Isiolo County. In Samburu County, Waso Division tended to have the highest stocking density (496 stems ha^{-1}) while Nyiro Division the lowest (250 stems ha^{-1}). The disparities in stocking density among plots in each category (low and medium) in each county as measured by the coefficient of variation was within acceptable limits (between 17.7 and 30.6 % in Isiolo County and 4.8 to 38.2 % in Samburu County), Table 3-6.

Table 3-6: Variation of stocking density of *Acacia senegal* in Isiolo and Samburu Counties

County	**Stocking density category**	**Mean**	**Standard Deviation**	CV (%)
Isiolo	Low	302	92.2	30.6
	Medium	600	106.1	17.7
Samburu	Low	292	111.5	38.2
	Medium	525	25	4.8

Gum arabic production potential

Based on the mean stocking density (356 and 302 stems ha^{-1} for Samburu and Isiolo counties respectively) and estimated average gum arabic yield per tree (0.5 kg), the potential annual gum arabic yield was estimated to be 178 and 151 Kg ha^{-1} for Samburu and Isiolo counties respectively (**Table 3-7**).

Table 3-7: Estimated gum arabic production potential for *Acacia senegal* in Samburu and Isiolo counties

County	Division	Density class	Mean stocking density (stemsha^{-1})	Estimated yield (Kgha^{-1})
Isiolo	Central	low	406	20.3
	East	low	425	21.3
	Oldonyiro	low	300	15.0
	Garbatula	low	294	14.7
	Total		**356**	**17.8**
Samburu	Wamba	low	258	12.9
	Waso	low	417	24.8
	Baragoi	low	283	14.2
	Nyiro	low	250	12.5
	Total		302	15.1
	Grand total		**339**	**16.9**

Based on the estimated area with *Acacia senegal* trees (1,294,557.3 ha), mean stocking density and a correction factor of 25 %, there are approximately 99,615,943 stems of the tree in the two counties. These 99,615,943 stems, with a mean crown diameter of 10 % and estimated gum arabic yield per tree of 0.5 kg have an estimated potential gum arabic production of 4981 MT for the two counties (Samburu -4145 MT and Isiolo- 835.4MT) (Table 3-8).

Table 3-8: Estimated gum arabic production potential for *Acacia senegal* in Samburu and Isiolo counties

County	Division	Stocking density (stemsha-1)	Potential area (ha)	No of stems	Potential gum production (MT)
Samburu	Baragoi	283	10,0013.6	7,084,295	354.2
	Wamba	225	45,8230.4	25,775,459	1,288.8
	Waso	417	39,1764.3	40,808,777	2,040.4
	Nyiro	250	147,834.6	9,239,664	462.0
	Sub-total	**302**	**1,097,842.8**	**82,908,195**	**4145**
Isiolo	Central	406	35,558.3	3,611,387	180.6
	East	425	33,054.3	3,512,015	175.6
	Oldonyiro	300	114,788.0	8,609,103	430.5
	Garbatula	293	13,313.9	975,243	48.8
	Sub-total	**356**	**196,714.5**	**16,458,113**	**835.4**
	Grand total	**296**	**129,4557.3**	**99,615,943**	**4,980.8**

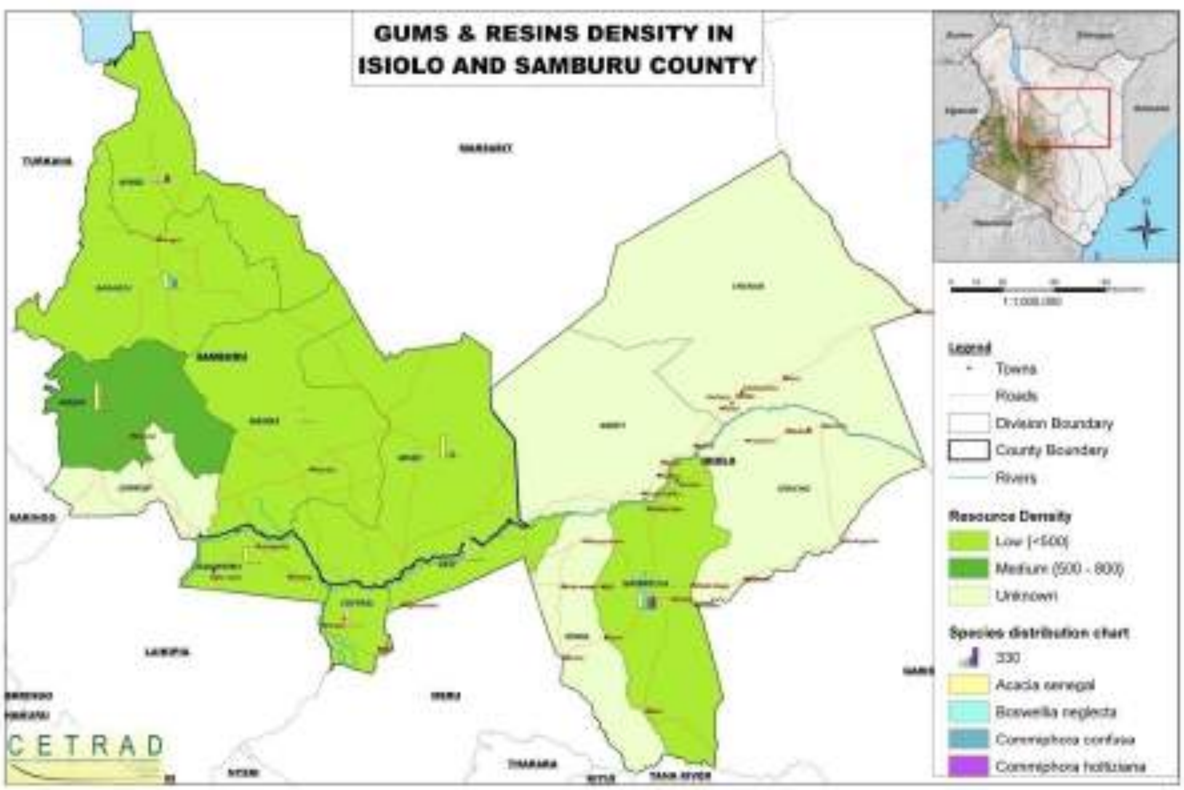


Figure 3-5: Map showing the distribution and density of gums and resins in Isiolo & Samburu Counties

3.2 Resource Mapping and Inventory of *Commiphora holtziana* in Isiolo & Samburu Counties

Commiphora holtiziana is mainly found in Isiolo County, in Garbatulla District. The data reported here were obtained in a study supported by the National Agriculture and Livestock Extension Programme (NALEP) and conducted by KEFRI in 2011-2012 (Muga *et al*, 2012). The study generated a lot of important information. The information obtained included data on site factors (e.g. soil type, terrain, current use of the resources and other vegetation in the neighbourhood), distribution of diameter classes, tree height, diameter and crown cover and their variations.

3.2.1 Site factors

The data on soil type, terrain, and species in the neighborhood for *Commiphora holtziana* are summarized in Table 3-8

Table 3-8: Data on soil type, terrain and other tree species at the sampling plots in Garbatula District

Locations	Stocking density (stems ha^{-1})	Soil type	Terrain	Current use	Other species in the same habitat
Garbatula, Boji, Eldera, Escort, Barambate, Gafarsa, Malkadaka	156	Brown/ reddish rocky and sandy or sandy loam	Flat to gently sloping and steep slope at Malkadaka	Gum collected for sale	*A. senegal, A.tortilis, A. melifera, B. coriasea, G. tenax, C. sinesis, P.resinosa, C. confusa, G. villosa, B. neglecta, Cadaba spp, S. pasica, C. campestris, C. africana, G.bicolor, L.triphyla, E. burtii, P.resinosa, C. Rostrata, A. horida, A. paoli, I. donaldsonia, C. faminosa, A. reficiens,*

3.2.2 Variations in tree diameter, height, crown diameter, crown cover and stocking density for *Commiphora holtziana*

The data obtained for diameter, height, crown diameter, crown cover and stocking density for *Commiphora holtziana* is summarized in Table 3-9 and 3-10.

The results indicate that most of the trees were in the diameter classes 21-30 cm (43.5 %) and 11-20 cm (40.8 %), Figures 5. The juvenile *Commiphora holtziana* trees (DBH ≤ 10 cm) constituted only 2 % of the population. This indicates that there is very low natural regeneration for this species in Garbatulla. The mean height was 6.4 m (ranging from 2.5 to 9 m), mean diameter at breast height was 22.2 cm (ranging from 7.9 to 36.7 cm) , mean crown diameter was 7.8 m (ranging from 1.7 to 12.5 m) and mean solid crown cover of 19.9 %. These results are consistent with those of …….

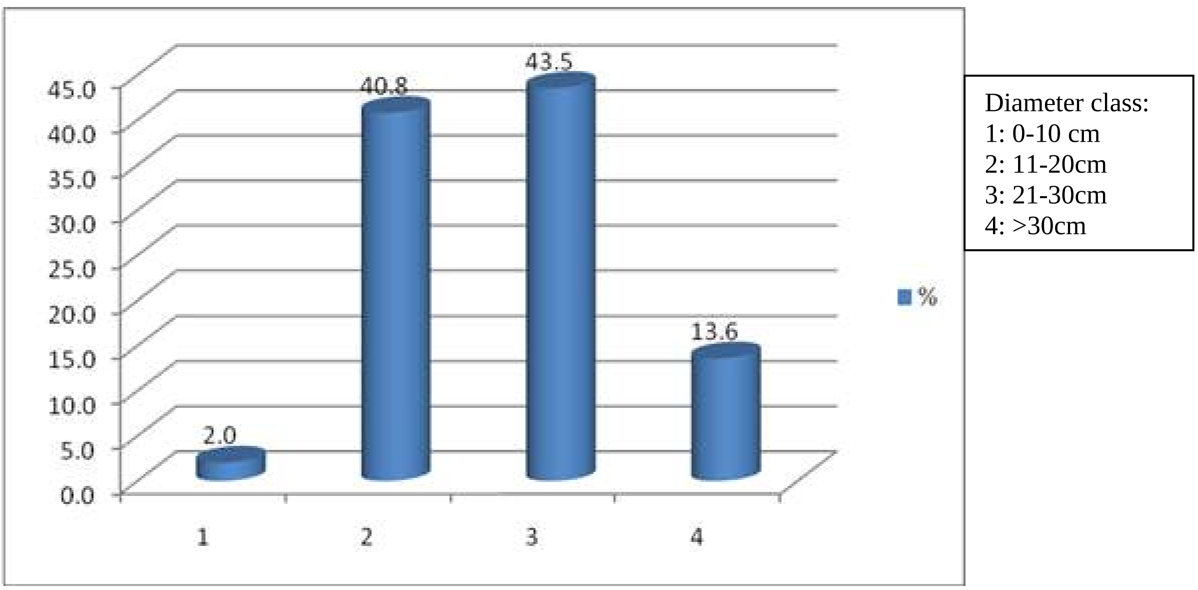


Figure 3-6: Distribution of Diameter classes for C. holtziana

There was a significant difference in dbh among the locations with Eldera having the highest dbh (25.9 cm) and Modoqa the lowest (19.5 cm). Eldera had trees with dbh significantly higher than those in Boji (21.6 cm), Escort (22.0 cm) and Madoyaqa (19.5 cm), Table 3-11.

Table 3-9: Variation in diameter, height, crown diameter, crown cover

Parameter	Division	No. of trees	Mean	Std. Deviation
Height (m)	Boji	31	6.6	1.14
	Eldera	15	6.5	1.39
	Escort	13	5.7	0.88
	Gafarsa	56	6.7	1.14
	Madoyaga	28	6.1	1.26
	Total	**143**	**6.4**	**1.19**
DBH (cm)	Boji	31	21.6	4.77
	Eldera	15	25.9	4.47
	Escort	13	22.0	8.46
	Gafarsa	56	23.4	7.92
	Madoyaga	28	19.5	6.95
	Total	**143**	**22.4**	**7.06**
Crown Diameter (m)	Boji	31	8.2	1.61
	Eldera	15	8.4	1.32
	Escort	13	7.5	1.95
	Gafarsa	56	7.8	2.08
	Madoyaga	28	7.2	1.97
	Total	**143**	**7.8**	**1.90**
Crown Cover (%)	Boji	31	20.7	9.08
	Eldera	15	22.7	7.45
	Escort	13	18.6	9.44
	Gafarsa	56	20.5	10.28
	Madoyaga	29	16.7	9.24
	Total	**144**	**19.9**	**9.53**

Stocking density

The mean stocking density for *Commiphora holtziana* was 156 stems ha^{-1} ranging from 100 to 300 stems ha^{-1}. This indicates low density. There were no significant difference in stocking density of *Commiphora holtziana* among the locations and the divisions. Kina division tended to have the highest stocking density (208 stems ha^{-1}), followed by Garbatula (154 stems ha^{-1}) and Sericho the least (117 stems ha^{-1}), Table 3-10. Among the locations, Boji had the highest stocking density (194 stems ha^{-1}) and Eldera (117 stems ha^{-1}) the lowest, Table 3-11. The low mean stocking densities seem to be influenced mostly by the low natural regeneration due to drought and overgrazing. The disparities in stocking density among the divisions as measured by the coefficient of variation was within acceptable limits (between 12.4 to 40.2%), Table 13-12.

Table 3-10: Variation of stocking density of *Commiphora holtziana* in six locations in Garbatula Sub-county

Location	No. of Plots	Mean	Std. Deviation	CV %
Boji	4	194	42.7	22.0
Eldera	3	117	14.4	12.4
Eskot	2	163	88.4	54.4
Garfasa	3	158	80.4	50.8
Garbatula	7	146	69.9	47.7
Madoyaga	5	140	51.8	37.0
Total	**24**	**153**	60.5	39.6

Table 3-11: Variation of stocking density of *Commiphora holtziana* in three divisions in Garbatula

Division	N	Mean	Std. Deviation	CV (%)
Garbatula	19	153.9	61.9	40.2
Kina	3	208.3	52.0	25.0
Sericho	3	116.7	14.4	12.4
Total	**25**	**156.0**	**60.5**	**38.8**

3.2.3 Areas covered by *Commiphora holtziana* resources and potential gum yield

Results of the resource mapping and inventory show that *Commiphora holtziana,* is the most abundant and resources cover about 25 % of the total land area of the district. Based on the area covered by the *Commiphora holtziana* resources (248,416.6 ha), mean stocking density (156 stems ha^{-1}), crown cover (20 %) and estimated average resin yield per tree (1.5 kg), the potential annual hagar gum yield was estimated to be **2,886.3** MT (**Table 3-12**). Garbatula Division had the highest area under *C. holtziana* (63.1%) and Kinna Division the least (16 %). It is however recognised that it is necessary to establish the actual average hagar gum yield per tree for *C. holtziana* in Garbatula District in order to compute a more accurate estimate of the total potential yield.

Table 3-12: Distribution (area covered), stem populations and estimated gum production potential for *Commiphora holtziana* in Garbatula District (Muga *et al* 2012)

Division	Density class	Mean stocking density (stemsha^{-1})	Area (ha)	Proportion of area	Population (stems)	Estimated yield (MT)
Garbatula	Low	154	156,801.6	63.1	6,036,862	1811.1
Sericho	Low	117	51,865.4	20.9	1,517,063	455.1
Kinna	Low	208	39,749.6	16	2,066,979	620.1
Grand total	Low	**156**	**248,416.6**	**100**	**9,620,904**	**2,886.3**

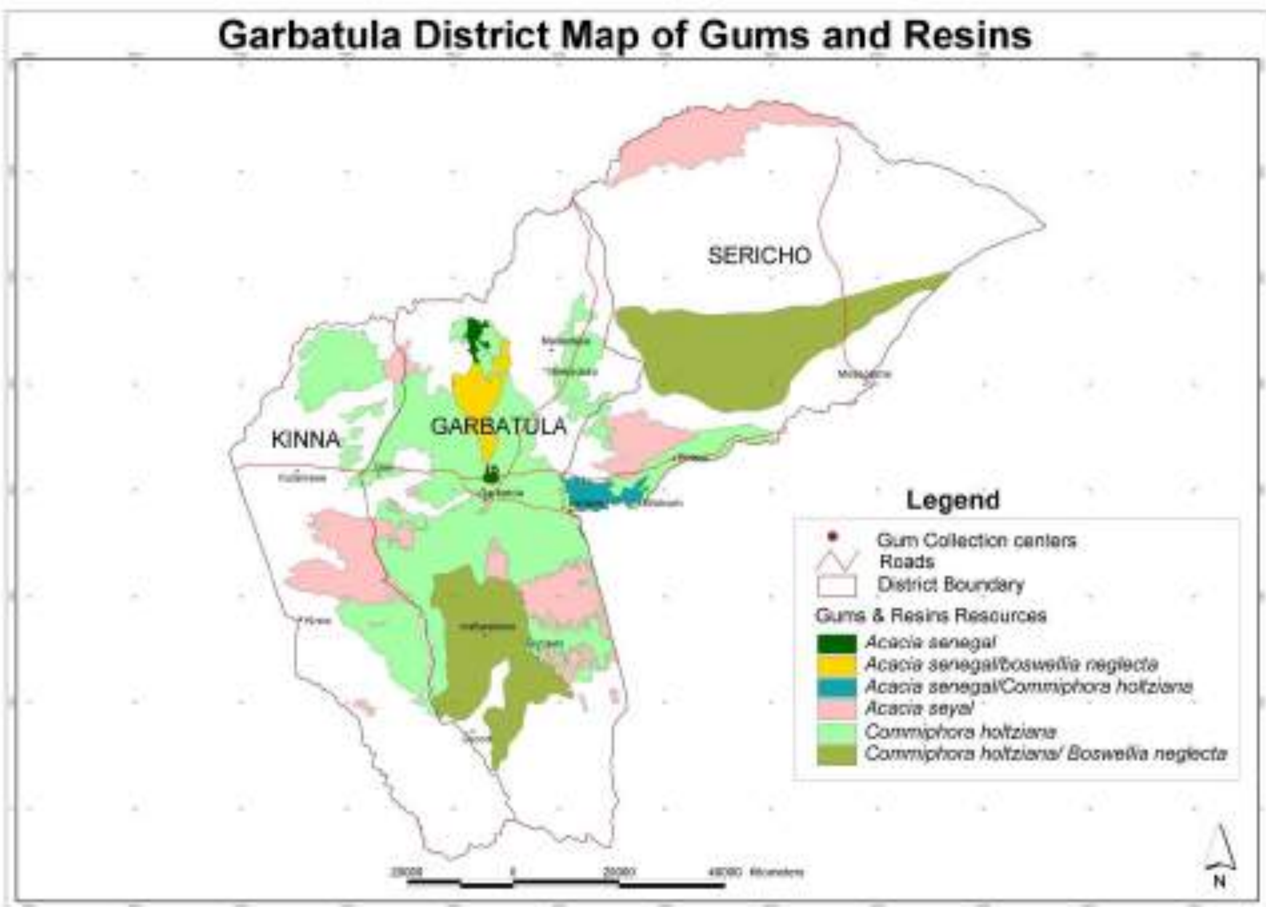


Figure 3-7: Map Showing the Distribution and Density of gums and resins in Garbatula

3.3 Resource Mapping and Inventory of *Boswelia neglecta* in Isiolo and Samburu Counties

Boswelia neglecta (*B. hildebrandtii*) is the source of frankincense, the main *Boswelia* gum resin of economic importance in Kenya. The resin is locally called Lobathin and it is also used as chewing gum. This is a much-branched shrub or tree up to 6 m tall branching from very near the base from a short bole. *Boswelia neglecta* is very common and occurs in most drylands in *Acacia-Commiphora* bushland particularly on red sandy soil over basement complex and on lava flows, between 200-1350 m elevation with 250-600 mm rainfall. Local names include: Dakhara, Hancha (Borana, Gabra), Kinodo (Kamba), Dakar (Orma), Lecholoo, Lkinoo (Samburu), Mathefur, Magafur (Somali). *Boswelia neglecta* is found in small patches in Isiolo and Samburu Counties, mainly in Baragoi, Sereolipi, and Garbatulla areas. A quick assessment of *Boswelia neglecta* in Baragoi shows a mean height of height 4.5 m, a DBH of 13.7 cm and a crown diameter of 6.1 cm. The stocking density ranged from 175 stemsha^{-1} in Baragoi to 662 stemsha^{-1} in Garbatula. Data on soil type, terrain and other tree species at the sampling plots for *Boswelia neglecta* is indicated in Table 3-13.

Table 3-13: Data on soil type, terrain and other tree species at the sampling plots for *Boswelia neglecta*

County	Division	Stocking density (stemsha^{-1})	Soil	Terrain	Current use	Others trees in the neighbourhood
Isiolo	Garbatula	662	Reddish sandy loam	Flat to gently sloping	Gum collected for sale	*A. horida, A. tortilis, C. africana, Cirdia sinesis, I. I. donaldsonia, C. holtziana and C. confusa*
Samburu	Baragoi	175	Gravelly sandy	sloping steeply	Mouth freshener	*A. tortilis, A. nubica, C. africana, Cirdia Sinesis, C. holtziana and C. confusa*

4. CRITERIA AND METHODOLOGY FOR SUSTAINABLE HARVESTING OF GUMS AND RESINS

4.1 Criteria and methodology for sustainable harvesting of gums and resins

The impact of harvesting/tapping of gums/resins is determined by the maturity of the plant and the frequency and intensity of tapping. If done properly, tapping will not kill the exploited tree. However, excessive tapping can lead to the death of an individual tree. Moderate tapping of a tree may weaken its vigor by diverting energy needed to produce seeds to be used in the production of the gum/ resin. When extracting exudates, the physiological demands on the tree to produce additional latex or oleoresin compete with the tree's ecological necessity to produce seeds (Peters, 1994).

In order to develop clear criteria for sustainable exploitation of the gums and resins the following questions need to be addressed:

1. How and to what extent the removal of gums and resins interferes with the carbohydrate allocation to growth, reproduction and storage?
2. What is the tapping level that maintains a stable gum or resin yield and tree vitality?

It is essential to conduct studies in sites in different agro-ecological regions consisting of high and low altitude. The guidelines and tools with respect to tapping regimes for sustainable harvesting of gums and resins can be applied in yield, management and conservation strategies of gums and resins woodlands in the country. The results will also strongly contribute to and ensure a permanent supply of the commodities on the national and international market.

Forest Stewardship Council (FSC) and FairWild[1] have developed standards that can be used for certification of gums and resins. **FSC has developed** standards for Non-Timber Forest Products Certification (FSC, addendum November 2002) that could be used in certifying gums and resins especially if these are to be harvested from trees grown in a plantation. However, given that currently gums and resins in Kenya are obtained mainly from the wild (naturally growing trees in wood lands), this study recommends the use of FairWild standards/ criteria for these commodities.

The FairWild Standard rating system has been designed to facilitate continuous improvement to implement and achieve adequate levels of ecological, social and economic practices that contribute to sustainable wild collection, and to demonstrate

---

[1] FairWild Foundation (www.fairwild.org) is an official international body responsible for the International Standard for Sustainable Wild Collection (ISSC -MAP) and the Fair Wild Standard. The Eastern Africa office is located in Nairobi and managed by a registered IMO inspector (email: imo- tanzania@tanzania-organics.com)

commitment beyond minimum performance. The FairWild Standard has 11 Principles and 29 Criteria (Annex 2). For each of the first 10 Principles and related Criteria that apply to wild-collection operations, indicators / control points are defined as quantitative or qualitative parameters that can be verified to assess an operation's compliance with the Criteria. In the FairWild rating system, each indicator / control point describes progressive levels of compliance to facilitate the self- or third-party auditing process and allow demonstration of progress. The rating system allows certification applicants some flexibility to meet the FairWild Standard Criteria according to specific situations, while ensuring a high overall performance level through compliance with clearly defined minimum certification requirements.

This document (Annex 2) defines two sets of performance indicators: one set (listed in Part I) that applies generally to all target species and collection operations, and a second set (listed in Part II) that applies additionally to any species considered by the FairWild Foundation to be at high risk of unsustainable wild collection. The 11FairWild principles and 29 criteria are outlined below:

Principle 1: Maintaining Wild Plant Resources
Wild collection of plant resources shall be conducted at a scale and rate and in a manner that maintains populations and species over the long term.
1.1. Conservation status of target species The conservation status of target species and populations is assessed and regularly reviewed
1.2. Knowledge-based collection practices
Collection and management practices are based on adequate identification, mapping, inventory, assessment and monitoring of the target species and collection impacts.
1.3. Sustainability of collection rate
The rate (intensity and frequency) of target resource collection does not exceed the target species' ability to regenerate over the long term.

Principle 2: Preventing negative environmental impacts
Negative impacts caused by collection activities on other wild species, the collection area and neighbouring areas shall be prevented.
2.1. Sensitive taxa and habitats
Rare, threatened and endangered species and habitats that are likely to be affected by collection and management of the target species are identified and protected
2.2. Habitat (landscape level) management
Management activities supporting wild collection of target species do not adversely affect ecosystem diversity, processes and functions.

Principle 3: Complying with laws regulations and agreements

Collection and management activities shall be carried out under legitimate tenure arrangements and comply with relevant laws, regulations and agreements
3.1. Tenure, management authority and use rights
Collectors and managers have a clear and recognized right and authority to use and manage the target resource
3.2. Laws, regulations and administrative requirements
Collection and management of target resources comply with all international agreements and with national and local laws, regulations and administrative requirements, including those related to protected species and areas.

Principle 4: Respecting customary rights and benefit Sharing
Local communities' and indigenous peoples' customary rights to use and manage collection areas and wild-collected target resources shall be recognized, respected and protected.
4.1. Traditional use and practice, access rights and cultural heritage
Local communities and indigenous people with legal or customary tenure or use rights maintain control, to the extent necessary to protect their rights, traditional knowledge or
resources, over collection operations
4.2. Benefit-sharing
Agreements with local communities and indigenous people are based on appropriate and adequate knowledge of target resource tenure, access rights, management requirements and resource value. The agreements ensure a fair and equitable sharing of benefits for all parties involved.

Principle 5: Promoting fair contractual relationships between operator and collectors
Collectors have the structures and access to information needed to represent their interests and participate in FairWild Premium decisions. There is no discrimination against particular groups as collectors.
5.1. Fair contractual relationships The economic relation between company and collectors is fair and transparent and allows collectors to be involved in important decisions such as premium use or pricing agreements.
5.2. No discrimination against collectors
There is no discrimination against collectors based on race, colour, ethnic origin, religion, sex or political opinion and encouragement of women as registered collectors.

Principle 6: Limiting participation of children in wild collection activities

Collection and processing by collectors is done without substantial work contribution of children.
6.1. Children and young collectors Children are not contracted as collectors.
Young collectors never do any hazardous work.
6.2. Collectors contracting children for collection work
Collectors do not contract children as workers to help them in collection or processing.
6.3. Children helping their parents in collection
Children do very limited work in collection and only under supervision

Principle 7: Ensuring benefits for collectors and their communities
Trade intermediaries are minimized, collectors are ensured a fair price for the collected goods, and community social development is supported through means of a FairWild Premium fund.
7.1. Fair pricing and payment of collectors
Collection operation ensures fair long-term prices are being paid to collectors by requiring transparent cost calculations, involving collectors in pricing decisions, keeping trade chains short and ensuring timely payment of collectors.
7.2. FairWild Premium use and administration
As soon as any FairWild Premium is received, it is administered transparently in a premium fund and decisions on use of the fund are taken in an accountable way by the collectors' organisation, collectors' representative committee or an assigned mixed stakeholder FairWild premium board

Principle 8: Ensuring fair working conditions for all workers of wild collection operations
The collection operation ensures good working conditions for all workers of the wild-collection operation. The following criteria and indicators apply to all staff of the wild-collection operation including field extension / supervision staff, purchase staff and workers in processing or packing units, including subcontracted FairWild purchase centres.
8.1. Basic labour rights for wild-collection operation staff
The wild-collection operation respects basic human values and fundamental rights at work of all workers
8.2. Safe work environment for wild-collection operation staff
A safe and hygienic work environment shall be provided, bearing in mind the prevailing knowledge of the industry and of any specific hazards.
In assessing whether the measures taken are sufficient to guarantee a safe work environment, a risk-based approach is applied, i.e. larger factories with many workers or any particularly hazardous processing activities will be expected to have

better developed procedures and safety measures in place than smaller, low risk operations
8.3. Fair employment conditions for wild-collection operation staff
The wild-collection operation acts as a socially responsible employer and provides good employment conditions

Principle 9: Applying responsible management practices
Wild collection of target species shall be based on adaptive, practical, participatory and transparent management practices.
9.1. Species / area management plan
A species / area management plan defines adaptive, practical management processes and good collection practices.
9.2. Inventory, assessment and monitoring
Management of wild collection is supported by adequate and practical resource inventory, assessment and monitoring of collection impacts.
9.3. Implementation of sustainable collection measures by collectors
The wild-collection operation ensures that only trained and competent collectors collect the target resources and monitors the effective implementation of the applicable Collection Instructions by the collectors.
9.4. Training and capacity building
Resource managers and collectors have adequate skills (training, supervision, experience) to implement the provisions of the management plan and to comply with the requirements of this Standard.
9.5. Transparency and participation
Wild-collection activities are carried out in a transparent manner with respect to management planning and implementation, recording and sharing information, and involving stakeholders.

Principle 10: Applying responsible business practices
Collection of wild resources shall be undertaken to support quality, financial and traceability requirements of the market without sacrificing sustainability of the resource.
10.1. Market / buyer specifications
The sustainable collection and handling of the target resources is managed and planned according to market requirements in order to prevent or minimise the collection of products unlikely to be sold.
10.2. Traceability
Storage and handling of the target resources is managed to support traceability from the collection area to sales.

10.3. Financial viability and accountable trade relations
Mechanisms are encouraged to ensure the financial viability of systems of sustainable wild collection of target resources.

Principle 11: Promoting buyer commitment
The buyer of wild-collected products (e.g. importer) strives for mutually beneficial long-term trade relations with the wild-collection operation based on respect, transparency and support for the supplier in quality aspects. The FairWild buyer obligations as a fair trade partner are verified based on self-assessment and documentary evidence of compliance with the following two criteria:
11.1. Mutually beneficial trade relations
11.2. Fair prices and FairWild Premium
No performance indicators have been defined in this section

Fairwild has also provided additional indicators for high risk species. The following additional performance indicators apply to any operation that collects at least one high risk species.
1.1. Conservation status of target species
The conservation status of target species and populations is assessed and regularly reviewed.
1.2. Knowledge-based collection practices
Collection and management practices are based on adequate identification, mapping, assessment and monitoring of the target species and collection impacts
1.3. Sustainability of collection rate
The rate (intensity and frequency) of target resource collection does not exceed the target species' ability to regenerate over the long term.

5. SUSTAINABLE WILD HARVESTING AND DOMESTICATION PROTOCOLS

5.1 Formation of gums and resins

Natural gums and resins are present either in the intercellular space (ducts or cavities) of the plant parts or as exudate produced due to injury. The ducts or cavities formed due to injury are called traumatic ducts/cavities. The causes of gum and resin formation and their biosynthesis are not fully understood. Poor soil, drought and other hostile environmental conditions promote their production. Gums and resins do not re-enter the metabolism of the plant in which they are produced and therefore, they are considered as by-products or end products of certain metabolic changes. It is suggested that gum formation may be a pathological response of the plants to protect the injured part by sealing the region to prevent water loss and infection.

5.2 Gums and resins yield

Gums and gum resins emerge naturally from slits in tree barks; or by creating additional man-made slits, which yields larger quantities. The amount of gum produced varies, depending on the tree species, age, site and season (ambient temperature).

Gum arabic

Annual yields of gum arabic from young *A. senegal* trees are reported to range from 188 to 2856 g/tree (avg. 900 g) and from older trees, 379 to 6754 g/tree (average 2000 g) (Duke , 1983). Yield per ha per year ranges between 30 to 40 kg in case of open stands and as much as 100 kg in case of dense stands (ITC, 1983). The average annual gum yields/tree range from 0.5-1 Kg in Sudan and 0.1-0.5 Kg in Nigeria (SSGCL, 2006). In Kenya the average annual yields per tree is about 1.5 g (non-tapped) and 6.2 g (tapped) (Wekesa *et al*, 2009). On average, a tree yields 250g per season (ITC, 2008, Boer, 2002), implying about 500 g annually. The highest gum yields have been reported for trees between 7 and 15 years old in Nigeria and 10 to 15 years old in Sudan (SSGCL, 2006). Yields from cultivated trees are said to increase up to the age of 15 years, when they level off and then begin to decline after 20 years (Boer, 2002).

In Sudan and Nigeria, virtually all gum from *A. senegal* is obtained by tapping the trees; there is very little natural exudation. The reverse is true with *A. seyal* gum. In Kenya *A. senegal* does produce gum naturally and all of the gum which is collected comes from harvesting natural exudate.

Tapping of trees is reported to increase gum yield of *A. senegal* by 77.4 % (Wekesa *et al*, 2009) and the gum yield from *A .seyal* of about 27.9-76. 7 % (Mohammed and Röhle, 2009). Tapping of *A. senegal* trees starts as early as 3 years (Muga *et al*,2009, Nour and Osman (1997)for trees from seedlings grown in plantations, though others report 4 years (Duke, 1983) or 5 years (Abdala, 2007) for trees obtained from direct seeding. Diameter of the *A. senegal* trees tapped ranges from 4 cm in South Sudan (Muga *et al*, 2009). Tapping of *A. senegal* trees for gum production varies from site to site and usually begins usually after the long rains when the trees are just starting to shed their leaves (Muga *et al*, 2009). The main gum collection season in Kenya is December-May.

5.3 Guidelines and tools with respect to tapping regimes for sustainable harvesting of gums and resins

To enhance production of gums and resins, tapping methods have been developed over the years which do not damage the trees, and handling and cleaning practices have been optimized to produce superior quality products.

5.3.1 Harvesting techniques for gums and resins

Tapping methods have been developed which do not damage the trees, and handling and cleaning practices have been optimized to produce superior quality products. Harvesting is done manually by labour-intensive traditional methods of tapping. Damage to the wood should be minimal. Several branches are treated in a similar manner at one tapping. In the subsequent years, other branches or the reverse side of the previously treated branches are tapped.

Tapping is carried out shortly after the rains when the trees begin to shade the leaves. Tapping and collection of gum is carried out following a specific pattern around mid-September up to the end of the dry season, usually June. Tapping involves the shaving of a very thin, i.e. 2mm deep and 4-8mm wide, external layer of the bark starting at 0.5m from the base of the stem using a hand tool, 'Mingaf' for resins and 'Sonke' for Gum arabic. Once the 1st tapping is done, the 2nd tapping will take place after 30-40 days and involves a moderate widening of the wound, which was started during the 1st tapping. This tapping process will continue for three to four months until the wound has reached 4cm width. After each wounding/incision, the exudates start to ooze and becomes dry in 2-3 weeks when it will be ready for collection. (Chikamai and Kagombe, 2002). Collection of gums and resins from the wild is mainly done by women and herders during the dry months of the year. As far as possible, the tears are picked by hand from the stems and branches where they have formed, and not by knocking to the ground where they can pick up dirt. They are placed in an open basket carried by the collector; the use of plastic sacks has been found to increase the risk of moisture retention and mould formation.

5.4 Sustainable wild harvesting of gums and resins

Sustainable wild harvesting of gums and resins entails ensuring a continuous supply of the products. A number of opportunities exist that need to be exploited in order to make the production of gums and resins sustainable and these include but not limited to the following:

i. *Selective tapping of the trees*
ii. *Increased production and marketing of the commodities*
iii. *Value added processing in the County of origin*
iv. *Development of producer and national associations to develop and promote the sub sector*
v. *Capacity building on tapping (sustainable tapping procedures), collection, post-harvest handling and quality control of gum resins*
vi. *Development of long term management or ecological conservation plans*

5.4.1 Selective tapping of the trees

Though gums and resins emerge naturally from slits in tree barks, creating additional man-made slits yields larger quantities. Though tapping enhances gum yield, it may have some detrimental effects on the trees if not properly managed. Studies have shown that untapped trees produce very healthy and viable seeds, it is therefore necessary that selective tapping be practiced for all production systems. Some of the trees should be selected and left untapped to serve as seed sources (mother trees) or a sufficient resting period of 3–5 years be allowed after trees/stands are consecutively tapped for a couple of years to enable the trees to regain vigour and vitality.

5.4.1.1 Planning Considerations/Scenarios

To ensure sustainable supply of the gums and resins in Kenya, adoption of selective harvesting is recommended. It is also critical that issues of grazing patterns, fair trade and social responsibilities of exporting companies be clearly outlined and sorted out. Each of the two counties should be divided into four units. Assuming that 50 % of the potential production will be harvested annually, the two commodities could be harvested as per the proposed harvesting schedules in Tables 5-1 to 5-3.

Table 5-1: Proposed harvesting plan for *Acacia senegal* in Isiolo County

Year	**1**	**2**	**3**	**4**	**5**
Gum arabic Production (MT)	400	400	400	400	400
Harvesting cycle No.[2]	1,4	2,3	1,4	2,3	1,4

Table 5-2: Proposed harvesting plan for *Acacia senegal* in Samburu County

Year	**1**	**2**	**3**	**4**	**5**
Gum arabic Production (MT)	2000	2000	2000	2000	2000
Harvesting cycle No.[3]	1,4	2,3	1,4	2,3	1,4

Table 5-3: Proposed harvesting plan for *Commiphora holtziana* in Isiolo County

Year	**1**	**2**	**3**	**4**	**5**
Hagar Production (MT)	1400	1400	1400	1400	1400

[2]The CFA will divide the county/ecosystem into 4 harvesting blocks and producer associations formed for each block. The CFA will be the overall manager of harvesting operations in the ecosystem.

[3]The CFA will divide the ecosystem into 4 harvesting blocks and producer associations formed for each block. The CFA will be the overall manager of harvesting operations in the ecosystem.

Harvesting cycle No.[4]	1,4	2,3	1,4	2,3	1,4

5.4.2 Increased production and marketing of the commodities

Gums and resins resources have the potential for generating wealth and uplifting the living standards of the local communities in the dry lands. The local communities' gain employment, social benefits and income from the gums and resins from the point of production, grading and cleaning, packaging, transportation, storage, value addition and export. Various species of *Acacia*, *Commiphora* and *Boswelia* in the drylands produce commercial gums (especially gum arabic) and gum-resins (myrrh, hagar, frankincense) that are currently in demand in many of the world's industries. The current annual world demand for gum Arabic is about 100,000 MT against a current supply of about 70,000 MT which is projected to reach 150,000 MT by 2020 (Muller and Okoro, 2005). The annual world demand for gum resins is estimated at around 2500 MT. The demand for gums and resins far exceeds current levels of production.

Kenya is a producer of both gum arabic and gum-resins, and the World's third largest producer and exporter of gum resins (after Ethiopia and Somalia), with export volumes averaging about 1000 MT per year (valued at over US$2.5 million). The potential for gum arabic production in Kenya is about 3,000 MT while for resins (myrrh, hagar, frankincense) the potential is 3,500 MT. However, production and export of gum arabic has remained low (peak production was 460 MT in 1995) due to both the intrinsic properties of the gum and issues related to handling and post harvest processing.

Recent studies on Kenyan gum arabic have revealed very positive results. Gum arabic from Kenya is produced from *Acacia senegal* var. *kerensis. Acacia senegal var kerensis* gum is significantly different from the *Acacia senegal var senegal* gum (standard type) produced from Sudan and other gum producing regions of Africa for example, Nigeria and Niger. One of the major differences of the *Acacia senegal var kerensis* gum from Kenya is that it has high specific rotation, high nitrogen content and a high molecular weight compared to the *Acacia senegal var senegal* gum. This leads to high viscosity, better emulsification and stabilization properties and high soluble fiber content. Approval in the UK and France of gum Arabic from *Acacia senegal* as a food dietary fiber is now well accepted thus *Acacia senegal var kerensis* can be added as an ingredient / dietary fiber due to its high fiber content. It is also used as a stabilizer/ thickener in viscous food such as yoghurt, cheese, jam etc. Gum arabic is mainly used in the confectionery industry, where it is incorporated

[4]The CFA will divide the ecosystem into 4 harvesting blocks and producer associations formed for each block. The CFA will be the overall manager of harvesting operations in the ecosystem.

in a wide range of products i.e. it is used in chewing gum as a coating agent and as a pigment stabilizer. *Acacia senegal var kerensis* is an effective encapsulation agent because of its high water solubility, low viscosity, and emulsification properties. It is also used in the bakery industry due to its high moisture content and which make the baked product tenderer.

It is therefore necessary to promote the Kenyan gum arabic for the above niche markets, build the capacity of the producers, traders and exporters on post harvest handling of gum arabic and intervene on some of the key constraints in the sub-sector. Addressing some the existing gaps and constraints will make the trade in gums and resins sustainable and more profitable and beneficial to the resource poor pastoral collectors.

5.4.3 Value added processing in the County of origin

Post harvest handling of gum involves, storage, cleaning, sorting, grading, packaging and labeling. All gums and resins produced in Kenya are exported in raw form except for a small quantity of the total volume produced that is processed for essential oils. There is only one processor of gum resins in Kenya. The name of this processor is Vetochem Limited. Vetochem limited extracts essential oils from myrrh, Olibanum (Frankincense) and Opoponax (Hagar) through steam distillation process with an efficiency level of 70%. The yield of essential oils at 70% efficiency level is 5% for myrrh and 6% for Olibanum and Hagar. Thus, the product derived from gun resins is mainly the essential oils. In Kenya, there is no company that processes gum arabic. However, Arid Land Resources Limited (ALRL) carries out value addition to gum arabic by grinding the product and grading it before exporting. Other exporters of gum arabic add value to the product by removing impurities such as the tree bark and then sorting and grading the gum into different grades before selling it to the export market. To enhance the quality of gum, gum arabic should not be stored in plastic bags but in clean sisal or polyethylene gunny bags as plastic bags forms moisture results in the contamination of the gums. The gum should also be stored in a dry, clean and cool place, right from the village level. The gum should be stored in a raised ground. Resins need to be stored separately in a different store to avoid mixing with gum arabic. Construction of stores for gums and resins in a number of districts has been supported by ENNDA, Centre for Training in Integrated Research in ASAL Development (CETRAD) and African Wild Life Foundation and more support is encouraged. Packaging is done according to the importers requirements. Powdered gum arabic is packed in 50 kgs net weight bags while first grade lumps are packed in 25kgs net wt bags.

5.4.4 Development of producer and national associations to develop and promote the sub sector

There are about 80 registered gums and resins producer associations that have been formed in the 8 key producer counties. At least 12 (15 %) of these are from Isiolo (6) and from Samburu (6) Counties. Through the establishment of producer associations, there are a number of Community Based Organisations (CBOs) that have been formed in the two counties that are active in the production and marketing of gums and resins and other nature based products e.g., handcrafts, tree seeds, bee products as well as hides and skins. Opportunities exist to strengthen these producer associations in terms of capacity building in capital base, development of infrastructure (such as depots, primary processing, collection and value addition centres, central processing centre and commercial trials) and non-physical structure (operations, and value chain development) and training in selected topics (section 5.4.5).

5.4.5 Capacity building on tapping (sustainable tapping procedures), collection, post-harvest handling and quality control of gum resins

More than 400 people including extension service providers (as TOTs) and local communities (about 60 %) have been trained on production and post harvest handling of gums and resins in Kenya (including Samburu and Isiolo Counties) by KEFRI through the support of various organizations such as FAO, ENNDA, NALEP, CETRAD and ACT*!*. In addition, the capacity of at least 5 producer associations, 3 in Isiolo and1 Samburu Counties have been enhanced through the construction of gums and resins stores through the support of Food for the Hungry International (FH), African Wildlife Foundation (AWF), ENNDA and CETRAD. There is still need for training of the local communities on sustainable harvesting and regeneration techniques, advocacy, marketing, group formation and dynamics and natural resource management techniques.

5.4.6 Development of management plans (MPs)

There are no management plans for gums and resins resources in Kenya as these occur naturally in the wild. There is therefore an opportunity to develop a five year management plan (MP) for the Acacia-Commiphora wood land in each county/sub-county. The MPs will identify the management options in a particular woodland that will include harvesting of the gums and resins, promotion of natural regeneration and planting of the gums and resin producing trees. The key activities for implementing the five year MP will include: formation a Community Forest Association (CFA)/ a gums and resins producer association (GRPA) for each sub-county/county, establishment of selective harvesting cycles/ schedules for gums and resins, awareness creation on fire risks and hazards, selection of mother trees and seed stands, establishment of a community based complaints registry, protection of the trees, training of collectors on efficient harvesting and post harvesting techniques, promotion of sustainable harvesting and regeneration techniques, promotion of fair trade & benefit sharing across the value chain, promotion of community certification, resource mobilization strategy, monitoring and evaluation framework and development of a work plan.

Production of regular monitoring and evaluation reports will ensure adequate preparedness for annual internal audits and/or external audits. In addition, the MP forms the basis of establishing an integrated management system for the wood land which is expected to have positive environmental and economic results (e.g. cost savings), when implemented.

5.5 Protocols for sustainable wild harvesting and domestication for gums and resins

Sustainable wild harvesting of plant products provides a tangible incentive for involved communities to value standing forests/trees and take a real interest in the welfare and management of their natural resources. Sustainable wild harvesting and value addition of plant products also provides opportunities for direct participation of women and landless families/communities.

The key constraints to sustainable wild harvesting of gums and resins in Kenya include but not limited to the following:

i) **Unsustainable harvesting methods-** Lack of sound production practices affects the quality and quantity of gum resins produced. There is need to introduce and validate suitable tapping methods to improve yield and quality. Less intensive tapping procedures should be adopted such as reducing number of tapping points and new tapping regimes to include rest periods to ensure sustainability of the resource.

***ii*) Low natural regeneration-**the proportion of the juvenile *Commiphora holtziana* trees in a stand is less than 30% and that of juvenile *Acacia senegal* in Isiolo County is just on the thresh hold (30 %). Unless the trees and saplings are protected from cutting and heavy browsing by herbivores (to promote flowering, seeding and enhanced natural regeneration) there will be no future trees to tap from.

iii) Inconsistent quality of products increases variability-proper post harvest handling procedures which will result in value addition for premium grades and hence better prices are required.

In order to ensure sustainable wild harvesting of gums and resins in Kenya, it is necessary to develop protocols for sustainable supply that entails the establishment and promotion of sustainable harvesting levels and the enforcement through externally (FairWild, Organic and FSC) and internally driven (ICS) certification and as part of the purchase criteria of the buyers. FairWild Sustainable wild harvest standards (Annex 4) are used for harvesting of indigenous plant materials and can easily be adopted for gums and resins. These standards assure buyers that Products are produced in a socially and ecologically sound manner. Annual inspections are carried out by the accredited inspection body.

The FairWild Standards apply to Wild Collection Companies, who wish to add high social performance and fair-trade aspects to their endeavours towards sustainability. **Operations are expected to be certified according to either the ISSC-MAP or organic standards.** At the very least, operations must show activities to comply with ISSC-MAP requirements or organic standards and must normally reach certification according to either standard within 1-3 years (ecologically high risk situations: 1-2 year; low-risk situations: up to 3 years) after reaching FairWild certification. *In exceptional cases no certification required, but compliance with sustainable collection principles checked as part of FairWild audit.* All operations must comply with the criteria of ISSC-MAP principle 4 (respecting customary rights and benefits sharing). For ease of reference, the FairWild Standards are attached in Annex 3.

In this study, indicators and verifiers (Annex 3) from Forest Stewardship Council, Smart Wood non timber forest products certification addendum have been reviewed and domesticated for adoption for gums and resins. Based on the 12 indicators, information gathered during resource assessment study, traditional ecological knowledge and other scientific information on the species, draft sample protocols for sustainable harvesting of *Acacia senegal* and *Commiphora holtziana* have been developed and reported.

Draft Protocol for Sustainable harvesting of gum arabic from *Acacia senegal* var. kerensis in Kenya

Introduction

The Joint FAO/WHO Expert Committee on Food Additives (JECFA) defines gum arabic as the 'dried exudation obtained from the stems and branches of *Acacia senegal* or *Acacia seyal* (FAO, 1998). The key gum arabic producing species *Acacia senegal* and *Acacia seyal are* both present in Kenya. *Acacia senegal* has three varieties namely: *Acacia senegal* var. *kerensis, Acacia senegal* var. *senegal* and *Acacia senegal var*. *leiorhachis*. *Acacia senegal* var. *kerensis*, is the main source of commercial gum arabic in Kenya.

The purpose of this protocol is to provide guidance for assessing the harvesting and management of *Acacia senegal* var. keriensis according to the FSC Principles and Criteria. This document contains the performance indicators and verifiers that are useful for sustainability issues related to gum arabic harvesting and management of *Acacia senegal* woodlands**.** Critical parameters that determine the impact of harvest include: harvest intensity, initial density or population size, regeneration and growth requirements, and degree to which the plant depends on animals for pollination and dispersal. It is recognized that geographic and climatic variations, such as elevation and moisture, may influence production and desirable levels of harvest. It is further recognized that though the FSC Principles and Criteria remain unchanged, the indicators and verifiers are to be adapted based on regional and site-specific considerations. Furthermore, not all the indicators suggested in this protocol will be used in each assessment. The following performance indicators and verifiers have been suggested for assessing the harvesting and management of *Acacia senegal* var. keriensis:

1. Tree/Species selection
Var. *kerensis* grows as a single or several-stemmed shrub with lateral branches from near the base. Where it is multi-stemmed, each stem is treated as a separate tree.
3. Diameter and/or age
The trees to be tapped should be at least 3 years **(**trees from seedlings grown in plantations and 4-5 years for trees obtained from direct seeding and a minimum basal diameter of 5 cm for trees in the wild.

2. Tapping period/Seasonality: December-March, May –June and September-October when trees shed off their leaves.
3. **Tapping Intensity:** Make 1-2 wounds per branch on up to 2-3 branches per tree per season depending on number of branches (not exceeding 30% of the branches per season) size and age of the tree.
• Documentation of harvest frequency will be made.

4. Quantity
The amount of gum Arabic obtained per production site and from various trees to be documented and monitored to ensure that the amount extracted does not exceed stipulated levels/ ha.

5. Number of trees to be tapped
The percentage of individual trees harvested from the entire population will allow for the retention of mature, reproducing individuals (as mother plus trees).
• The portion of mature, reproducing individuals to retain is to be specified.

• The number of individual trees harvested per year to be pre agreed and should be 50 % of the population based on stocking density (about 50-338 trees/ha).

6. Genetic diversity and population structure

A minimum number of mature, reproducing individuals and the population will reflect natural diversity in composition and structure.

• Structural and genetic diversity is to be specified.

• Structural and genetic diversity is to be maintained.

7. Harvest/Tapping techniques

- Tapping techniques are applied according to defined best management practices so as not to damage the trees, and post harvest handling and cleaning practices to be optimized to produce a superior quality product.
- Harvesting to be done manually by labor-intensive traditional methods of tapping.
- During tapping, 1-2 branches to be treated in a similar manner at one tapping.
- In the subsequent years, other branches or the reverse side of the previously treated branches are tapped.
- A very thin layer 2mm deep and 4-8mm wide is shaved off, external layer of the bark starting at 0.5m from the base of the stem using a hand tool 'Sonke'. Once the 1st tapping is done, the 2nd tapping to take place after 30-40 days and involves a moderate widening of the initial wound cut during the 1st tapping. The tapping process to continue for three to four months until the wound has reached 4cm width. The oozing exudate to be left for 2-3 weeks when it will be dry and ready for collection.
- The tears to be picked by hand and placed in an open basket.
- Avoid knocking the tears to the ground where they can pick up dirt.
- Use of plastic sacks must be avoided as they increase the risk of moisture retention and mould formation.

It is important to note the following:

• Do not fell or destroy plants during tapping.

•Tap only trees that are 5 cm and above in basal diameter

• Do not over tap a tree or branch

• Follow carefully the specified tapping techniques and do not exceed the specified widths and depths.

- Adopt selective harvesting/tapping of gum arabic to ensure sustainable supply of the gum. Divide each tapping area into four units (Table 1).
-

Table 1. Proposed harvesting plan for *Acacia senegal*

Year	1	2	3	4	5

Gum arabic Productionha^{-1} (Kg)	x	x	x	x	x
Harvesting cycle No.[5]	1,4	2,3	1,4	2,3	1,4

8. Growth and regeneration rates

- Monitor growth and regeneration rates of trees regularly and bi-annually using a well-designed inventory system that is appropriate to the complexity, scale and intensity of the management system.
- The data (class distribution) should include juvenile trees. The proportion of juvenile trees (with diameter < 5 cm) should be at least 30 % or more. If over time seedling or sapling densities significantly decline, harvest adjustments are to be made by:
  a) Limiting the total area from which the resource can be harvested;
  b) Regulating the number of seeds being harvested; and/or
  c) Enrichment planting of harvested species.
  d) Regulating the number or size of the plants being harvested;

9. Visual appraisal of health and vigor

- Regular visual appraisals of the behavior and condition of harvestable plants/trees to be conducted pre- and post-harvest.
- Visual observations of the tapped trees to be done and recorded periodically (at the start of tapping and bi-annually) to ascertain that over a period of 5-10 years, harvestable plants/trees do not display loss of vigor, disease, aborted fruit/leaves or stunted growth.
- If harvested individuals display a weakened condition, harvest volumes to be reduced to allow for Individual and population recovery.

10. Wildlife /dispersers

Periodic assessments to be conducted in order to evaluate populations of animals that disperse seeds.

• Within the harvest area, populations of animals that disperse seeds remain stable.

• If populations of animals that disperse seeds decline, harvest adjustments are made in the frequency, quantity, seasonality and techniques of the harvest

[5]The CFA will divide the county/ecosystem into 4 harvesting blocks and producer associations formed for each block. The CFA will be the overall manager of harvesting operations in the ecosystem.

Draft Protocol for Sustainable harvesting of gum hagar from *Commiphora holtziana* in Kenya

Introduction

Hagar is an oily resin exudate from the stems of *Commiphora holtziana*. It oozes out and hardens to form lumps of various sizes and shapes with variable colour from yellow to dark brown or black. Locally, hagar is used as an acaricide against ticks, snake bites, scorpions, foot rot, mange and other livestock ailments. Commercially, it is a well-established herbal medicine and essential oil in cosmetics.

The purpose of this protocol is to provide guidance for assessing the harvesting and management of *Commiphora holtziana* according to the FSC Principles and Criteria. This document contains the performance indicators and verifiers that are useful for sustainability issues related to hagar harvesting and management. Critical parameters that determine the impact of harvest include: harvest intensity, initial density or population size, regeneration and growth requirements, and degree to which the plant depends on animals for pollination and dispersal. It is recognized that geographic and climatic variations, such as elevation and moisture, may influence production and desirable levels of harvest. It is further recognized that though the FSC Principles and Criteria remain unchanged, the indicators and verifiers are adapted based on regional and site-specific considerations. Furthermore, not all the indicators suggested in this protocol will be used in each assessment. The following performance indicators and verifiers have been suggested for assessing the harvesting and management of *Commiphora holtziana:*

1. Tree/Species selection
Where it is multi-stemmed, each stem is treated as a separate tree.
3. Diameter and/or age
The trees to be tapped should be at least 10 cm in diameter.

2. Tapping period/Seasonality: December-March, May –June and September-October when trees shed off their leaves.
3. **Tapping Intensity:** Make 3-4 tapping spots on each side of the tree (depending on tree size) (not exceeding 30% of the branches per season)
• Documentation of harvest frequency to be made.

4. Quantity

The amount of gum Arabic obtained per production site and from various trees to be documented and monitored to ensure that the amount extracted does not exceed stipulated levels/ ha.

5. Number of trees to be tapped

The percentage of individual trees harvested from the entire population will allow for the retention of mature, reproducing individuals (as mother plus trees).

- The portion of mature, reproducing individuals to retain is to be specified.
- The number of individual trees harvested per year to be pre agreed and should be 50 % of the population based on stocking density (about 75-150 trees/ha).

6. Genetic diversity and population structure

A minimum number of mature, reproducing individuals and the population will reflect natural diversity in composition and structure.

- Structural and genetic diversity is to be specified.
- Structural and genetic diversity is to be maintained.

7. Harvest/Tapping techniques

- Tapping techniques are applied according to defined best management practices so as not to damage the trees, and post-harvest handling and cleaning practices to be optimized to produce a superior quality product.
- Harvesting to be done manually by labor-intensive traditional methods of tapping. During tapping, selected branches are wounded in a similar manner at one tapping. In the subsequent years, other branches or the reverse side of the previously treated branches are tapped.
- Tapping is carried out shortly after the rains when the trees begin to shed off the leaves. Tapping and collection of hagar is carried out following a specific pattern around mid-September up to the end of the dry season, usually June.
- **Tapping**:
- ✓ Slightly shave the external layer of the bark and form a circular wound of about 1–2 cm high, 1–1.5 cm wide and 0.5–1.0 cm deep. Make 3-4 tapping spots on each side of the tree (depending on tree size), starting at about 0.5 m from the base of the stem.
- Repeat tapping every 15–20 days after the first tapping.
- During the subsequent tapping cycles, older wounds are refreshed and the blaze is moderately widened by removing more bark from the upper edges of the former wound and by carving down 2 cm of the lower edge.
- Continue tapping until the onset of the rainy season. Thus, a tree is tapped 8–12 times a year, and at the end of the production year each wound may attain a width of about 10 cm or more.
- Pick the tears by hand from the stems and branches where they have formed.

- Do not knock to the ground where they can pick up dirt. They are placed in an open basket carried by the collector (the use of plastic sacks is discouraged as they increase the risk of moisture retention and mould formation).

It is important to note the following:
• Do not fell or destroy plants during tapping.
•Tap only trees that are 5 cm and above in basal diameter
• Do not over tap a tree or branch
• Follow carefully the specified tapping techniques and do not exceed the specified widths and depths.

- Adopt selective harvesting/tapping of gum arabic to ensure sustainable supply of the gum. Divide each tapping area into four units (Table 1).
- Table 1. **Proposed harvesting plan for *Commiphora holtziana***

Year	**1**	**2**	**3**	**4**	**5**
Hagar Productionha^{-1} (Kg)	x	x	x	x	x
Harvesting cycle No.[6]	1,4	2,3	1,4	2,3	1,4

8. Growth and regeneration rates

- Monitor growth and regeneration rates of trees regularly and bi-annually using a well-designed inventory system that is appropriate to the complexity, scale and intensity of the management system.
- The data (class distribution) should include juvenile trees. The proportion of juvenile trees (with diameter< 10 cm) should be at least 30 % or more. If over time seedling or sapling densities significantly decline, harvest adjustments are to be made by:
  a) Limiting the total area from which the resource can be harvested;
  b) Regulating the number of seeds being harvested; and/or
  c) Enrichment planting of harvested species.
  d) Regulating the number or size of the plants being harvested;

9. Visual appraisal of health and vigor

- Regular visual appraisals of the behavior and condition of harvestable plants/trees to be conducted pre- and post-harvest.
- Visual observations of the tapped trees to be done and recorded periodically (at the start of tapping and bi-annually) to ascertain that over a period of 5-10 years, harvestable plants/trees do not display loss of vigor, disease, aborted fruit/leaves or stunted growth.

[6]The CFA will divide the county/ecosystem into 4 harvesting blocks and producer associations formed for each block. The CFA will be the overall manager of harvesting operations in the ecosystem.

- If harvested individuals display a weakened condition, harvest volumes to be reduced to allow for Individual and population recovery.

10. Wildlife /dispersers

Periodic assessments to be conducted in order to evaluate populations of animals that disperse seeds.

• Within the harvest area, populations of animals that disperse seeds remain stable.

• If populations of animals that disperse seeds decline, harvest adjustments are made in the frequency, quantity, seasonality and techniques of the harvest

6.0 A TEMPLATE FOR DEVELOPING SUSTAINABLE WILD HARVESTING PROTOCOLS FOR OTHER INDIGENOUS SPECIES IN KENYA AND EASTERN AFRICA

Sustainable community driven enterprise and ethical trade of Non Timber Forest Products is one of the most effective ways of bringing out lasting changes in socio-economic and environmental conditions in rural regions. This can help in effectively achieving Global Millennium Goals. Depending on many factors, including density, regeneration and pollination, non timber forest products (NTFP) species may be more or less susceptible to exploitation than others. Some of the parameters which will determine the impact of harvest include: harvest intensity, initial density or population size, regeneration and growth requirements of the species, and degree to which the plant depends on animals for pollination and dispersal. Geographic and climatic variations, such as elevation and moisture, will influence production and desirable levels of harvest. While, the FSC Principles and Criteria are relatively unchanging foundation, the following template based on indicators and verifiers derived from FSC (addendum for NTFPS) can be adapted for other exudates based on regional and site-specific considerations.

TEMPLATE FOR DEVELOPMENT OF PROTOCOLS FOR SUSTAINABLE WILD HARVESTING OF NTFPS

Protocol for Sustainable harvesting of ---------------------(commodity) from -------------------- (spp) in-------------(Country)

Introduction
Brief definition of commodity/product--------------------------------------

Purpose of the protocol

The purpose of this protocol is to provide guidance for assessing the harvesting and management of ---------------------------------- (insert spp name) according to the FSC Principles and Criteria. This document contains the performance indicators and verifiers that are useful for sustainability issues related to harvesting and management of -------------------------woodlands**.** Critical parameters that determine the impact of harvest include: harvest intensity, initial density or population size, regeneration and growth requirements, and degree to which the plant depends on animals for pollination and dispersal. It is recognized that geographic and climatic variations, such as elevation and moisture, may influence production and desirable levels of harvest. It is further recognized that though the FSC Principles and Criteria remain unchanged, the indicators and verifiers are to be adapted based on regional and site-specific considerations. Furthermore, not all the indicators suggested in this protocol will be used in each assessment. The following performance indicators and verifiers have been suggested for assessing the harvesting and management of ----------------------(spp):

1. Tree/Species selection
Where tree is multi-stemmed, each stem is treated as a separate tree.
3. Diameter and/or age
The trees to be tapped should be at least -------years **a**nd a minimum------- diameter of ----- cm for trees in the wild.

2. Tapping period/Seasonality: -------------(indicate month) when harvesting is most appropriate
3. **Tapping Intensity:** Describe harvesting techniques or procedure that ensures sustainability of the production.(30% of the harvestable parts of the plant should not be exceeded per season)
• Documentation of harvest frequency to be made.

4. Quantity

The amount of-------------- obtained per production site and from various trees to be documented and monitored annually to ensure that the amount extracted does not exceed stipulated levels/ ha.

5. Number of trees to be tapped

The percentage of individual trees harvested from the entire population will allow for the retention of mature, reproducing individuals (as mother plus trees).

- The portion of mature, reproducing individuals to retain is to be specified.
- The number of individual trees harvested per year to be pre agreed and should be at most 50 % of the population based on stocking density (about -------------- trees/ha).

6. Genetic diversity and population structure

A minimum number of mature, reproducing individuals and the population will reflect natural diversity in composition and structure.

- Structural and genetic diversity is to be specified.
- Structural and genetic diversity is to be maintained.

7. Harvest/Tapping techniques

Provide harvesting/tapping protocol from literature

It is important to note the following:

- Do not fell or destroy plants during tapping.
- Tap only trees that are ------ cm and above in basal diameter
- Do not over tap a tree or branch
- Follow carefully the specified tapping techniques and do not exceed the specified widths and depths.
- Adopt selective harvesting/tapping of ----------- (commodity/product) to ensure sustainable supply of the product. Divide each tapping area into four units (Table 1).

Proposed harvesting plan for *Acacia senegal*

Year	**1**	**2**	**3**	**4**	**5**
Name of commodityha^{-1} (Kg)	x	x	x	x	x
Harvesting cycle No.[7]	1,4	2,3	1,4	2,3	1,4

8. Growth and regeneration rates

[7]The CFA will divide the county/ecosystem into 4 harvesting blocks and producer associations formed for each block. The CFA will be the overall manager of harvesting operations in the ecosystem.

- Monitor growth and regeneration rates of trees regularly and bi-annually using a well-designed inventory system that is appropriate to the complexity, scale and intensity of the management system.
- The data (class distribution) should include juvenile trees. The proportion of juvenile trees (with diameter ,< ----- cm) should be at least 30 % or more. If over time seedling or sapling densities significantly decline, harvest adjustments are to be made by:
  a) Limiting the total area from which the resource can be harvested;
  b) Regulating the number of seeds being harvested; and/or
  c) Enrichment planting of harvested species.
  d) Regulating the number or size of the plants being harvested;

9. Visual appraisal of health and vigor

- Regular visual appraisals of the behavior and condition of harvestable plants/trees to be conducted pre- and post-harvest.
- Visual observations of the tapped trees to be done and recorded periodically (at the start of tapping and bi-annually) to ascertain that over a period of 5-10 years, harvestable plants/trees do not display loss of vigor, disease, aborted fruit/leaves or stunted growth.
- If harvested individuals display a weakened condition, harvest volumes to be reduced to allow for Individual and population recovery.

10. Wildlife /dispersers

Periodic assessments to be conducted in order to evaluate populations of animals that disperse seeds.

• Within the harvest area, populations of animals that disperse seeds remain stable.

• If populations of animals that disperse seeds decline, harvest adjustments are made in the frequency, quantity, seasonality and techniques of the harvest

7.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are made from the study:

- Samburu and Isiolo Counties have *A. senegal, C. holtziana, B. neglecta, and C. confusa* as the key gums and resins species. However, it is only *A. senegal var kerensis* (Isiolo and Samburu) and *Commiphora holtziana (in Isiolo)* that have reasonable quantities for commercial exploitation. Populations of both *Acacia senegal and Commiphora holtziana* in most of sites surveyed, have low natural regeneration and their protection is critical and sustainable tapping methods should be introduced and promoted to enhance sustainable production of gum Arabic and Hagar.
- Gums and resins in Kenya being currently obtained mainly from the wild (naturally growing trees in wood lands), the sustainable production can be gauged and audited using FairWild standards.
- Based on the 12 FSC indicators for NTFPs, information gathered during resource assessment study, traditional ecological knowledge and other scientific information on the species, draft sample protocols for sustainable harvesting of *Acacia senegal* and *Commiphora holtziana* have been developed and are to be validated by key stakeholders.

Recommendations

To ensure sustainable production of gums and resins in Isiolo and Samburu counties, it is essential that the tapping methods and timing be improved on. Ensuring sustained production of gums and resins from natural stands requires managing the resource in a responsible way. This involves, among others, managing the natural regeneration of the trees, through appropriate management of the ecosystem. Management options that support adequate regeneration of the trees include: regulated harvesting of gums and resins and intensive management of the stands among others. Generating sustainable benefits from the gums and resins sub-sector depends on the reconciliation of biological sustainability and commercial viability.

Several possible approaches for increasing the production and quality of gums and resins such as using appropriate collection tools and methods, improving the management of natural stands, domestication of the species, certification and should be employed in order to increase production and improve productivity. There should also be a funding mechanism for the selected sites.

Furthermore, with enhanced consultations with various actors, the process of moving the protocols to standards development is likely to gain more recognition and acceptance and thus also influence work on gums and resins collections in the entire East Africa sub region where potential is higher but still remains untapped

Once the protocols are finalized, there will be need to produce a policy paper for discussion by policy makers

8. ANNEXES

Annex 1: Inventory tool for gum resources

Data collected by:………………………………….. Date:……………………………

Sample plot No: -----------GPS readings: N--------------- E----------------- Alt: ……

State: ……………..…County: …………..………Payam: ……………….Boma……………..…

Tree species assessed: ………………….. Local Names……………………

Total No. of mature trees: …………… Mean DBH…………..Average Ht (m)……………..

Total No. of juvenile trees: ……………… Mean DBH……… Average Ht (m)…………….

Soil type: ………………………………………………………………………….

Terrain conditions: ……………………………………………………………..

Current use of resource: ……………………………………………………………

Extent of resource: From: ……………………………to……………………………..

Other vegetation in the neighbourhood…………………………………………………

Tree age category	**Tree No**	**Tree Height (m)**	**Tree diameter (cm)**	**Crown diameter (m)**		
				A	**B**	**Mean**
	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					
	11					
	12					
Mean						

Annex 2: Fairwild standards version 1 (11/2006)

APPLICABILITY

This standard applies to Wild Collection Companies, who wish to add high social performance and Fair- Trade aspects to their endeavors towards sustainability.

Operations are expected to be certified according to either the ISSC-MAP or organic standards. At the very least, operations must show activities to comply with ISSC-MAP requirements or organic standards and must normally reach certification according to either standard within 1-3 years (ecologi- cally high risk situations: 1-2 year, low-risk situations: up to 3 years) after reaching FairWild certification. *In exceptional cases no certification required, but compliance with sustainable collection principles checked as part of FairWild audit.*

All operations must comply with the criteria of ISSC-MAP principle 4 (Respecting customary rights and benefits sharing). For easier overview these sections are included below as part of the FairWild Stan- dards. The ISSC-MAP criteria regarding workers rights (section 6.5) are included in the FairWild Stan- dard in a more elaborate version.

FAIR WILD STANDARD ISSUES

SECTION I: RELATION BETWEEN COLLECTORS AND COLLECTION COMPANY

Criterion		Nr	Indicator	Form of indicator/ Method of control	Responsible			Category[1]
					Col-lec-tion man	Proc-essing Man-ager[2]	Cer-ti-fier	
Principle 1: Fair contractual relationship between company and collectors Collectors have the structures and access to information to represent their interests towards the wild collection company								
1.1	**Contractual relationship** The economic relation	1.1.1	Collectors receive basic information on approximate quantities that can be sold to the group	• Interview with collectors • Interview with purchase officer or collection support staff • Purchase estimates	X		X X	2

between company and collectors is fair and transparent.	1.1.2	Collectors feel fairly well treated in the contractual relationship	• Interview with collectors • Communication between company and collectors	X		X	2
	1.1.3	The collection company aims at long- term collection agreements with collectors. Collectors contracts are only cancelled with documented due reasons (insufficient quality, less sales)	• Collectors list comparison over year • Documentation on changes in collectors list	x		x	
	1.1.4	Collector can resign from collection activities within an appropriate and fair time frame.	• Contract with collectors • Interview with collectors	x		x	2
1.2 Collectors Organisation Collectors have the organisational structures to represent and defend their interests	1.2.1	Within 1 year from 1st certification on- wards, the contracting company initiates and supports the set up of one or several collectors' representation organisation(s).	• Reports on initialisation process, information from collectors • Statutes or minutes from collectors organisation meetings	X X			1
	1.2.2	Within 1 year from 1st certification on- wards, the collectors' representation organisation has at least constitutionally a democratic structure with voting rights for all members to elect their representatives.	• Statutes (or similar) • Collectors are at least aware of the organisation	X		X	1
	1.2.3	Within 2 years from first certification onwards, collectors' representation organisation is effectively in place and discussing collectors' interest with con- tracting company	• Documents or oral information on activities of the organisation	X			2
	1.2.4	If wished by the collectors group, it shall be permitted (to gradually take over more and more responsibilities of an independent collector organisation that sells its products to the collection com- pany.	• Interview with collectors or- ganisation representative and general manager • Communication between company and collectors or- ganisation	X		X	2

Principle 2: No Discrimination

No discrimination of particular social groups as collectors. The company supports the registration of women as collectors.

2.1	**Selection of collector No discrimination of particular social groups and en- couragement of women as registered collectors**	2.1.1	Company policies or Statutes (or similar effectively used guidelines) do not re- strict access to collectors groups based on race, colour, religion, sex, political opinion, national extraction or social origin	• Company policy on collectors contracting • Oral information from personnel selecting new collectors	X		X	1
		2.1.2	Disadvantaged groups (other than women) are not systematically excluded as registered collectors.	• List of collectors – cross check with local typically most disadvantaged social groups • Interviews with collectors from potentially disadvantaged groups in the area (also some not working for	X		X	2
		2.1.3	All collectors (irrespective of their social status) have the same working conditions (contract, trainings, prices paid, etc.)	• Contracts of different collectors • Interviews with collectors from potentially disadvantaged groups	X		X	1
		2.1.4	Women are not excluded from registration as collectors. Wives of registered collectors can also attend meetings and trainings.	• Interviews with personnel in charge of recruiting new col- lectors • List of collectors	X		X	2
		2.1.5	Women are actively encouraged to participate in the group and become full group members or: many women as registered collectors.	• Company policies • List of collectors	X X			3
Principle 3: Child Labour is avoided Collection activity is done without substantial work contribution of children								
3.1	**Child Workers and Young Workers** **Children** are not contracted as collectors nor used by collectors as workers. All young workers never do any hazardous work.	3.1.1	The collection company does not con- tract children below 15 years as collectors	• Collectors list • Interviews with collectors (also non- contracted ones)	X		X	2
		3.1.2	If the collection company contracts young collectors of age 15-18 years, it monitors carefully that the collection activity is not dangerous to the young people's health, safety or may jeopardize their development.	• Collector list indicates all young collectors clearly • Risk assessment of collection activities				
		3.1.3	The collectors do not CONTRACT children below 15 years for their collection activities (*does not concern children helping their parents in collection, see 3.2*)	• Interview with collectors (even non- contracted ones in the area) • View of collection activities • Company monitoring of collection situation with regard to child labour				2

Criterion		Nr	Indicator	Form of indicator/ Method of control	Collection man	Processing Manager	Certifier	Category
		3.1.4	Young workers (15-18 years) contracted by collectors do not engage in work that is dangerous to their health, safety and that may jeopardize their development.	• Interview with collectors • Risk assessment of collection activities	X		X X	1
		3.1.5	If there are still some children con- tracted: Children (< 15 years) never do work that is dangerous to their health, safety and that may jeopardize their development.	• Risk assessment of collection work	X		X	1
3.2	**Children helping their parents in collection** Children do very limited work in collection and under supervision only.	3.2.1	Children helping their parents: Children below the age of 12 do only very little collection related work (less than app. 2 hours/day regularly).	• Interview with collectors and of other people in the collectors communities • View of collection activities • Company monitoring of collection situation with regard to child labour	X		X X	2
		3.2.2	Children helping their parents: the work of children < 12 yrs does never jeopardize educational and physical development and is not hazardous or heavy.	• Interview with collectors • Risk assessment of collection activities • Information from local NGO's	X		X X X	2
		3.2.3	If there are many children <12 years working SUBSTANTIALLY in the collection for their families or there are some contracted children workers/collectors, the companies develops together with collectors a plan to gradually re- duce/eliminate child labour and improve attendance at school	• Child labour elimination plan	X			1

The following ISSC-MAP Standard section (=Principle 4 in ISSC-MAP Standard) must be met by all FairWild applicants (only additionally audited in case the company is not ISSC certified).

Criterion	Nr	Indicator	Form of indicator/ Method of control	Responsible			Category[3]
				Col-lec-tion man	Proc-essing Man-ager[4]	Cer-ti-fier	
Principle 4: Respecting Customary Rights Local communities' and indigenous peoples' customary rights to use and manage collection areas and wild collected MAP resources shall be recognized and respected.							

4.1 Traditional use, access rights, and cultural heritage Local communities and indigenous people with legal or customary tenure or use rights maintain control to the extent necessary to protect their rights or re- sources, over MAP collection operations	4.1.1	Knowledge of legal or customary rights, traditional uses and cultural and religious significance of MAP and other species and their habitats is available	• Documentation on traditional MAP and collection area uses so as on cultural and religious significance • Information gathering documents • Information from local groups/ indigenous peoples • Consultation with relevant authorities and specialists	X X X X			2
	4.1.2	Traditional uses / access rights are included in the resource / collection area management plan (according to criterion 5.1)	• Management plan	X			2◎1
.	4.1.3	Collection of MAP resources respects the cultural and religious significance of MAP and other species and their habitats (according to 4.1.1).	• Agreements with local groups / indigenous peoples • Maps indicating location and boundaries of these areas • Stakeholder interviews	X X		X	1
	4.1.4	Potential impacts of MAP collection activities on traditional use, access rights, and cultural heritage in the collection area (on the basis of indicator 4.1.1) are defined (including the influx of collectors).	• Risk analysis of potential impacts • Overall assessment	X		X	2◎1
	4.1.5	Measures are taken to avoid loss or damage affecting the legal or customary rights, resources, health security or livelihoods of local communities and indigenous peoples (on the basis of indicator 4.1.1).	• Management plan • Overall assessment	X		X	2◎1
	4.1.6	Fair compensation is provided in the case of such loss or damage.	• Evidence (e.g. document records) of consultation / conflict resolution • Stakeholder interviews	X			2◎1
	4.1.7	Availability, accessibility, and quality of medicinal plant resources for local and traditional use (on the basis of indicator 4.1.1) are not undermined or diminished by commercial collection.	• Records on consultations with local communities and indigenous people concerning avail- ability, accessibility and quality of medicinal plant resources • Exclusive collection areas • Stakeholder interviews	X X		X	2◎1

		4.1.8	Appropriate and effective mechanisms are used to resolve grievances.	• Evidence (e.g. document records) of consultation / conflict resolution with local com- munities and indigenous peoples concerning MAP collection activities • Overall assessment	X			2◎1
4.2	**Benefit sharing** Agreements with local communities and indigenous people are based on appropriate and adequate knowledge of MAP resource tenure, management requirements, and re- source value.	4.2.1	Agreements with local communities and indigenous people on the use of the resources exist.	• Agreement record/document	X			2
		4.2.2	Agreements are in compliance with relevant national laws and regulations concerning access and benefit sharing.	• National legislation / regulations	X			1
		4.2.3	Concerning the use of traditional knowledge: Informed consent is given by the source community, and mutually agreed terms are reached for access to this knowledge and the equitable distribution of benefits arising from its use.	• Agreement documents • Stakeholder interview	X		X	2◎1
		4.2.4	Evidence exists of prior informed con- sent (PIC) and mutually agreed terms (MAT) with respect to genetic resource access, management responsibility, and delegation of control to other agencies.	• Contracts and agreements include evidence of prior in- formed consent (PIC); statement of mutually agreed terms (MAT)	X			2◎1
		4.2.5	Resource access and benefit sharing agreements reflect available scientific, local, industry, and other relevant sources of knowledge / information concerning the current and anticipated value of the resource.	• Agreement document • Records, reports or other evidence reflecting the re- source value • Overall assessment	X X		X	2◎1
		4.2.6	Mechanisms for sharing benefits are perceived as fair by beneficiaries.	• Declaration of the beneficiaries • Stakeholders interview	X		X	2◎1
		4.2.7	Agreements allow for new information and changing local conditions affecting these communities.	• Agreement document • Overall assessment	X		X	2◎1
		4.2.8	Collection and processing of wild- collected MAP products are conducted in a manner that strengthens and diversifies the local economy.	• Evidence of reasonable provision for local employment • Local ownership of/ investment in MAP wild collection operations • Overall assessment	X X		X	1

Principle 5: FairTrade benefits the collectors and their communities

FairTrade minimizes trade intermediaries, ensures collectors a fair price for the collected goods and allows for social community devel- opment through means of a FairTrade premium fund.

5.1	**Transparent Cost Calculations** Transparent calculation of costs allows fair price negotiations between company and collectors as well as with buyers/traders	5.1.1	The collection company presents at least a basic cost calculation. This cost calculation includes costs of collection, prices paid to collectors, purchase & processing costs, overhead & profit as well as sales prices. The cost of collection requires detailed data collection on the basis of resource assessment and sustainable resource management implementing species/area management plans (i.e. it must be economically viable to issue a collection permit). Sustainable resource management includes decision making whether or not a resource is harvested at all in the context of FairWild.	• Cost calculation	x			2
		5.1.2	In setting prices with collectors the company bears in mind that collectors shall earn a fair share of the profit and that they should receive slightly higher prices since they do not receive any social benefits that employees get (in addition to very uncertain income)	• Price setting mechanisms and cost calculations	x			2
5.2	**Payment of Collectors** The Collection company agrees with collectors on fair prices and effectively pays the agreed prices on time.	5.2.1	The company gives sufficient information about its cost/benefits calculations (e.g. to collectors organisation) in order to allow open discussion on prices paid to the collectors.	• Cost calculations • Interviews with collectors´ organisation representative.	x		x	2
		5.2.2	The collectors are paid always within reasonable time after product delivery and according to the rates agreed with them. *First certification → ok if clear plans/agreements to pay on time in future*	• Collectors delivery and payment records • Interviews with purchase responsibles and collectors	X		X	1
		5.2.3	The collectors are paid in a way convenient to them (cash, normally).	• Payment records • Interviews with collectors	X		X	2

		5.2.4	Collectors receive at least slightly higher prices for the sustainably collected products than from local traders (*First certification → ok if such prices are planned*)	• Payment records • Information on local prices (from non-contracted collectors, etc.)	X X		X	1
		5.2.5	Collectors are paid a pre-payment, if requested (e.g. 20% of estimated sales value). *In case of new collectors or substantial misuse by collectors in the past, this requirement may be waived.*	• Contract/pre-payment agreements • Records on pre-payment • Interview with collectors' organisation	X X		X	
5.	**Intermediate traders and product assortment** FairTrade minimizes trade intermediaries and keeps long term interests of collectors in 3mind	5.3.1	If collectors' dependency on a single product (very limited product group) is a serious economic problem, the collection company makes reasonable efforts to promote product diversification.	• Company long-term trade policies / strategies • Communication with buyers • Interview with general man- ager	X		X	2
		5.3.2	The trade relation between the company and the collector (the person or family actually doing the collection) comprises not more than one trader/middlemen collector who only receives locally common margins for his service (or only contracted purchase personnel).	• Purchase procedures • Price comparison of payment to trader and payment to col- lector • If necessary comparative data from other local traders.	X X X		X X	2
5.4	**FairTrade Premium use** As soon as any FairTrade premium is received, it is administered transparently in a premium fund and decisions on the use are done in a democratic way.	5.4.1	Use of FairTrade premium is decided by the collectors' assembly or by a Fair- Trade committee with at least 2 collectors in the committee.	• Decision or Minutes of collectors assembly or of fund committee • List of member of fund commit- tee if relevant	X X			2
		5.4.2	If the use of premium fund money is decided by a committee (not collectors assembly), collectors are informed on fund activities and basically support the projects.	• List of member of fund commit- tee if relevant • Information to collectors (given on meetings or trainings, writ- ten information) • Collectors interviews	X X		X	2
		5.4.3	Any FairTrade premium paid into a FairTrade premium fund is responsibly administered and any use well documented.	• FairTrade fund book keeping documents (all expenses are accounted for)	X			1

	5.4.4	The premium fund committee or board writes each year a short report on all activities financed by fund money (with detailed budget).	• Fund activity report (present and planned activities)	X			2
	5.4.5	The records of used expenses paid from the fund correspond satisfactory to the spent amount and the activities reported in the annual fund report.	• FairTrade fund book keeping documents (all expenses are accounted for)	X			2
	5.4.6	The effective use of the FairTrade premium fund is basically for the agreed projects (small other justifiable expenses accepted).	• FairTrade fund bookkeeping • Fairtrade fund activity report & decisions on use of premium	X X			2
	5.4.7	The use of FairTrade premium should preliminary be for social projects. If considered necessary by the groups it may also be used for investment in business (but not to cover ongoing costs of running the business).	• Assessment of projects implemented (FairTrade fund activity report)	X			2

SECTION II: FAIR LABOUR CONDITIONS FOR WORKERS

Applies to all employees and workers of certified companies, e.g. in company's processing unit, but also employed/contracted field staff. (Rights of collectors are listed separately because not actually "workers")

Criterion	Nr	Indicator	Form of indicator/Method of control	Responsible			Category[5]
				Collection man	Processing Manager[6]	Certifier	
Principle 6: Fundamental principles and rights at work are respected Basic human values and most fundamental rights at work respected by the employer.							
6.1 **No forced labour** workers work voluntarily and are not kept against their will	6.1.1	No indication of forced labour	• Information from NGOs or in the media • Overall assessment			X X	1

		6.1.2	Family and dependents of workers are free to have other employment (without deductions for main worker).	• Family members work elsewhere • Worker testimony		X	X	2
		6.1.3	Employer does not retain workers documents (i.e. identity card) for times longer than demanded by law.	• Worker testimony • Staff files		X	X	1
		6.1.4	No kind of manoeuvre to prevent or delay workers from leaving the job (e.g. retaining salaries or benefits, high debts)	• Contract content • Workers testimony • Information from unions, NGOs, worker representatives		X	X X	1
6.2	**Freedom of Association and Collective Bargaining** Workers have the right to join or form workers unions or alternative organizations to represent their interests towards the employer and to bargain collectively.	6.2.1	Employer allows associative activities and collective bargaining and does not hinder union representatives to meet workers.	• Workers testimony • Testimony of union/workers representatives • Presence / documentation of active union or workers organisation • Collective bargaining agreements		X X	X	1
		6.2.2	Employer provides workers with at least some basic information about freedom of association & collective bargaining.	• Information for workers about their rights (e.g. information board; in contract, etc.)			X	2
		6.2.3	No indication of discrimination because of union membership or union activities (or activities in other kind of workers´ organisations).	• Union member worker testimony • List of recent dismissals, disciplinary actions		X	X	1
		6.2.4	Employer or management are not pre- sent during workers meetings (unless requested).	• minutes of workers meetings • union workers testimony		X	X	1
6.3	**No Child Labour** Children (<15 yrs) are not employed. Any children still working and all young workers (16-18) do not perform work that is hazardous or dangerous. If	6.3.1	There are no children below the age of 15 working in the operation (except very light household work like e.g. occasion- ally bring tea).	• staff files • visit of production premises – interviews with young-looking workers		X	X	2
		6.3.2	Children do not engage in work that is dangerous to their health, safety and that may jeopardize their development.	• Inspection of workplaces of children workers • Work reports/work allocation plans of children workers		X X	X	1

	children are still working there are adequate programmes to allow them to attend school.	6.3.3	Young workers do not engage in work that is dangerous to their health, safety and that may jeopardize their development.	• Inspection of workplaces of young workers • Work reports/work allocation plans of children workers		X X	X	1
		6.3.4	Young workers are never engaged in work not appropriate for their age (too complex/hard/dangerous, etc.).	• Inspection of workplaces of young workers • Work reports/work allocation plans of children workers • Workers testimony		X X	X X	2
		6.3.5	Young workers & child workers: work does not interfere with education and, normal school attendance.	• Young worker testimony • School attendance records • Company policies		X X	X	2
		6.3.6	If there are any child workers: company provides for schooling or specific education and training.	• Records on school fee payment or schooling programmes		X		3
		6.3.7	There is no new recruitment of child labour <15.	• Staff documentation • Interview with personnel man- ager		X	X	1
		6.3.8	Working hours of children workers from 12 to 14 years age do not exceed 7 hours/day including travel and school, sufficient rest periods.	• Working hours records / payment records of young workers • Child workers testimony		X	X	1
		6.3.9	Working hours of young workers from 15-17 years age do not exceed 10 hours/day including travel and school; sufficient rest periods.	• Working hours records / payment records of young workers • Young workers testimony		X	X	2
		6.3.10	If there is still or was child labour in past year: Company has satisfactory policies and programmes for remediation of children workers, and shall provide adequate support to enable such children to attend and remain in school until no longer a child.	• Staff files of past year • Company policy on transition of working children, school attendance support programmes, etc.		X X		2
6.4	**No Discrimination** No discrimination in hiring, compensation,	6.4.1	No indication of systematic discrimination (distinction, exclusion or preference) with respect to remuneration (wages and benefits).	• Comparison of wages of different workers, especially potentially/traditionally discriminated groups			x	1

	access to training, promotion, termination, benefits or retirement based on race, caste, national origin, religion, age, disability, gender, marital status, sexual orientation, HIV and Aids, union member- ship or political affiliation.	6.4.2	No indication of systematic discrimination (distinction, exclusion or preference) with respect to opportunities (training, promotion).	• Comparison of job positions, especially of potentially/traditionally discriminated groups • Workers representatives testimony			X	2
		6.4.3	No indication of systematic discrimination in hiring practices.	• Staff lists • Company policies in hiring • Interview with personnel man- ager		X X	X	2
		6.4.4	No indication of discriminating behaviour such as gestures, language, physical contact that is sexually coercive, threatening, abusive or exploitative.	• Workers testimony • Information from union or workers representatives			X X	1
		6.4.5	Employer is actively engaged to reduce discrimination amongst workers and to increase mutual respect and good inter- action amongst different groups of workers (i.e. cultural, educational activities).	• Company policy • Anti-discrimination awareness programmes or trainings • Cultural events • Workers information documentation • Awareness of head workers		X X X X	X	3
6.5	**Disciplinary Practices** Disciplinary practices are trans- parent and do not include corporal punishment, verbal abuse or other forms of intimidation	6.5.1	No corporal punishment.	• Clear instructions to head workers/managers (may be oral) • workers testimony & appearance		X	X	1
		6.5.2	No indication that disciplinary practices do violate dignity and basic human rights.	• Clear instructions to head workers/managers (may be oral) if potentially an issue • workers testimony		X	X	1
		6.5.3	Disciplinary practices are fair and trans- parent.	• company policy • testimony personnel manager • records on disciplinary measures or recent dismissals		X X	X	2
6.6	**Health & Safety** A safe and hygienic working environment shall be provided. Adequate steps are taken to prevent accidents and injury	6.6.1	Comprehensible warning signs on all main danger spots (if any).	• Warning signs (checked during site inspection)		X		2
		6.6.2	Fire extinguishers in place (accessible and ok maintained).	• Fire extinguishers (checked during site inspection)		X		1
		6.6.3	At least basic emergency procedures with emergency numbers well displayed.	• displayed emergency procedures • if no displayed, workers knowledge what to do in case of emergency		X X	X	1

to health arising out of or associated with or occurring in the course of work.	6.6.4	Emergency exits are unobstructed and clear to find (in small units normal doors are sufficient).	• indication exists (in small places no indication necessary)		X		1
	6.6.5	Workplaces, machinery and equipment are safe and without risk to health (as per good industry standard).	• Risk assessment whether present machinery is potentially dangerous for workers (incl. watching workers handling of dangerous machinery)		X	X	2
	6.6.6	Workers are at least comprehensively informed about risks of working place (better: workers are well trained).	• Workers testimony • Workers training records • Head workers interviews		X	X X	1
	6.6.7	Sufficient and well maintained first aid equipment is available on site.	• first aid equipment • Workers/head workers aware- ness of procedures in case of accident		X X	X	1
	6.6.8	Ok Records about accidents at work and work related sicknesses (or no accidents/illnesses ever).	• Records on accidents/sicknesses • Staff files: any major injuries/working absences due to accidents/illness • Head workers interviews		X X	X X	2
	6.6.9	Work-related accidents: medical care is covered/medical care paid by company (or insurance).	• Documentation on any work related accidents and medical payments (if any) • Company policy/insurances for work related accidents		X X		2
	6.6.10	Special risk groups such as pregnant women and children are fully excluded from unreasonable/potentially hazardous work.	• Head worker awareness of protection, training of head workers • Work allocation plans		X X		2
	6.6.11	Adequate protection from noise, dust, light and exposure to chemicals provided, maintained and effectively followed/implemented.	• Protective gears etc. are present (if necessary for type of machinery used) • Workers instruction		X X	X	2꩜1
	6.6.12	If health or safety is an issue in the company, safety committee or general management works on improvement of situation.	• Safety committee meeting minutes or Interview with general manager/safety responsible • Improvements plans, suggestions from worker organisation		X X	X	2꩜1

	6.6.13	Light situation at workplaces are satisfactory for respective tasks.	• Site inspection • Workers interviews		X	X	2
	6.6.14	Good quality of air / temperature: sufficient fresh air & ok temperature (by local working standards).	• Site inspection • Workers interviews		X	X X	2
	6.6.15	Access to drinking water of good quality: convenient access, free of charge.	• Drinking water sources • Any deductions for drinking water?		X	X	1
	6.6.16	Workers can consume/prepare food according to their habits in clean place.	• Eating areas existing and hygienically ok		X		2
	6.6.17	If there is on-operation accommodation: safe & sufficient accommodation at local standards, hygienic (local standard).	• Sufficient minimum furniture • Maximum number of inhabitants per area respected • Sufficient & ok sanitation		X X X		2
Principle 7: The company is a socially responsible employer and provides good working conditions (COMPANIES > 10 WORKERS) All workers enjoy good working conditions as defined by international labour standards as well as industry best practice standards.							
7.1 Contracts & Relation be- tween employer and workers Employment is based on a contractual relationship between the employer and workers. The employer informs workers on their rights and duties in the contract and internal communication	7.1.1	There are written employment contracts at least for all permanent workers.	• Contracts		X		1
	7.1.2	Within 1 year after certification all workers have written contracts (even temporary/seasonal labour).	• Contracts		X		2◎1
	7.1.3	All workers who should have a contract (as per system in place), actually have a complete and correct contract (accepted if a few contracts not correct/missing but worker have effectively same rights).	• staff files		X		2
Criterion	**Nr**	**Indicator**	**Form of indicator/Method of control**	**Responsible** **Col-lec-tion man**	**Proc-essing Man-ager[6]**	**Cer-ti-fier**	**Cate-gory[5]**
	7.1.4	Contract contains information about job description, scope of job, working hours, type and amount of remuneration, including overtime, rest and social benefits etc.	• contract		X		2

		7.1.5	Workers are (0) not (1) sufficiently (2) well informed about their duties and rights.	• Workers interview			X	2
		7.1.6	There is a (exceptionally) positive working atmosphere with very good interaction between employer and workers.	• workers interviews • records on social/cultural internal events, etc		X	X	3
		7.1.7	Employer offers worker good formation and continuous training (best: even with certificates/official qualifications for trainings).	• training policy & programmes, apprentice programmes • training certificates		X X		2
7.2	**Wages** Wages and benefits paid for a standard working week meet, at a minimum, national legal standards or, if not available, industry bench- mark standards. In any event, wages should always be enough to meet the basic needs.	7.2.1	Wages of all workers are at least in line, official minimum wages or (if not avail- able) industry benchmark standards*. (In case of pay-per-production, calculate income of an average production day without overtime). * in case industry- normal wages are always below the official minimum – ok if there is a written plan to pay minimum wages within 1 year.	• Wages in contracts or staff files • Crosscheck with minimum wages		X X X	X	1
		7.2.2	The paid wages are sufficient to meet the basic needs of the workers and their family.	• Assessment of wages with average living costs (information from NGOs and other qualitative sources of information)		X	X	2
		7.2.3	Training sessions or other kind of unproductive work (except working time loss due to weather conditions) are remunerated at the average daily wage rate.	• Contractual rules • Wage records • Worker interviews		X X	X	2
		7.2.4	Unproductive time due to poor weather conditions etc. is remunerated, even if with reduced rate.	• Contracts • wage records		X X		2
		7.2.5	If accommodation or other in kind remuneration is offered, worker can choose freely the type of remuneration preferred (i.e. cash instead of housing).	• Worker interview • Contract or other related agreement		X	X	2
		7.2.6	Deductions for food or housing are in line with local prices.	• Overall assessment		X	X	1
		7.2.7	Workers payments are regularly done and on time.	• Payment records • Workers interviews		X	X	1

		7.2.8	Payments are well documented.	• Payment records		X		1
7.3	**Working hours** Working hours are in line with national labour legislation and do not exceed internationally agreed maximum hours per week. There are adequate rest days and periods, even at peak times.	7.3.1	Normal weekly working hours are in line with national labour legislation.	• Working hours documentation (may be included in wages documentation)				2
		7.3.2	Usual weekly working hours are not more than 48 hours.	• Working hours documentation • Workers interviews • Information from NGOs´ etc.		X	X X	2
		7.3.3	Ok Documentation of working hours and overtime.	• Working hours documentation				1
		7.3.4	Overtime is obligatory for the workers only during peak times (less than 6 weeks/year); (best: voluntary only).	• Overtime regulations in con- tract • Overtime policy • work allocation plans		X X X		2
		7.3.5	Overtime does not exceed 12 hours/week.	• Working hours documentation at peak season				2
		7.3.6	Overtime is remunerated according to local legislation; at least paid extra or can be time-compensated (best: remunerated at premium rate).	• overtime rules in contract • actual payment records in peak seasons		x	X	2
		7.3.7	Rest breaks & rest days, even during peak times: 1 day for every 7-day period agreed and guaranteed (may be aver- aged over 2 weeks at peak times). Adequate rest times during the day.	• Working hours documentation at peak seasons Workers interviews		X	X	2
		7.3.8	Special consideration is given to workers who need more flexibility in working hours (parents, young workers studying etc.).	• Workers interviews • Work allocation plan • Interview with person preparing work plan		X	X X	3
		7.3.9	If overtime is an issue in the company: there is a written agreement between workers and employer regarding maxi- mum and minimum normal weekly work- ing hours, annual number	• Overtime agreement		X		2⊚1
		7.4.1	Compliance with national legislation in regard to social benefits (sickness, retirement, maternity).	• Crosscheck with social benefit regulations • Actual deductions and payments to social security programmes		X	X	1

7.4	**Social Security** The employer shall provide access to adequate schemes to support the workers' welfare such as social insurance, pension funds, health insurance, medical care	7.4.2	Basic coverage for retirement (independent from legislation) is guaranteed at least for all permanent workers.	• Retirement benefit records, deduction shown in wage re- cords		X		2
		7.4.3	Basic coverage for maternity and sick- ness (independent from legislation) is guaranteed at least for permanent workers.	• Maternity & sickness benefit records in staff files • Deductions in wage records		X		2
		7.4.4	Workers receive extra social benefits such as additional medical insurance, unemployment insurance, accident/death insurance, membership to a private retirement fund	• Social benefit records		X		3
		7.5.1	With regard to salaries, there are no differences between permanent and temporary workers for work of equal value (use daily rates for comparison).	• Salaries in contracts • Effective wages paid (wage documentation)		X X		2
7.5	**Equal treatment of different worker types** Working conditions of the most disadvantaged workers (often contracted/seasonal labour) shall be improved gradually and differences to permanent workers gradually diminished.	7.5.2	With regard to social benefits & working conditions, there are only little differences between permanent and temporary workers for work of equal value.[8]	• Wages documentation • Benefits according to contract		X		2
		7.5.3	If there are still substantial differences between permanent and temporary workers, a plan for gradual improvement is established within 1 year after certification.	• Improvement plan		X		1
		7.5.4	Employer does NOT hire and fire workers on a continuous basis to avoid social security and benefits payments.	• Overall assessment			X	2
		7.5.5	There is no indication that sub- contracting, home-working, apprentice- ships etc. is used to avoid regular employment or direct contracting.	• Overall assessment			X	2
		7.5.6	In case work is sub-contracted: working condition of subcontractor are (basically the same as for directly contracted workers for similar tasks.	• Communication with subcontractor on social issues • Qualitative assessment of subcontractors, if required au- dit of subcontractor		X	X	2
		7.5.7	If there are foreign/migrant workers: Employer informs and, if wished by worker, assists workers in obtaining a work permit.	• Interview with manager • Records on assisting workers with permit applications etc.		X	X	2

SECTION III: FAIRTRADE OBLIGATIONS OF WILD COLLECTION COMPANIES TOWARDS BUYERS

Criterion	Nr	Indicator	Form of indicator/Method of control	Responsible: com pany	Responsible: buyer	Responsible: Cer- ti- fier	Cate- gory[9]
Principle 8: Wild Collection Companies strive for fair and quality conscious trade behaviour The wild collection companies respects common FairTrade principles in the trade relation with its FairTrade buyers.							
8.1 **Responsible & transparent trade relation** The wild collection company works closely with its clients on clear and transparent trade agreements	8.1.1	Buying/sales commitments are negotiated at the beginning of the season among the trading parties and fixed in writing specifying expected quantities and quality.	• Sales commitments	X			2
	8.1.2	The company has fulfilled the agreements or if not, has found a mutually agreed solution with his clients.	• Communication with buyers • Sales versus agreements	X		X	2
	8.1.3	The company shares upon request its cost calculation with its buyers (*and they also make their cost calculations clear*- see 9.2).	• Cost calculation				2
8.2 **Quality Management** The company continuously works towards quality improvement and re- solves quality problems in mutual consent with buyers.	8.2.1	The company works continuously to- wards continuous improvement of product quality.	• Quality policy or related internal trainings or internal communication • Interview with management	X		X	1
	8.2.2	If there have been substantial quality problems and quality claims partners have found agreement on the consequences (e.g. return of produce) and the company has taken steps to improve the situation.	• Communication with buyers on quality problems and quality claims • Information from buyers (also during buyers audit)	X		X	1
8.3 **Use of Pre- payment**	8.3.1	If any prepayment has been received, it has been used to pay collectors in advance/on time or any other measure agreed with trade partner.	• Records on use of prepayment • Communication with buyers	X			1

SECTION IV: FAIRTRADE OBLIGATIONS OF BUYERS TOWARDS THEIR WILD COLLECTION PRODUCT SUPPLIERS

***Verified in audit of buyers of FairTrade products** (e.g. importer in Germany)*

Criterion	Nr	Indicator	Form of indicator/Method of control	Responsible: Sel- ler	Responsible: Buyer	Responsible: Cer- ti- fier	Cate- gory[10]
Principle 9: FairTrade practices The buyer of FairWild products (e.g. importer) strives for mutually beneficent long term trade relations based on respect, transparency and support of the supplier in quality aspects.							
9.1 Mutually beneficent trade relations The buyer endeavours to maintain with its FairWild suppliers long-term trade relation, keeps trade chain short and allows sup- pliers trade flexibility	9.1.1	Buyer has (or plans) a long-term relation with its FairTrade suppliers.	• List of FairWild Suppliers with begin of trade relation • Justification in case of shift from one supplier to another		X X		2
	9.1.2	The number of trade intermediaries between wild collection company and importer: no intermediaries / basically direct from producing company.	• Trade invoices		X		2
	9.1.3	If the buyer pays & owns the FairTrade certificate of the supplying producer company: The producer company is permitted to sell its products also to other buyers directly in case the contracting buyer cannot buy all products (at agreed price), possibly the producer company has to bear part of certification costs if selling as certified to other traders.	• Communication with the sup- plier regarding trade with other clients • Feedback also from suppliers FairWild audit		X	X	2
9.2 Transparent Trade agreements Trade is based on written, clear trade	9.2.1	Buying/sales agreements are negotiated at the beginning of the season among the parties and fixed in writing specifying approximate expected quantities and quality.	• Buying agreements	X	X		1

	agreements that outline both parties' obligations	9.2.2	Buying agreements outline the expected quality (with tolerances), quality claim procedures, delivery conditions and payment conditions in clear terms, in a way that both trading partners know their obligations clearly (level of detail required will depend on product).	• Buying agreements	X	X		2
		9.2.3	In case of fresh / perishable products, the buyer provides the suppliers with sourcing plans with projected quantities in regular intervals.	• Regular updates on planned quantities		X		2
		9.2.4	In price setting negotiations, the buying company also informs its suppliers at least roughly on its cost calculations, in order to allow fair negotiations.	• Price setting calculation • Communication with suppliers		X X		1
		9.2.5	FairTrade pricing is not avoided by linking FairTrade sales contracts to reduced prices for "normal" sales con- tracts: no such cases at all or all cases really fair and transparent.	• FairWild and "conventional" purchases from same supplier and related communication • Buying agreements		X X		1
9.3	**Prepayment** Small wild collec- tion company are partially pre-paid (if needed) to finance their purchase from collectors	9.3.1	If requested by supplier (small wild collection companies only), the buyer provides partial pre-payment. Exception: new trade relation or substantial delivery problems in the past.	• Communication with suppliers on requested prepayment • Prepayment transfers • check with info from supplier audit		X X	X	2
9.4	**Quality improvement** Support of the supplier on quality improvements and deals with quality problems in tolerant and transparent way.	9.4.1	If there have been substantial quality problems and quality claims: partners have found agreement on the consequences (e.g. return of produce) and have taken steps to improve the situation.	• Communication with supplier on quality problem • Interview with purchase personnel			x	1
		9.4.2	The buyer supports its suppliers with relevant market information and gives assistance with quality issues.	• Communication with suppliers • Assistance /support programmes/visits/trainings		X X		2

Principle 10: Fair Prices and FairTrade Premium

The buyer of FairWild products pays fair prices and some FairTrade premium to allow for social development of the collectors communi- ties.

Criterion	Nr	Indicator	Form of indicator/Method of control	Responsible: Seller	Responsible: Buyer	Responsible: Certifier	Category[10]
10.1 **Fair Prices** The buyer of FairWild products pays fair prices and a FairTrade premium to allow for social development of the collectors' communities	10.1.1	Prices paid for certified FairWild products are based on individual cost calculations, but always slightly above normal market prices paid on the conventional market.	• Market Price analysis		X		1
	10.1.2	Prices paid for certified ISSC or organic FairWild products are based on individual cost calculations, but as a general guideline at least 3% higher than normal market prices for the respective non- certified product.	• Trade invoices • Market price analysis		X X		3
	10.1.3	In addition to the agreed fair price for the product, the buyer pays an agreed Fair Trade premium into the supplier's Fair- Trade collector's fund.	• Price agreements / purchase contracts • Prices paid as per trade in-voices		X X		1
	10.1.4	The agreed fair price plus FairTrade premium shall be negotiated with regard to the whole quantity purchase (not some lots "fair prices", others very low prices).	• Price calculations and considerations • Actual price paid				2
	10.1.5	The buyer agrees with the suppliers on minimum prices in order to avoid prices for producers falling under costs of production for the collectors.	• Minimum price agreements / purchase contracts • Interview with manager & purchase responsible		X	X	3
	10.1.6	The buyer shows efforts to understand actual production costs and to adapt his pricing policy as much as possible to this understanding	• Communication with suppliers • Reports on visits of suppliers, cost calculations, etc.		X X		3
	10.1.7	The buyer pays the supplier fully & on time / as agreed in purchase contracts.	• payment records • purchase contracts		X X		1

1. Tree/Species selection

Multi-stemmed trees that have the ability to re-sprout are harvested preferentially.

2. Knowledge

Rates of harvesting intensity, frequency, and seasonality are defined based on a combination of scientific

Study and/or long-term local experience and knowledge.

- Scientific information is available.
- Local management/use of selected species exists.
- Harvest rates are documented in writing.
- Analysis of implications of different harvest rates is available.

3. Diameter and/or age

Minimum diameter at breast height (DBH), age, or height at which plant part may be harvested has been determined in a manner which explicitly aims to reduce negative impacts on long term vigor and production, nor excessively impact the species population.

- Minimum age, DBH or height for first harvest is specified.
- Individuals are harvested at or above the minimum age/DBH/height.

4. Quantity

The quantity of material removed minimizes any negative impacts on long-term vigor and production.

- Volumes extracted are documented.
- Volumes extracted do not exceed stipulated volumes.
- Data (or visual observations) on the relationships between volume extracted and plant growth, development and reproductive biology are available.

5. Frequency

The frequency of harvest from a population or individual in a given time period has been determined and is conducted in a way that reduces negative impacts on vigor and production.

- Frequency of harvest does not exceed stipulated frequency.
- Frequencies are adjusted according to the DBH, age, size or height of the harvestable tree.
- Records of harvest frequency are documented.
- Information on frequency is based on the observations of a number of different sources.

6. Timing / Seasonality

Harvesting is explicitly timed and designed to reduce stress during reproductive periods and minimize impacts on reproductive capacity.

- Harvesting takes place according to specified timing/seasonality.
- Information is available on the reproductive cycles.

• Instructions on periods to avoid and concentrate harvesting exist.
• Harvesting minimizes a negative impact on the plant's reproductive capacity.

7. Density / abundance

The percentage of individuals harvested from the entire population will allow for the retention of mature, reproducing individuals (as mother plus trees).

• The portion of mature, reproducing individuals to retain is specified.
• A portion of mature, reproducing individuals is retained.
• The number of individuals harvested is according to a pre-agreed density (trees per hectare).

8. Genetic diversity and population structure

The management system guarantees that a minimum number of mature, reproducing individuals and the population will reflect natural diversity in composition and structure.

• Structural and genetic diversity is specified.
• Structural and genetic diversity is maintained.

9. Harvest/Tapping techniques

Tapping techniques are applied according to defined best management practices.

• Plants are not felled or destroyed during tapping, unless part of approved silvicultural system (e.g. coppicing).
• Negative, indirect impacts of tapping/harvesting are minimized.
• Tapping/ harvesting takes place according to specified techniques.
• Appropriate heights for taps/incisions are determined.
• Taps/incisions are located at specified height.
• Appropriate depth of tap is determined.
• Tap does not exceed specified depth.

10. Growth and regeneration rates

Growth rates and regeneration are regularly monitored using a well-designed inventory system that is appropriate to the complexity, scale and intensity of the management system.

• Frequency of monitoring is specified.
• Periodic regeneration surveys are conducted as specified.
• Size class distribution includes seedlings to large adults.
• Seeding or sapling densities as recorded in a vegetation or regeneration survey remain equal to or above baseline values.
• If over time seedling or sapling densities significantly decline, harvest adjustments are made by:

a) Limiting the total area from which the resource can be harvested;
b) Regulating the number or size of the plants being harvested;
c) Regulating the number of seeds being harvested; and/or

d) Enrichment planting of harvested species.

11. Visual appraisal of health and vigor

Regular visual appraisals of the behavior and condition of harvestable plants/trees are conducted pre- and post-harvest.

- Over a specified period of time, harvestable plants/trees do not display loss of vigor, disease, aborted fruit/leaves or stunted growth.
- If harvested individuals display a weakened condition, harvest volumes are reduced to allow for individual and population recovery.
- If visual assessments and inventories indicate a decline in the density of non-targeted species in the area of harvest, adjustments are made in the management regime to recover density.

12. Wildlife /dispersers

Periodic assessments are conducted in order to evaluate populations of animals that disperse seeds and fruits.

- Within the harvest area, populations of animals that disperse seeds remain stable.
- If populations of animals that disperse seeds decline, harvest adjustments are made in the frequency, quantity, seasonality and techniques of the harvest

REFERENCES

Abdala, 2007. Gum acacia Belt Potential in the Livelihood improvement of Central Sudan Drylands. Forests National Corporation

Beentje, H. 1994. Kenya Trees, Shrubs and Lianas.National Museums of Kenya, Nairobi.

Berkes, R, ed. 1989. *Common Property Resources: Ecology and Community-Based Sustainable Development.* London, Belhaven Press.

Brenan, J.P.M. 1953. Tropical African Plants: XXIII. Kew BULL. 8: 97-101, London.

Brenan, J.P.M. 1959. Leguminosae, subfamily Mimosoideae.In Flora of Tropical East Africa (eds. Hubbard, C.E. & Milne-Redhead, E.), Crown Agents, London.

C. Wekesa, A. M. Luvanda; **M. O. Muga,** B. N. Chikamai, P. M. Makenzi**.** 2013. Market Chain Analysis of Gum Arabic Trade in Kenya. *Octa Journal of Environmental Research April - June, 2013.* International peer-reviewed journal ISSN 2321-3655. *Oct. Jour. Env. Res. Vol. 1(2): 93-106***.** Available online http://www.science beingjournal. com.

C. Wekesa, P. Makenzi, B. N. Chikamai , J. K. Lelon, A. M. Luvanda and M. Muga. 2009. Gum arabic yield in different varieties of *Acacia senegal* (L.) Willd in Kenya

Chikamai, B,N., M. Muga and M. Marangu. 2010. Development of the gum arabic sub-sector in Kenya. A paper presented during the conference on "New Developments in Acacia Gums Research, Products and Processes" held at Glyndwr University, UK, September 20-22, 2010

Chikamai, B.N., E. Casadei (eds). 2005. Production and Marketing of Gum resins: Fankincesnse, Myrrh and Opoponax. NGARA series 5. 97 pp

Chikamai B.N. and Odera J.A. eds. 2002. Commercial Plant Gums and Gum Resins in Kenya: Sources of Alternative Livelihood and Economic Development in the Drylands. Executive Printers, Nairobi, Kenya.

Chikamai, B.N. and J. Kagombe (2002): Country report for Kenya. In Chikamai, B.N. (Ed.): *Review and synthesis on the state of knowledge of Boswelia species and commercialisation of frankincense in the dryland of Eastern Africa.* FAO, EU and FORNESSA. Pp 36 -51

Chikama, B.N., 2001: Taxonomic and ecological characteristics of the Acacia Gum tree; Paper presented at the Symposium on "Acacia Gum: Food ingredient for the future.", Nefta, Tunisia: 21st to 23rd February 2001

Chikamai, B.N., Hall, J.B., 1995: Survey of *Acacia senegal* resources for gum Arabic in Northern Kenya. Commonwealth Forestry Review 74 (3), 1995

Chikamai, B.N., Gachathi, N., 1994: Gum and resin resources in Isiolo District, Kenya: Ethnobotanical and Reconnaissance survey; E. Afr agric, For. J (1994) 59(4), 345-351

Dharani, N. 2006.Field Guide to Acacias of East Africa.Struik Publishers (Adivision of New Holland Publishing (South Africa) (Pty) Ltd). Cape Town.

Duke, J. A. 1983. Handbook of Energy Crops. Unpublished

FAO, 1998. Food and Nutrition Paper No. 52, FAO, Rome.

FAO, 1995b.Non-Wood Forest Products for Rural Income and Sustainable Forestry. FAO, Rome.

FAO 1993. International trade in non-wood forests: An overview. F.O: Mis/93/11.

Gachathi, F.N.M. 1994. Variation in *Acacia senegal* and its Relationship with *Acacia circummaginata* and *Acacia thomasii* in Kenya. Msc. Thesis in Pure and Applied Fungal Taxonomy, University of Reading, Reading.

Gachathi, F.N.M., and Muga, M.O., 2009: A review of commercial gums and resins resources in Kenya. Proceedings of the 4 th KEFRI scientific conference. KEFRI Headquarters, Muguga, Kenya, 6-9 October, 2008.

Muga, M.O, Kiama, S., Oriwo, V.A., Mbiru, S. S, Gachathi, F.N., Waithera, R. and Chikamai, B.N. 2012. Resource Assessment and Mapping of *Commiphora holtziana in Garbutla*. A study carried out for NALEP.

Muller and Okoro. 2004. Production and marketing of Gum acacia. NGARA Publication Series 2.

ITC. 1983. The Gum acacia market and the development of production. International Trade Centre, UNCTAD/GATT, Geneva and the United Nations Sudano-Sahelaian Office.

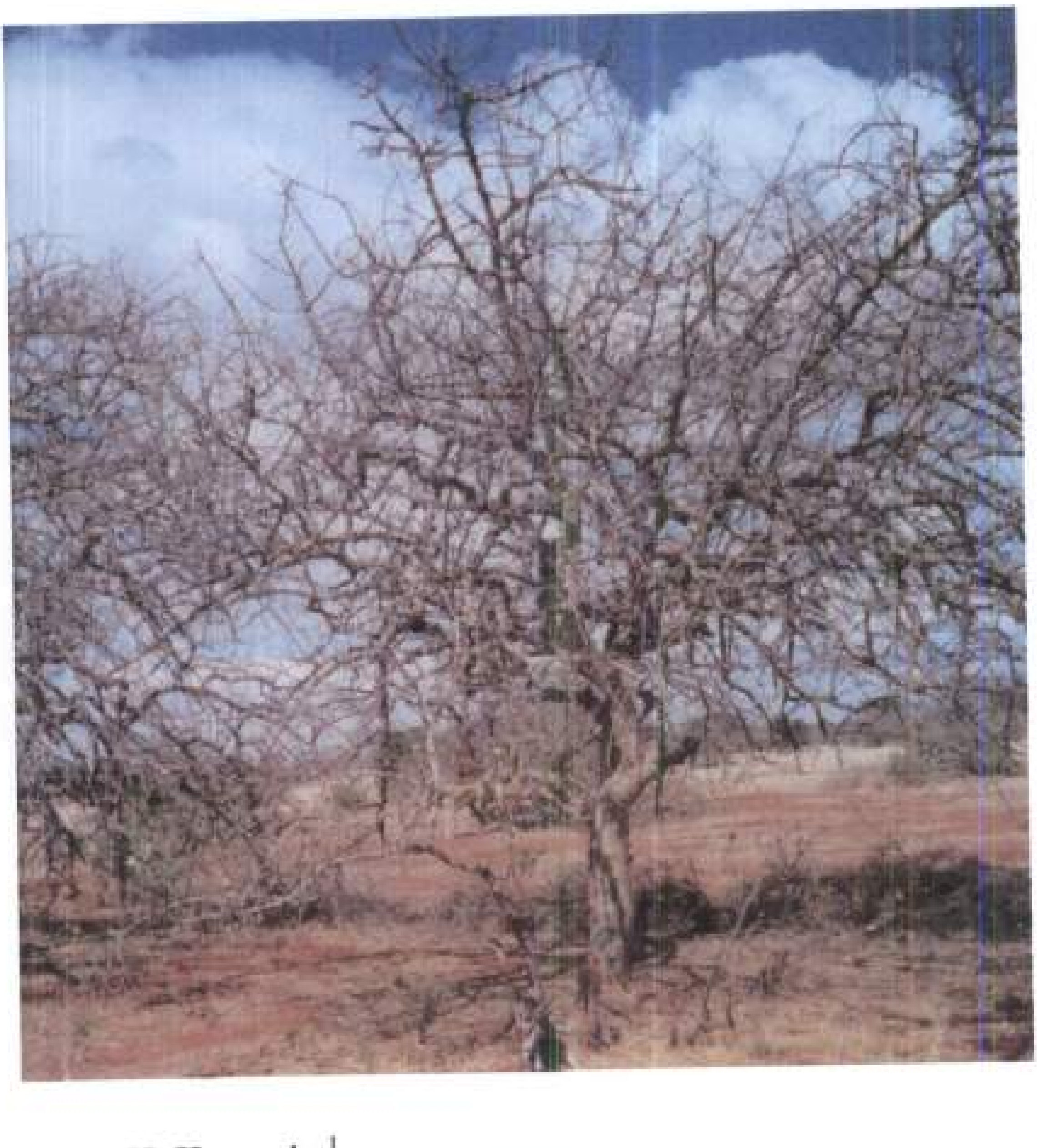
ITC, 2008. Gum acacia news service (Mns). Quarterly edition. International Trade Centre UNCTAD/WTO(ITC).

Muller and Okoro. 2004. Production and marketing of Gum acacia. NGARA Publication Series 2.

NGARA publication series 5. 2005. Production and Marketing of Gum Resins: Frankincense, Myrrh and Opoponax

Ross, J.H. 1979. A conspectus of the African Acacia Species. Mem. Bot. Surv. S. Afr. No. 44: 55-58

Field Appraisal on the state of knowledge on *Boswellia* species and commercialization of frankincense in Kenya: Report of Field visit to North Eastern Province



Joram K. Kagombe[1]

October 2002

[1] Research officer working in KEFRI, Muguga

Ackowledgement
I wish to thank the individuals and organizations who contributed information which enabled compilation of this report. In particular I wish to thank the community members and merchants of gum who shared their knowledge with me. I would also thank Mr. Quaresh, Propietor Elegant Trading Company for frank and open discussions. The government department were also supportive of this study. I would like to thank Mr. Kittonyo, DFO Garissa, Mr. J.M. Wafula, DFO Wajir and Ms Abian Osman, DFO Mandera for supporting me during the study.

The study would not have been possible without technical support provided by Dr. Ben Chikamai, National program coordinator, Drylands research program , KEFRI. The financial support was provided by FAO through drylands research proramme. I am grateful to them for enabling this study to be conducted.

1. Introduction

The *Boswellia* species is found in rocky and red loam or clay soils with 220 – 1350 metres above sea level and 250 – 600mm rainfall. *Boswelia* species mostly grow in k1 floral area. *B.catteri* that grows in Somalia has the most valued frankincense attracting Ksh. 800/kg. The most valued species in Kenya is *B. rivea*.

The main species for olibanum in Kenya is *B. neglecta*, which grows throughout the northern Kenya. It produces olibanum with fresh fragrance that is less valuable and has only a small market compared to olibanum from the Somalia and Ethiopian species. The most fragrant incense in Kenya comes from *B. rivae* that is found on the Ethiopian border near Mandera. The third species, *B. Micropylla* occurs in Wajir and Mandera disricts. There are four species of *Commiphora* and one composite herb that produce resins resembling olibanum but with less attractive fragrance and which can be mixed with commercial olibanum.

B. neglecta is found in Northern and Eastern Uganda, Northern Tanzania, E. Ethiopia, Somali and most drier parts of Kenya including S. TurkanaMutha (Kitui), NE province, Dandu, Meru National park, N. Baringo in Acacia commiphora bushland chiefly in rocky and red loam or clay soils. Altitude 2120 – 1350 m. Rainfall 250 – 600m. Zones v - vi.

Boswellia microphylla – **MUGLI (Somalia)**
An Ethiopian and Somali species that is also found in East of Wajir, Moyale and Mandera. Grows intermingled with B. neglecta which it closely resembles except that the compound leaves have fewer leaflets and bark is harder and not wrinkled. Local people prefer the fragrance of the incense from B. neglecta but prefer to chew the resin from B. microphylla.

Boswellia rivea – **Mudufur Ade (Somali)**

Ethiopian and Somali species found on the hills bordering Ethiopia from Ramu East towards Mandera town (Banissa, Ramu, Mandera). Distinct from other branches in that the bark is white not grey and the lower branches run horizontally to the ground rooting where they touch the soil giving rise to new trees. The species is found in dry land ecosystem on open Acacia bushland and on limestone hill with 220mm rainfall. Found on dryland ecosystem on open acacia commiphora bushland and on limestone hill with 220 mm pa. It produces the most fragrant incense in Kenya and people in this area who have access to all prefer this resin for chewing.

B. Papyrifera – n U1/K2 boarder . Found in Turkana district at the Sudan/Uganda boarder

Figure 1: Distribution of *B. neglecta* by Districts in Kenya

Figure 2 :Distribution of *B. rivea* and *B. microphylla* by districts

2.1 Discussion with Mr. Quaresh, proprietor, Elegant Trading Company Limited.

Elegant Trading Company is a private trading company based in Nairobi and registered in 1995. The proprietor serves as the Managing Director though he is also having formal employment in the public sector where he serves as General Manager of a Parastatal. A supervisor for general administration assisted by a clerk who handles stores and documentation runs the day-to-day activities of his company. The company employs 20 workers who are paid a monthly salary. The company is registered to trade in all gum and gum resin commodities but is at present specializing in hagar and opoponax. In fact it is at the present moment leading in the export of hagar and opoponax in the country. On the production side, it has established a strong network of buyers at the level of wholesalers who are paid competitive prices on the understanding that they pay a reasonable amount to the suppliers (collectors and duka owners).

The following issues emerged from discussions with Mr. Quresh

- Olibanum production is low in Kenya due to lack of good commercial outlets. Low commercial outlets are due to low quality of the product which is as a result of inadequate quality control.
- Local people in North Eastern province are knowledgeable on uses of olibanum.
- Resource grows in the wild where its neither planted nor tended. It is not in abundant supply. The resource is communal owned. Experience has shown that once the commercial value of a resource improves, it leads to clear ownership.
- There is potential for plantation establishment since land is available and weather conducive. There is no myth against tree planting.
- Main constraints for commercialisation in olibanum is poor marketing of the resource, low quality control systems and harsh/difficult terrain where resource is collected
- Main opportunities for commercialisation are availability of land, conducive weather, people knowledgeable on its uses, people poor and so consider it as an alternative income generating activity, infrastructure for marketing available especially the air strip in Wajir
- Production process – Olibanum collected from trees by collectors who sell to hawkers who in turn sell to merchants. No much care is taken for the product. The product is commercially viable if some cleaning is done especially removal of impurities that stick to the gum.
- Price for olibanum is subdued at all levels. Due to lack of market outlets, some merchants buy it for speculative purposes
- Marketing of the resource should be fronted by NGOs in collaboration with government agencies. A private investor may not be able to undertake marketing on its own due to high cost involved and long time taken before returns can be achieved.

2.2 Garissa District

Maalim Salim is the only main dealer in gums .He used to sell 3 – 4 tons of olibanum to Mombasa every month. The buyer has since relocated to London and so has not sold since year 2000. The sources of gums are Barabara, Shibilia, Modogashi and Bangal. Merchant gives orders to the pastoralist. The shop was not having any olibanum at the time. The consumers prefer white type of olibanum to the black type. The gums are packed in sisal bags. Price of white olibanum per kilogram is 35 to 40 while black one goes for 30. The production is done during the dry season September to December. Olibanum is available at Modogashi, Barabara, Riboi and Shimbiri. The markets for Olibanum are erratic. The pastoralists in Garissa have no interest in gum collection unlike their colleagues in Wajir and Madera.

The olibanum in the market is mainly from Ethiopia which comes to Garissa through Moyale. Most Somalis believe that the quality of smell of Olibanum that is found locally is low. However the poor families burn the local Olibanum since they cannot afford the exported one.

2.3 Wajir District

There are 5 main merchants in Wajir who mainly trade in Malmal and Hagar. The traders in order of importance are:

- Sharif Ali
- Abdi Wei
- Ado Yusuf
- Dagana Abire
- Abire Muhhamed

The main trader, Sharif Ali, buys 150 tons of gums per month, which he sells, to Nairobi and Mombasa. Main products bought are hagar and malmal that is bought at 50 and 85-100 per kg respectively. The production areas for hagar and malmal are Tarbaj, Dambas, Salaman, duunto, and Mbutehero divisions.

Production areas for lubadini are Danaba location bordering Mandera on the Ethiopian boarder. Lubadini is only sold on order
Retailers exchange the gums with money, clothes, shoes, sugar, tea leaves, pesticides, wormicide. Sugar is most preferred. Almost every shop in the rural areas has retail inlet for gums. Retailers buy at 35 per kg while the main merchant in Wajir buys at 50 per kg. Retailers check the gum for quality before purchase and then pack them in bags. They then hire vehicle jointly, which transport the gums to Wajir. In case the gums do not fill up the vehicle they carry hides and skins. The main merchants in Wajir weighs the product on arrival, check for quality by opening the bags to remove wastes and then weigh again. The gum is later repacked in new bags for sale in Nairobi. Loaders repack into new bags at a price of Ksh. 10 – 15 per bag
Lubadini price is low compared to labour involved. A collector can collect only 2kg from morning to lunchtime.
Count council charge Ksh. 800 per ton or 80 per bag for every gum sold.

Photo 1: ***Boswellia rivae*** **in Madera District**

Photo 2: ***Boswellia neglecta*** **in Madera district**

2.3 Mandera District

Haji Gaiye
Buys gum from middlemen and directly from collectors. Initially he could buy 5 to 10 tons of boswellia per month but cannot buy such quantity now due to lack of funds. Used to buy from neighbouring Somali. Buys large quantities of Hagar and malmal. Purchase depends on orders but on average buy 10 tons per month, which he sells to Nairobi and Mombasa
Merchants in Mandera felt that FD and other agencies have not assisted the gum industry. They requested to be assisted in getting market outlets of the products

Second merchant – Bario
Combines hides and skins business with gum
Buys lubani at 40 to 45 per kg and sells at 65 to 70 per kg in Nairobi

Table 1 : Kenya commercial gums and resins

Commercial name	*Local name*	*Scientific name*	*Distribution of trees in Kenya*	*World distribution of species*	*Other exporting countries*
Myrrh	Malmal (Somali)	Commiphora myrrha	Wajir &Mandera	Somali, eastern Ethiopia, S.W. Arabia, N.E. Kenya	Ethiopia Somali
Hagar opoponax	Hagar (Somali) Hagarsu (Borana)	Commiphora holtziana subspp. holtziana	N.E. Kenya, eastern Isiolo	Kenya, Uganda, Tanzania, Ethiopia, Somali	Somali
Olibanum frankincense	Madful (Somalia), Dakara (Borana)	Boswellia neglecta	Northern Kenya	Kenya, E. Ethiopia, Somali, Uganda & Tanzania	Somali, Ethiopia, India
Gum arabic	Ada (Somalia)	Accia Senegal var kerensis	Northern kenya	Ethiopia, Somali, Kenya, Uganda & Tanzania	Sudan, Niger, Chad

3 .Uses of Olibanum

3.1 Household

- Used to improve scent of drinking water
- Used by maternal mothers when they give birth to their first child
- Smell repellent and used to chase away evil spirit
- Chewed by pregnant women
- Local people know of only local uses of olibanum. But do not know of other uses it can be used – Need to sensitise on potential uses
- Good scent in houses

Kenya

4. Sources in N. E. province

4.1 Garissa District

Banane, Danyere/Mbalambala divisions, the highest concentration is area between the two divisions

4.2 Wajir district

Met 20 community members from Danawa located 220 Km from Wajir who had come to sell their product in Wajir. They identified Boswellia with the local name Mirafur. It produces Lubadini which is of two types, white and black. The product is in large quantities in this area but since the price is low, it is not considered as an important product. The price of Lubadini is 10 per kg compared to 52 per kg for Hagar.

The trade in Malmal and Hagar is commercialised in Wajir. There are six merchants in town each with about 200 bags of stock. Each merchant sells 14 tons of the products to Nairobi every two weeks. The main form of trade in gums is barter trade. The collectors exchange the gum with sugar, tea, clothes and shoes

4.3 Mandera District
Lubadini found in the following divisions; Rhamu, Hareria, Bambu, Kumbiso, Sala, Rhamu Dimtu, ola, Malkamari, Kokai, Ashabito. There are large quantities of Boswellia in Mandera district
Malmal and Hagar in less quantities. Commiphora found in the following divisions; Fino, Lafey, Elwak, wargadud, Shimbir Fatuma, Damasa, Katulo and Barisa

5.0 Production

- Herders collect Olibanum as a secondary activity when they are looking after the livestock. Men, women and children do collection. They collect the droppings on the ground though in some cases they pick the mature gum from the tree. In Garissa, Wajir and Mandera, the tree is not tapped for gum production. In some cases Somali women remove the bark of the tree that is used for tanning leather, dying wooden containers and making strings for traditional house frames. This result to injury to the tree that produces gum though the intention is not to injure the tree.

- Gum naturally oozes from the tree. No tapping done. Collected by hand from the tree or on the base of the tree where it drops
- Bark of the tree used as a relaxative medicine by pregnant mothers. Bark also used as dye for decorating houses. As a result of these two uses tree is injures while removing bark leading to production of gum
- Production in Wajir and Mandera was introduced by Arab traders. These had no influence in Garissa
- Hagar and malmal produced in September to November while Lubadini is produced throughout the year but mainly during dry season.
- Collectors move in groups of 3-4 persons but each person collects own gum
- One collector gets 5 kg per day but can collect 0.5 kg if the area is not virgin. Well-experienced collectors can attain 10 kg per day in a virgin area
- Best time for collecting is during the dry season (August to November). Rains spoils malmal, hagar and gum arabicthe product. Better quality of product is obtained in the gums comes out on its own without tapping

Most gum dealers combine trade of gums and selling of hides and skins. The trade in hides and skins supplement gum trade since in cash and transportation

5.1 Production quantities

Production quantities were assessed through records of revenue returns from county councils. The councils charge Ksh. 80 for every bag

Mandera

In the period July 2000 to June 2001, Ksh. 70,460 (880 bags) was collected
From July 2001 to March 2002, Ksh. 75,730 (946 bags) was collected.

The amount collected is just about 1/3 of the total since most of the gums end up being sold without council knowing. The council have no machinery to enforce payment

Table 2: Wajir: records were obtained for financial year 2000/2001

Month	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Marc.	Apr.	May	June	Total
Revenue	18220	64240	8240	-	-	51000	12000	1320	18680	10400	10400	42000	236500

Each bag contains a 100 kg and is charged Ksh. 80. Hence the total revenue collected is for 2957 bags

6.0 Markets

Olibalinum collected from trees is sold to local merchants in rural areas. There is mainly a merchant in every shopping center. The main products bought by these merchants are gum from *commiphora* species. Barter trade is the main mode of trade in which merchants exchange gum with household items like sugar, tea, clothes and shoes. The local merchants sell the gum to merchants in big towns like Mandera, Wajir who in turn sell to merchants in Nairobi and Mombasa.. There is no stable and continuous market for gums. Lubadini has no market in Wajir. It is sold to Ethiopia at Ksh. 50 per kg and used to be sold in Somalia when there was a government. . Ethiopians also do collect Lubadini in Kenya. Lubadini has high market in Ethiopia where they buy at 50 –55 and sells at 70-80 per kg. The Somali government used to assist its people to perfect trade in Boswellia through training them in sorting and opening up markets

Barter trade used in Wajir and Elwak and Lafey divisions of Mandera district. In other parts of Mandera trade is by cash exchange

Photo 3: Hagar and Malmal trade is commercialised in Wajir and Madera: Packed in bags ready for market

6.1 Prices

- Prices of livestock are predictable; they rise immediately after the rains and goes down during drought. On the other hand the potential for olibanum production is high during drought and so can act as an important alternative livelihood support
- Price of malmal in Madera is Ksh. 150 –160 for high quality and Ksh. 80 – 120 for low quality
- Price of hagar in Madera is Ksh. 50 – 70 per kg for best grade
- Price of lubadini is Ksh. 80 in local market and 130 in Mombasa. Lubadini price is low since buyers dictate the price
- Price in Mandera
    - Malmal - 80 during low season and and 100-120 during good season. The merchant pays Ksh 5per kg to county council, 5/kg for transportation, 1.50/kg for loading, 1.50 for sack and sisal and then sells the product in Nairobi at 150 – 160 per kg. Graded products is bought at 100 for first grade and 80-85 for second grade
    - Hagar bought at 45- 50 per kg and sells at 70/kg

7. Quality control

- No quality control since product is not commercialised and there are no qualified people to control quality
- Sorting of gum labour intensive, have to empty the bags, cut them through to loosen them before sorting

- In Mandera, merchants know the various products. Buyers specify the quality and do sorting when buying. The gums are graded into grade 1 and 2. The seller of the gums has to sort out the products or else will sell the product at a low price

8. Tenure and ownership

- Boswellia species in Kenya grows in the wild environment. The tree regenerates naturally and no evidence was seen on communities planting the tree. The tree is highly valued by the communities. The Somali community in Kenya have no taboo against tree planting.
- Resource located in communally owned land.
- Each community unit has responsibility of managing resources in their vicinity. Each clan in a particular section handles management of resource in their vicinity
- There is clear ownership of land in towns and along the riverbanks where agriculture activities are conducted. The open ownership of land is mainly in livestock grazing areas

9. Socioeconomic indicators

9.1 Gender Roles

- Gums collected by both men and women with men collecting at a large scale while women collect small quantities
- Women are more preferred in sorting out of the gums
- Selling of milk is done by women
- Men controls sale of livestock

9.2 Wealth indicators

The main wealth indicator within the Somali community is the number and type of livestock owned. Most valued livestock are camels followed by cattle and then goats. The second wealth indicator is the size of the family with big families being preferred. The third indicator is extent of crop farming. This used to be considered as poverty indicator but this has changed over time with more community members adopting farming. Collection of gums used to be considered as a poverty indicator especially for the collectors but this is changing as the price of the products improves.

10. Prospects of plantation establishment

- Issue of ownership is a hindrance to plantation establishment. However if the product is commercialised it can lead to redefinition of ownership. This has happened in areas where farming has been introduced especially in riverbanks areas
- Trees planting along Daadab refugee camp have made community realise that indigenous trees can be planted
- Community has no tradition of planting indigenous trees but on the other hand, they have no taboo against planting trees
- Community have been planting ornamental and aesthetic trees in the urban areas

- Livestock grazing/browsing is a major problem to plantation establishment This means fencing is necessary at the initial stages of establishment. For any fencing to be done, the chief and local leaders have to be consulted

11. Areas of assistance

The community identified areas where they need assistance . They include:

Creation of market outlets for the olibanum and other gums

- Establishment of Credit schemes to support the collectors and merchants. It was noted that the merchants are paid three months after delivery and so must have some capital base to pay the collectors as they wait for payment.
- Training/seminars on tapping techniques, tree management, marketing, quality control and entrepreneurship.
- Construction of godown for storing products before marketing
- Area for sorting out the products
- Analysis aimed at improving market outlets
- Tools and equipments for collectors
- Training to mobilize various groups

12. Opportunities and constraints for commercialization

12.1 Opportunities

- Gum producing trees available in large quantities
- There is potential for improvement of marketing channels
- Community take up opportunities very fast
- Community value the trees and are knowledgeable about trees that produce gum and so protects the trees
- Community has diverse use of gum producing trees and have a tradition of using wooden utensils, tools and collects medicine from trees
- Potential for training gum harvesters
- Gum production an important alternative source of income
- Poor households mainly collect Olibanum and so improving production is a good strategy for targeting poor households
- Can provide income during dry season, which can push community to the next season
- The production can increase ten fold if market outlets are created

12.2. Constraints

- The main constraint to commercialisation is the low pricing of olibanum, which is brought about by lack of outlets of the product. A collector of gum from commiphora gets 50 – 100 per kg compared to 10 – 20 per kg of olibanum.
- Trees dispersed
- Lack of markets for the products
- Lack of husbandry techniques to enhance production
- Lack of quality control leading to low quality products
- Adulteration of products
- Germination problems
- Ownership not defined
- Dealers in Nairobi buy at a credit making the merchants hold their capital

- No credit for collectors and merchants unlike for gum arabic where credit scheme exist. This makes the merchants hold a lot of money in stock before they can sell the product and so cannot buy large quantities
- Long distance for collectors without food and water
- Collectors not aware of need for quality

13. Recommendations

- Merchants should form an association that can deal with marketing of the products
- Government and other agencies need to come in to assist community in marketing the products
- FD should create a budget line/AIE that can be used to support gum collection and marketing
- Need for training in collection and capacity building in tapping technology
- Need to assist collectors/merchants during dry season when their products cannot sell
- Conduct analysis to determine active ingredients in Olibanum that can be used to market the product
- Assist communities in quality control and value adding of the product
- Establish credit schemes that could assist merchants/hawkers/collectors

14. Contact persons

Nairobi

Hassan Abdikadir and Mwasaro. Phoenix house , Nairobi
QuareshH. Ahmed – General Manager, Bomas of Kenya

Garissa

Mr. Mwanasawe, Provincial Director of Agriculture, N.E. province
Mr. Abdahim Omar, DALEO, Garissa District
Mr. Joseph Kitonyo, DFO Garissa
Mr. Maalim Salim, Merchant Garisaa town
Mr. Idris S. Kelon, MOA, Garissa
Mr. Idris Y. Abass, MOA, Garissa

Wajir

Sharif Ali - Merchant
Abdi Salim Mohammed
Wafula DFO Wajir

Mandera

Abian Osman – DFO Madera
Mohammed Khalif – Merchant
Abdille Sheikh
Billow

References

Curry Patricia, 1997. Ethnobotanist research project, progress report and financial statement August 1996 – March 1997, VSO/SALTLICK

Curry Patricia, 1998. Gums and Resins Research project, August 1996 – August 1998, phase 1 final report, VSO/SALTLICK

J.B. Gillet, M.A. (Cantab) F.L.S, 1991. Flora of tropical E. Africa prepared at the royal Botanic Gardens/Kew with assistance from East African Herbarium

Proceedings from a workshop on gums & resins production and trade, Jan 2000, held in Wajir

Annex 1: Checklist for questionnaire and group discussions

1. Botanical sources
   - Main frankincense producing areas per district. Indicate locality by name and give GPS coordinates, main species available and extent of the resource. Compare this information with literature
   - Develop community maps
   - Methods used in indicating boundaries of the resources; marks used, names

2. Production process, highlight the production process from the tree to the end product
   - Who collects gum and when collected
   - Containers used to collect and store gum
   - Methods used in collection
   - Instruments used in production
   - What else do they do when collecting
   - Who does the sorting and grading
   - Agents dealing with research, production and marketing of gum locally

3. Annual calendar of events
   - Division of labor
   - Prediction of gum production based on rainy season
   - Division of labor by gender

5. Organization of frankincense production
   - Organization/community structures that exist in management of the resource
   - Number of men in a work party
   - How proceeds from the field is shared out
   - Credit schemes in the production
   - Institutions in place to regulate the trade
   - Distribution of frankincense collection points
   - Labour organization

6. Who owns the resource?
   - Individual or a group of families
   - Resource sharing among the group owning the resource
   - Lineage traditions within the community and does frankincense qualify as one of the lineage properties
   - Tradition of renting out the resources

7. How income from gum is used; who controls
8. Social and property value of frankincense
   - Wealth indicators in the community and is resin gum considered as a wealth indicator

9. Community perspective on domestication of Boswellia species ie plantations,
   - Community perspective on tree planting especially Boswellia species

- Arguments for and against domestication

10. Quality and quality control
    - Community knowledge of the final usage of the resin gum that they sell out
    - Methods used by the community and agents to control quality
    - Comparison of quality produced by different agents
11. Prices of the resource
    - Is pricing dependant on the quality
    - Price fluctuations within the year
    - Do the community feel exploited
12. Marketing
    - Market channels
    - Main problem in marketing
13. Constraints and opportunities towards development of the subsector
    - Problems encountered in the sector
    - Opportunities for development of the sector

Workplan

1. North Eastern Province – Garissa, Wajir, Mandera

Time Schedule

Date	Venue
11.8.02	Travel to Garissa by Road
12.8.02 – 13.8.02	Survey in Garissa District
14.8.02	Travel to Wajir by Road
15.8.02-16.8.02	Survey in Wajir
17.8.02	Travel to Mandera
18.8.02	Sunday
19.8.02-20.8.02	Survey in Mandera
21.8.02	Fly back to Nairobi

Total number of night outs 10 days

Gum Resins Value Chain Desk Study

1. Production

Northern Kenya is endowed with a variety of gum and resin yielding trees. This resource is exploited for both commercial and domestic purposes. Commercial production of gums and resins in Kenya is confined to the arid counties of Isiolo, Marsabit, Mandera, Wajir, Garissa and Samburu. Vegetation in these areas is dominated mostly by Acacia and Commiphora species, classified as Acacia-Commiphora woodlands (Beentje 1994). Gums are mainly produced by Acacia species while gum resins are extracted from Commiphora. Based on the estimated area with gum resin resources in Wajir County (681,030.4 ha), mean stocking densities and a correction factor of 25 % (low density), there are approximately 5,808,956 stems in the county with an estimated potential gum resin production of 2,178.4 MT, with an approximate export value of Ksh 1,000,248,560.2.

Estimated potential gum resin production in Wajir County and the approximated export value

Species	Product	# of tree stems per ha	Potential area (ha)	Estimated total # of stems	Estimated gum yield per annum (MT)	Estimated income to producers (Kshs)	Estimated export value (Kshs), FOB Mbsa
Commiphora myrrha	Myrrh	31	68,773.50	532995	199.9	54,765,197.7	109,930,141.4
Commiphora holtziana	Hagar	40	527,596.10	5275961	1978.5	205762479.0	890,318,418.8
Total			**596,369.60**	**5,808,956**	**2,178.4**	**260,527,676.7**	**1,000,248,560.2**

Source: ENNDA assessment

Planting of gum and resin trees is not currently practiced in the area, and domestication is not an option the community members are currently considering. The majority of respondents still consider that there is substantial cover of the gum and resin yielding trees in the locality and in their own opinion there is no need to domesticate them. Other reasons for not planting gum and resin trees include lack of knowledge on methods of propagation; lack of financial capital; scarcity of water; and tendency of opoponax producing trees to grow less well in the homestead, as they prefer rocky and rough terrain.

Collection and selling of gums and resins is currently considered the work of people who are less endowed with livestock wealth and rely on a commodity that is despised among well-to-do members of society due to the smell and staining of clothes and hands associated. The number of livestock owned and the amount of income the household gets from gums and resins was negatively correlated. Households with more than 50 heads of cattle are 24 times less likely to collect gums and resins as compared to households with no livestock. Its collection involves walking long distances, sometimes traversing transitional border areas occupied by different tribal groups.

The quantity of gums and resins harvested in northern Kenya is currently below their potential. The communities are not knowledgeable on tapping methods that can result in better yield. In most cases tapping is rarely practiced, and in areas where the practice is exercised it is not done in the most efficient way. Moreover, the communities are ill-equipped in terms of the accessories used in collecting and transporting the gums and resins. Collection of gums and resins also has detrimental effects on collectors' skin; hence provision of gloves and other protective equipment is required.

There are various ways of obtaining gum arabic. The first is the collection of natural gum exudates collected from trees and the second is tapping acacia trees for gums. Some farmers and pastoralists collect from acacia species gums that ooze naturally. In this case, the gum collection is not their sole occupation, and hence they accomplish collection side by side with herding and farming activities. Tapping of Acacia for gums starts at the beginning of the dry season. It takes place in October and November and lasts throughout the dry season. A two-edged axe is used for tapping, one edge cuts the bark of the tree and the other is used to peel-off the bark to allow the release of exudates. Nonetheless, tapping, unlike in the case of Boswellia papyrifera, is done once, which is sufficient to trigger the release of the gum. There is no standard procedure involved in tapping of acacia trees in Northern Kenya. Mature acacias trees are tapped at several points on the truck and the main branches. The wound allows the gum to ooze out and it is left to solidify and dry while on the tree.

2. Inputs

Capacity building- collectors can benefit from capacity building, especially training on tapping methods and proper storage techniques that do not encourage adulteration or loss of quality or quantity due to unfavorable weather conditions. Trainers and extension officers need to be deployed to capacitate the collectors.

Financial assistance- Financing the collectors will facilitate their operational activities and buying of necessary equipment, materials and alimentation required during gum and resin collection. Operating capital needs to be advanced to traders in the form of grants or microenterprise loans, similar to other sectors in the country. Market and value chain development is an essential component to advance gums and resins enterprise in the area. There is a need to provide reliable information on market trends and prices to enable communities to understand benefits associated with the enterprise. Furthermore, the inculcation of practices that are compliant with statutory standards in international markets needs to be given proper consideration to maximize benefits accruing from gum and resin collection and trade.

3. Post-Harvest

There is almost no support from the government in advising the collectors on methods of sustainable harvesting or boosting production of gums and resins in northern Kenya. Communities still use traditional systems of harvesting with basic tools and improper collection vessels. Gums and resins require proper storage facilities to maintain quality and quantity of the product. Most of the gums and resins contain an oil/fluid component which dries up if not subjected to proper storage conditions. In northern Kenya most collectors store their collections in gunny bags, resulting in loss of quality and quantity of the harvested gums and resins. Collectors lack appropriate collection equipment and storage materials. Appropriate sacks like polypropylene are not available to collectors so they are forced to store the fresh produce in a variety of often unclean paper and plastic bags. Handling the products with poor hygiene interferes with the quality and jeopardizes smooth entry into lucrative international markets. Communities also lack access to warehouse facilities or central storage areas which can facilitate proper storage and transportation to market destinations.

In order to address these challenges and improve the lives of the local communities, development of the gums and resins sub sector is seen as key to providing alternative sources of income. The ENNDA through the board of directors made a proposal to the treasury through the then Ministry of Regional Development Authorities and received support under the economic stimulus programme in 2011-12 to put in place a gums and resins plant in the Ewaso Ng'iro basin. The Authority then set up a pilot processing plant in Wajir in order to promote value addition of gums and resins with a view of establishing three other areas of the basin once this was fully operational and successful. To date, the plant is closed due to tensions between the contractor and the Authority.

4. Marketing

Studies show that the potential production of gum arabic from Kenya is about 3,000 MT per year (Muller and Okoro, 2004; Chikamai and Odera, 2002). However, currently, export volumes average 300-400 MT per year, indicating that only 10% of the production potential of gum arabic is exported. This is largely as a result of bottlenecks related to production, quality, collection and more notably, poorly developed market organization that causes irregularity in supply (Chikamai, 2001).

Currently, the price per MT is around US$ 4,500, having risen from US$ 1,500 in the year 2003 and therefore all collection can be sold immediately at a favourable rate (Muller and Okoro, 2004; Chikamai and Odera, 2002). Thus, small producers can penetrate the market and increase their market share if they produce and export good quality of gum arabic that meets buyers' expectations and make profits (Chretin et al., 2008).

It takes a long time to market gums and resins and collectors lack sound market information to guide them. The price of the gums and resins increases as the commodity heads to the end of the value chain. The number of traders buying gums and resin is small, mostly based in trading centres or enlisting agents who buy at collection points or small centres and in return sell to them. However, there is an emerging trend where traders are going around and buying gums and resins from the small towns where they have stationed their agents and also buying directly from collectors. This group of traders is those whose exclusive business is gums and resins, and they operate as cartels. They are the ones who buy and sell in bulk to exporters who are mainly based in Nairobi or Mombasa.

The traders who organize themselves in cartel-type operations have some access to market information, though they are not well informed due to their localized operations. The exporters of natural products (gums and resins) who are at the end of the value chain at the national level are more informed on price and demand due to their linkages with buyers on the international market. The current market operation benefits few individuals, primarily the traders who buy the products at low prices and sell them to the next traders in the value chain. The collectors tasked with the bulk of the work in terms of locating and collecting the products, get prices which are far below the market price. There is little government involvement in terms of developing the sector through capacity building of the collectors so that they are informed about the price and market trends to guide them in appropriately marketing their products. The Government of Kenya takes an active role in developing and empowering farmers involved in crop production by putting in place mechanisms that enable them get the best market price, but it neglects bio-enterprises in northern Kenya, providing neither material nor policy support.

Collectors are paid Kshs 60-100 per kg for opoponax by both agents and traders. Agents mostly sell at Kshs 100-120 to the traders, while traders who transport the gums and resins to Nairobi or Mombasa get Kshs 180 250 from exporters. The bulk of opoponax is currently exported to the Chinese market and exporters get Kshs 300-450 per kg.

5. Organizations in the Value Chain

There are no active collective actors or cooperatives in this value chain. Many organizations both governmental and non-governmental have tried to pursue the establishment of vibrant gum & resins associations that would have fostered developments within the value chain and stood for the rights of the producer groups be marketing, capacity buildings or even environmental conservations but this has not nurtured any progress.

6. Regulatory Environment

The Forest Policy (2005), the most recent policy in Kenya on forest resources, aims to enhance the contribution of the forest sector in the provision of economic, social and environmental goods and services. Among the specific objectives of the policy is to promote dry land forestry to produce wood fuel and supply wood and non-wood forest products. The policy mentions the potential of the dry land forest to supply marketable commodities on a sustainable basis such as gums and resins, aloe, commercial juices etc., but apart from mentioning gums and resins in the policy document there is no effort in place to effectively and sustainably develop the sector so that it can yield substantial income to support communities in the ASAL.

The government had also formulated Vision 2030, a policy document that targets to achieve middle-income status by 2030 through implementing activities that will enable an average annual economic growth rate of 10 percent. The Vision highlights what needs to be done to improve development in the pastoral areas, including marketing of livestock and alternative livelihood options like gums and resins, although there is not much by way of practice towards achieving this intent. While the Vision mentions dry lands, forest resources in these areas have been undervalued or ignored by decision-makers because of the difficulty in valuation, and they are often situated outside formal markets and pricing mechanisms (Republic of Kenya 2003).

The government had also formulated an ASAL Policy (Republic of Kenya 2012) that aims at fostering sustainable development of northern Kenya and other arid lands. In the policy, the government takes cognizance of the importance of livelihood diversification as a strategy to reduce vulnerability to hazards in northern Kenya. The policy recognizes that ASALs are rich in natural resources and highlights that there is growing interest in the production and marketing of natural products such as gums, resins and medicinal plants. The government's plan is to support livelihood diversification strategies which add value within the livestock sector and complement livestock production, as well as facilitation of production and marketing of dry land products. The policy, if properly implemented, can act as a tool to develop the gums and resins sector in northern Kenya.

Collection of the gums and resins in these localities is hampered by insecurity, and in most cases the government takes little action to solve conflict in these areas, so they act as a disincentive to development of the gums and resins sector in the region. Insecurity has been cited as one of the major factors undermining development in northern Kenya and is anticipated to slow down the positive impacts that are expected to accrue as a result of the devolved county government.

7. Conclusion

There is potential for production of gum & resin in the region because of the large acacia trees coverage but there are many bottlenecks that need to be addressed before said potential is realized. More community awareness on the product benefits and strengthening the value chain needs to be done prior to any investment in this value chain.

Formation of collector groups, associations or cooperatives is needed to foster cooperation and coordination of the collection and sale of gums and resins. Pooling resources will enhance economies of scale in production and foster bargaining power for better prices.

Maintaining peace and putting in place appropriate conflict resolution mechanisms in areas prone to conflict will allow communities to move freely across ethnic boundaries in search of gums and resins.

Boswellia in Somaliland: An Overview

Prepared for the CITES Plants Committee

Dr. Kenedid A. Hassan
Director of Research, CFESS
March 2020

Centre for Frankincense, Environmental and Social Studies (CFESS)
Kood Bur, Boqol Jire, Hargeisa, Somaliland
Email: kenedidhassancfess@gmail.com
www.cfess.org

CFESS is a research center based in Somaliland committed to fostering knowledge about the social, political, security and environmental dynamics in the Horn of Africa. Through conducting applied research and sharing our findings in publications, workshops, trainings and conferences, we aim to provide practitioners, academics and policy makers with data that will promote sustainable production practices. CFESS is comprised of a team of Somaliland-based researchers from a variety of fields, ranging from sociology and law to agronomy and religious studies.

About the Author:
Dr. Kenedid Hassan has over two decades of experience conducting research and teaching social science in Canada and Somaliland. He is currently involved in several on-going research projects focusing on the Horn of Africa related to the international frankincense trade, political Islam, democracy in Somaliland, and music and nationalist discourse in Djibouti, Somalia and Somaliland. He has taught courses ranging from international relations and development studies to sociology and popular music, and also held consultancies with governments and international NGOs. Dr. Hassan holds a PhD in Sociology from the Université du Québec à Montréal (UQAM).

Glossary

Bari	"east", also the name of an administrative region in Puntland
Cal Madow	"large black mountains"
dayr	smaller rainy season that generally lasts from October to December
dhuraad	a light basket that collectors use to carry resin while harvesting
gu'	main rainy season that generally lasts from April to June
Guban	hot areas located near the coastline; *guban* literally means "burnt"
jaaf	the tapping of a tree/to tap a tree
jilaal	dry, colder season that lasts from January to March
koley	a large basket used to transport resin to the station
malmal	a myrrh tree (Commiphora Myrrh)
maydi	a type of frankincense tree (Boswellia frereana)
mingaaf	a double-bladed knife used for making incisions and scraping off resin
moxor	a type of frankincense tree (Boswellia carteri)
muruqmaal	a landless resin collector
xagaa	a hot and dry season that lasts from July to September

Overview

This report discusses key issues and practices related to the Boswellia industry in Somaliland, an unrecognized state in the northwest region of Somalia. Many of the findings similarly apply to Puntland,[1] the Boswellia-producing region of Somalia, as Somaliland and Puntland share the following similarities: both regions were part of the Somali Republic from 1960-1991, though the state had a minimal presence in both areas; anti-government resistance movements were active in both regions in the 1980s; and issues of inaccessibility and mistrust due to civil war affect both regions. However, Puntland and Somaliland have been politically stable and peaceful for over two decades, and their respective states' legitimacy and legality have been relatively widely accepted. This report summarizes the research done to date, government interventions into the industry (including legal frameworks), as well as the practices of farmers and various other stakeholders involved in the sector.

Boswellia Regions

The Somali frankincense farmers in Somaliland live mainly in the northwest of Sanaag region, within a territory of about 120 square miles, with some further settlements in adjacent areas north east of Erigavo, the region's capital city. There are an estimated 100,000 Somali farming households, inhabiting more than 50 communities, the majority of which are either in the remote and inaccessible steep hillsides, located atop the narrow ridges, set beside the river beds, or in the rich Dalloo area, while others are situated further to the west, on the coastal mountains that stretch toward the Gulf of Aden. These places range in size from the smaller harvester settlements of perhaps a few hundred people, made up of a collection of households related to one another as a single patrilineal extended family, to the large city of Erigavo. The Boswellia harvesting areas, which are all located across the Golis escarpment, are often divided into three sub-regions, though the names locals use vary somewhat by region. Most commonly, the western part of the escarpment is referred to as *Cal Madow* (West of Erigavo)*,* the middle part as *Cal Miskeed,* and the eastern part (located East of Bossaso in Puntland) as *Cal Bari.* Sometimes, however, the western region is referred to as *Cal Dubbo.*

Research to Date

In Somaliland (and Somalia), no in-depth research or study on Boswellia has been conducted since 1981. According to our observations on the ground in the region, since 1990 there has been no comprehensive and credible research carried out related to Boswellia trees' population size and distribution, population trends, identification information, and its role in the ecosystem. In great part, the whole country has been or is still affected by the civil war, including the Boswellia producing regions of Sanaag (Somaliland) and Bari (Puntland). Prior to Somalia's protracted internal conflict, only sporadic and sketchy researches dealt with a few aspects of the country's gums and resins. While the civil war made it difficult for these studies to be confirmed or refuted, they were fundamental for the advancement of knowledge. Two studies exemplify the field of frankincense research in the 1980s: M. Thulin and A. M. Warfa's study on Boswellia in 1987[2] and

---

[1] Unlike the self-proclaimed Republic of Somaliland, Puntland State of Somalia is part of the Federal Government of Somalia and does not seek independence.

[2] Thulin, M., Warfa, A. M. 1987. The frankincense trees (*Boswellia* spp., Burseraceae) of northern Somalia and southern Arabia. *Kew Bull*. 42: 487-500.

1990[3], and Ahmed Farah's political economy PhD thesis in 1988 (later turned into a book in 1994).[4] Thulin's research focuses on the taxonomy of the genus and engages in an academic dialogue – at times polemic – with other authors regarding the distinction between Boswellia carteri and Boswellia sacra. Farah's principal area of concern, the plight of collectors, is more or less a government/NGO commissioned study in line with the Siad Barre military government's policies against the so-called capitalist mode of production. While it is commendable to illustrate the power relations at play in the sector, Farah overlooks how social groups (collectors, farmers, merchants) resist structural constraints. Both studies seem to assume that Somalis (collectors, farmers and merchants) play no direct role in defining and naming the frankincense tree as an object of knowledge or structuring the field.

More recently, some 'environmentalist' groups with questionable objectives and controversial hypotheses have asserted that Somali farmers and merchants are responsible for the so-called environmental degradation in the Boswellia-producing regions of Somaliland. Whilst purporting to want to save the frankincense tree, these studies have been based on dubious approaches and sources, and very little on-the-ground research. In certain cases, unsubstantiated claims have caused harm to the local industry, with one report even drawing problematic linkages between overharvesting and the funding of Islamic terrorism.[5] It is important, of course, not to ignore how conflict and political ecology – the relation between ecology and political economy – affect farming and land use. Historically, the partition of the Somali territories by colonial powers (British, French and Italian) restricted the movement of pastoralists between the high plateau and the *Guban* (burnt areas, coastlines), leading to overgrazing, including in the Boswellia producing regions. However, no one ought to suggest either that collectors, farmers and Somali merchants are naturally disinterested protectors of the trees. Somali pastoralists used fire to clear the land, cut down trees and allowed – and still allow – their goats and livestock to overgraze most areas, causing soil degradation. Other reports with sensational titles such as 'Frankincense in Peril' extrapolate their 'findings' in Ethiopia, Eritrea and Sudan to Somaliland without considering local specificities.[6] These types of superficial reports harm the credibility of potential long-term scientific studies in the eyes of Boswellia producing populations. Scholars and policy makers therefore ought to advocate for a careful investigation based on long term fundamental researches that take into account local knowledge (cultural ecology), sustainable development, as well as the wider political ecology of Boswellia producing areas in Somalia/Somaliland and beyond.

Government Interventions

The frankincense market in the Erigavo region of Somaliland has gone through considerable changes since the 1930s. Most of the changes, imposed from above by successive regimes, were exogenous to local stakeholders' socio-economic beliefs and desires. Pre-independence colonial administrations intervened in the frankincense sector either to "modernize" the industry or to fix

---

[3] Thulin, M., Claeson, P. 1991. The botanical origin of scented myrrh (Bissabol or Habak Hadi). *Economic Botany* 45(4): 487-494. This short fieldwork was possibly carried out in 1989 and 1990 during Somalia's major civil war. However, Thulin and Claeson do not specify the period (months, weeks).

[4] Farah A. 1994. *The milk of Boswellia forests: Frankincense production among the pastoral Somali*, Uppsala: Uppsala University Press, 142 pages.

[5] DeCarlo, A., Johnson, S., Phillips L. D. 2019. Frankincense geopolitics, trade and transparency, Part 1. *Perfumer & Flavorist*, Vol. 44, September. It is worth noting that these authors are not experts of the Somali regions or political Islam, and in the case of DeCarlo and Johnson their experience in Somaliland is not more than a few weeks.

[6] Bongers, F. *et al.* 2019. Frankincense in peril, *Nature Sustainability*, 2, 402-610.

the unequal relations, imagined or real, between farmers, collectors and traders. The Italians, for instance, attempted to introduce auction-based markets run by cooperatives as the best way to solve inequality. To support the sector, the British attempted to build storage facilities in Aden and Maydh, but only completed the building in Maydh. After independence (1960), civilian governments have reproduced the same colonial initiatives and policies – market-based auctions and labour laws – to solve the perceived imbalance in relations between the social groups in the sector. Under the military regime of Siad Barre (1969-1991), the 'revolutionary' planning committee created cooperatives under the guise of protecting the rights of farmers and collectors, who were seen as belonging to an exploited class. In the case of Somaliland since 1991, three actions/strategies can be identified: 1) sporadic government campaigns against deforestation, 2) the development and elaboration of laws (see legal framework section) and 3) market analysis/development.[7] These actions are far from sufficient to protect the trees, but necessary considering the government's meager resources (human resource and knowledge, i.e., new skills and techniques of harvesting) and lack of international aid.

Legal Frameworks

The Somaliland Constitution provides legal protection of the environment (Art.18.1): *'The State shall give a special priority to the protection and safeguarding of the environment, which is essential for the well-being of the society, and to the care of the natural resources*. Somaliland has enacted four laws to protect the environment and combat deforestation:

> 1) Law on the Prevention of Deforestation and Desertification – Law no. 04/1998, into force in 1998; 2) National Environment Research and Disaster-Preparedness – Law no. 35/2006, into force in 2007; 3) Forestry and Wildlife Conservation Law – Law no. 69/2015, into force 06/02/2016; 4) Environment Management Law – Law no. 79/2018, into force 25/08/2018

Somaliland has enacted the law on Prevention of Deforestation and Desertification (PDD) to specifically and directly deal with frankincense trees and other plants. The law prohibits (art. 1.b) the commercialization or the cutting of a category of plants. Article 17 states that *'anyone who violates this law shall be subject to a penalty of 6-9 months of imprisonment* and/or a fine from Sl. Sh 200,000 to Sl.Sh.1.000.000 (roughly 25-125 USD). However, article 1.a of the law allows for the commercialization of thirty types of plants/trees, including frankincense trees (*B. carteri* and *B. frereana* and myrrh C. *myrrh*), with the authorization of the Ministry of Environment.

Trade/Usage

In 2017, Somaliland exported about 1000 tons of frankincense, according to the Somaliland Government data.[8] Most of it was exported to China, UAE, Yemen, Saudi Arabia, Europe and the USA. However, no data exists on the regional trade (within Somaliland/Somalia, and to Djibouti and Ethiopia), which is a lot more significant than the export outside of Horn of Africa, as Boswellia is used during religious ceremonies (both Christians and Muslims use it on large scale), social gatherings and other forms of rituals as well as an anti-inflammatory drug. Regional governments will likely have serious challenges enforcing environmental protection laws.

---

[7] According to my interlocutors in Hargeisa and Burao, Somaliland frankincense traders were sent to Kordofan (Sudan) to learn how the gum arabic auction market works.

[8] Somaliland Government. 2019. *Somaliland in figures 2018*, Ministry of Planning, Hargeisa, Somaliland.

Types of trees

In Somaliland and Puntland, farmers grow mainly three varieties: *moxor* (Boswellia carteri) *maydi* (Boswellia frereana) and *malmal* (Commiphora myrrh). These trees grow in different geographical areas. *Moxor* and *maydi* can be found in the *Guban* regions of Erigavo and Puntland's Bari region, whereas *malmal* grows near the coast and spreads across the semi-arid hinterlands. *Moxor* and *maydi* are cultivated in *ardaa* (farm) and owned by families through a complex ownership system registered under the Gums and Resin Registration. *Malmal* is harvested according to the rule of whoever gets to the trees first may harvest them. Unlike most trees in the region that grow in soil, *moxor*, which has at least three known major varieties – *moxor lab* (male), *moxor cad* (white) and *moxor madow* (black) – and *maydi* grow on rocks. Resin of both trees are considered of higher quality. *Foox*, sometime referred as *xashish* (rubbish) by Somalis in the region[9] and considered as lower quality grades, contains mainly barks and other waste materials from *malmal*, *maydi* and *moxor*.

Harvesting cycles

Harvesting cycles are dictated by the seasons and the rains. Somalis distinguish four seasons: *jilaal* (Winter), *Gu* (Spring), *Xaaga* (Summer) and *Dayr* (Fall). The main rainy seasons are spring and fall, while winter and summer are dryer, though there are some intermittent rains in the summer (*xaaga*). Different trees are tapped at different times of the year. *Moxor* and *malmal* can only be harvested in the four-month period between the spring and fall rainy seasons, because rain washes away the resin (rain during the *xaaga* is thus detrimental for crops). *Maydi* may be harvested during a nine-month period, beginning at the "*dabshid"* – which literally means lighting-the-fire-day – around mid-July, and continuing until the following *gu'* season.

Tapping tools

Frankincense tools have barely changed since citizens started to farm in Erigavo. Harvesters mainly use three instruments to extract resin from the trees: *mingaaf, koley* and *dhuraad*. The *mingaaf* is the knife that workers use to administer incisions. It has two blades: a sharp blade used for making incisions and scraping off coagulated resin of a high quality, and the second blade for scraping off low quality resin. *Mingaaf* should be kept away from the fire because of fear of wounding the tree and leaving it open to viruses. Tetanus infection from the *mingaaf* (due to the iron in the blade) worries farmers in this region. *Koley* is a large basket used to carry resin to the stations and *dhuraad* is a light basket carried by collectors while harvesting resin. One (1) to four (4) kg of resin is collected from a tree per season. One kg costs between USD 3-6.

Local Knowledge/Training

New collectors go through training on tapping before and during harvesting periods. At the beginning, collectors learn about the history of the tree and the region as well as the importance of using the appropriate tapping instruments. Collection is only done by men. According to one local farmer, elders and farm owners provide an overview picture of the system of ownership and labour production and relations. Adequate on-site training led by the most experienced collector is delivered during each cycle. Potential land-less collectors are identified and selected according to their ability to learn quickly and master the different stages of incision operations. In many cases,

---

[9] Somalis outside the frankincense producing regions use the term *foox* to collectively refer to all three of these types of trees.

a boy from the age of 15 learns from his father or from other family members and he could be proficient in administering incisions.

Our team has observed that there is no variation in the training approaches: Somalis use the same training method, which has been taught and practiced in virtually all of Erigavo's frankincense-producing areas since the beginning of the farming system at the turn of the 20th century. Generally, we were told that potential collectors are evaluated on dexterity (the handling of incisions with care is fundamental to the health of the tree), physical endurance (frankincense regions are harsh, especially during the summer), and the ability to grasp the grading system and quickly identify the different type of frankincense resin.

Stakeholders

In the frankincense-producing areas, observers conventionally distinguish between three categories of stakeholders: farm owners, collectors and local merchants. However, these groups are often not obviously demarcated. For example, a landowner could perform all three functions depending on the size of the farm. Collectors could be landowners but could still rent a farm and assume the trading aspect of the venture.[10] Additional stakeholders also include government representatives and international traders. In the frankincense-producing regions of Somaliland, there are many local traders, but only three major international traders. Although the frankincense industry is an underdeveloped sector compared to the livestock trade, many observers agree on its potentialities in post-conflict Somaliland – political stability and governmental authority seem to make this an environment conducive to a brighter future for frankincense trade.

Traceability/Market Chain

In Somaliland, tracing the origin of frankincense products is the result of a complex dynamic fraught with complications. Supply chains can sometime involve many parties (transportation companies, storage sites, etc.). However, complications can be overcome if a systematic method of traceability is implemented and all the links of frankincense trees' supply chain are clearly identified. Our team assessed traceability practices by observing how one Somali-American company sources and exports its products. Local company representatives buy product from stations near farms, and products at each station can be traced to the farmer or farm of origin. Products are packed, sealed, stamped and labeled with the station name and farm of origin. Products are then transported to Berbera Port, where they are shipped out in container to their terminal ports. Local agents of this company produced various official documents for us – licenses from relevant authorities, tax records, transportation certificates, export licenses and organic certification documents (in November 2015, the company had organized organic certification workshops in three stations). Packages are not opened until they reach their final destinations, where reconciliation includes weigh in and log review.

Conclusion

The Boswellia trade in Somaliland has a long history that has been shaped by local stakeholders, colonial powers, and successive post-colonial governing regimes. However, very little research has been carried out to date on this sector. Successive government interventions have historically failed to improve the health of Boswellia trees and the conditions of the population in the

---

[10] Hassan, Kenedid. 2019. Dynamic fields: the social production of frankincense in Somaliland. Paper presented at the annual meeting of the American Anthropological Association/Canadian Anthropology Society, Changing Climate/Changer d'Air, Vancouver, Canada, November 20-24.

frankincense-producing areas, for their actions were guided more by ideology than concrete research. Contemporary stakeholders—collectors, farmers, the government, NGOs, the business community and interested international organizations—should bear this history in mind as they collaborate to improve the frankincense trade in Somaliland/Somalia and beyond. For the health of the trees and the benefit of those whose livelihood depends on them, future policy-making exercises should be supported by long-term interdisciplinary research that takes into account local knowledge and the wider political economy of Somalia/Somaliland's Boswellia producing areas.

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party: India	
1b.	Institution: c	
1c.	Contact information of the representative who responded to the questionnaire:	Name: Dr. K.N. Reddy
		Phone: 08331015022
		Email: drknreddyatp@gmail.com
		Other:

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

1. *Boswellia ovalifoliata* Bal. & Henry
2. *Boswellia serrata* Roxb. ex Colebr.

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
• *Boswellia ovalifoliata* Bal. & Henry	☐	☐	☐✓		☐
• *Boswellia serrata* Roxb. ex Colebr.	✓☐	☐	☐	Very commonly found in wild state especially in Dry Deciduous forests	☐
•	☐	☐	☐		☐

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• *Boswellia ovalifoliata* Bal. & Henry	☐	☐✓	☐		☐
• *Boswellia serrata* Roxb. ex Colebr.	☐✓	☐	☐	Small increase in population in many areas due to the absence of commercial exploitation	☐
•	☐	☐	☐		☐

2d. For each species occurring in your country, please provide its habitat trends. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• *Boswellia ovalifoliata* Bal. & Henry	☐	☐✓	☐		☐
• *Boswellia serrata* Roxb. ex Colebr.	☐✓	☐	☐	No grazing & lofting & no local threat	☐
•	☐	☐	☐		☐

2e. Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.

1. *Boswellia ovalifoliata* Bal. & Henry: Endemic to Seshachalam and Nallamala hills. Commonly growing on the foot-hill slopes of rocky areas. No habitat loss. Regeneration is poor.

2. *Boswellia serrata* Roxb. ex Colebr. : Common in dry hill slopes of dry deciduous forests in gravelly and poor soil. No habitat loss, Regeneration by Vegetative propagation through Pole cutting is better compared to Reproductive method by seeds. It was found that propagation through seeds can be improved by hot water treatment & acid treatment of seeds.

2f. Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.

1. *Boswellia ovalifoliata* Bal. & Henry : Population is stable, population size is fragmentary, distribution is endemic to Southern Andhra Pradesh specially Cuddapah, Kurnool, Chittoor & Nellore districts of Andhra Pradesh.

2. *Boswellia serrata* Roxb. ex Colebr. : Population is stable in some areas, but it is increasing in many other areas, particularly due to pol cutting plantation along the fences of tribal hamlets, and commonly distributed in dry hill slopes specially the areas of dry deciduous forests. *Boswellia serrata* widely distributed in 16 states in India, which include Andhra Pradesh, Telangana, Karnataka, Tamil Nadu, Maharashtra, Orissa, Chattisgarh, Madhya Pradesh, Jharkhand, Bihar, West Bengal, Uttar Pradesh, Rajasthan, Gujarat, Haryana, Punjab. Natural regeneration is progressive in Andhra Pradesh, Telangana & Orissa States.

2g. Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.

Boswellia serrata Roxb. ex. Colebr.

1. No main threats to affect the conservation and sustainable use of *Boswellia serrata*, but there is some threat due to urbanization, cash crop forming, fire wood collecting, etc in very limited areas.

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
1	a. S. N. Jadhav *et al*. 2001. Proceedings of the Workshop on Conservation Assessment and Management Planning (CAMP) for Medicinal plants of Andhra Pradesh. FRLHT, Bangalore & EPTRI, Hyderabad. b. S.N. Jadhav & Reddy, K.N, 2003. Threatened Medicinal Plants of Andhra Pradesh. Medicinal Plants Conservation Centre (MPCC), EPTRI, Hyderabad.	Based on the proceeding of a camp workshop on conservation assessment in Andhra Pradesh and Telangana, *Boswellia serrata* has not been considered for IUCN threat category, as this TAXON is widely available
2	a. T. Pullaiah & Sandhya Rani. S, 1999. Trees of Andhra Pradesh, India. Regency Publications, New Delhi. b. K.N. Reddy & Sudhakar Reddy. C, 2016. Flora of Telangana State, India. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.	The Publications says that *B. serrata* is commonly found in Andhra Pradesh and Telangana
3	a. Hajra, P.K., Nair, V.J & Daniel, P. 1997. Flora of India Vol. 4. Malpighiaceae-Dichapetalaceae. BSI, Calcutta. b. Hajra, P.K., Sharma, B.D, Sanjappa, M & Sastry, A.R.K. 1996. Flora of India Introductory Volume. Part-1. BSI, Calcutta.	The Publication says that *B. serrata* is commonly found through out India

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use? *Boswellia ovalifoliata* Bal. & Henry: Endemic to southern Andhra Pradesh. There was gum tapping prior to 2000-2002 in some tribal areas, but currently no gum tapping as the distribution falls under wild life protected Area & Red sanders prone area. *Boswellia serrata* Roxb. ex Colebr. : The population is un-tapped for gum-resin as the availability of other Non Wood Forest Products (NWFPs) is plenty in Andhra Pradesh and Telangana States. The focus is on collection of other profitable NWFP like Tendu patta collection, Honey collection, Pongamia seed collection, Mehua flower and seed collection, etc as more profitable options.
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)? 1. *Boswellia ovalifoliata*: Little bit harvesting prior to 2000-2002 for medicine or incense, no harvesting currently. 2. *Boswellia serrata*: No harvesting of gum resin so far in Andhra Pradesh & Telangana States.
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors.

<table>
<tr><td></td><td colspan="2">1. Boswellia ovalifoliata: No gum tapping since 2002 onwards. Before 2002 in few quintals only.

2. Boswellia serrata: No commercial harvesting in Andhra Pradesh, Telangana States so far as forest dwellers focus on other NWFPs.</td></tr>
<tr><td>3d.</td><td colspan="2">What volume is exported (approximate annual export)?
1. Boswellia ovalifoliata: Nil

2. Boswellia serrata: Nil</td></tr>
<tr><td>3e.</td><td colspan="2">Please specify to what extent (if any) harvest or export affects the sustainability of Boswellia populations.

-Nil-</td></tr>
<tr><td>3f.</td><td colspan="2">Please specify if harvest or export reduce or otherwise affect the regeneration capacity of Boswellia populations.

-No effect-</td></tr>
<tr><td>3g.</td><td colspan="2">Please summarize any initiatives to artificially propagate/cultivate Boswellia species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries.

We conducted experiments by vegetative propagation using pole cutting method during April –May and found that nearly 70-80% of stem cutting are sprouted and 50% success rate observed while in Transplantation stage. Some tribal’s are still adopting pole cutting propagation of B. serrata as fencing along the fields and backyards in Orissa & Telangana States.</td></tr>
<tr><td>3h.</td><td colspan="2">What are the challenges to artificially propagate/cultivate Boswellia species in your country?

There is some challenge in reproductive regeneration through seed in some areas, but found to be successful in other areas. The hot water treatment/ Acid treatment of seeds is known to improve the regeneration.</td></tr>
<tr><td>3i.</td><td colspan="2">Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.</td></tr>
<tr><td></td><td>File/attachment</td><td>Comments (if any)</td></tr>
<tr><td></td><td>c. S. N. Jadhav et al. 2001. Proceedings of the Workshop on Conservation Assessment and Management Planning (CAMP) for Medicinal plants of Andhra Pradesh. FRLHT, Bangalore & EPTRI, Hyderabad.

d. S.N. Jadhav & Reddy, K.N, 2003. Threatened Medicinal Plants of Andhra Pradesh. Medicinal Plants Conservation Centre (MPCC), EPTRI, Hyderabad.

e. Personal observations and my field knowledge on various phyto-vegetations & tribal interactions from 1995onwards.</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

Section 4: Supply chains and international trade (paragraph a), b) and f) of Decision 18.205)

4a.	Who are the predominant legal or customary owners / custodians of *Boswellia*? Government-owned ☐√ Local communities ☐ Individual ownership ☐ Community-based or individual land tenure ☐J Please describe the land ownership structure where *Boswellia* spp. occurs, including harvest rights. The reserve and non-reserve forest are completely owned and controlled by government. However, the harvesting rights are given to the local communities/forest dwellers.
4b.	If known, please specify who are the main harvesters of *Boswellia* specimens? Individual collectors ☐√ Collector associations ☐√ Private companies ☐ Other ☐ Please provide further details on the types of harvesters. Only forest dwellers/tribal. Outsiders have no right to enter the reserve forest areas
4c.	Is there any in-country processing capacity for *Boswellia* specimens? Please describe. Yes, the Herbal Manufacturing companies process the gum resin into extracts for use as supplements and Ayurvedic products
4d.	Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones. Not known
4e.	What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)? Gum resin and extracts
4f.	Which are the main known importing countries of *Boswellia* specimens sourced from your country?
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported.
4h.	What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)?
4i.	What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen.
4j.	Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries.
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded.
4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade.

4m.	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206.	
4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Personal observations and my field knowledge on various phyto-vegetations & tribal interactions from 1995 onwards.	

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a. Please describe any regulations or management measures in place or in preparation concerning

i. The conservation of *Boswellia* populations and/or habitats?

1. The Boswellia forests are protected under local VSS groups
2. Measures in place to prevent fire in dry season
3. Government encouraging artificial regeneration by vegetative and reproductive method
4. Establishing In-Situ Conservation sites
5. Conducting various awareness programs.

ii. The sustainable harvest of *Boswellia* specimens?

No harvesting in Andhra Pradesh, Telangana and Orissa states. At the harvesting areas in Madhya Pradesh, the forest dwellers are trained in sustainable harvesting by the Government and Local NGO (Non-governmental organization)

iii. The export of *Boswellia* specimens?

iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.

In Andhra Pradesh & Telangana States (Combined Andhra Pradesh in 2000-2003) In-situ Conservation carried out by demarking the area under Medicinal Plants Conservation Areas (MPCAs) under the project sponsored by United Nations Development Programme (UNDP) Executed by the Ministry of Environment & Forests, Govt. of India.

5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	a. S. N. Jadhav et al. 2001. Proceedings of the Workshop on Conservation Assessment and Management Planning (CAMP) for Medicinal plants of Andhra Pradesh. FRLHT, Bangalore & EPTRI, Hyderabad. b. S.N. Jadhav & Reddy, K.N, 2003. Threatened Medicinal Plants of Andhra Pradesh. Medicinal Plants Conservation Centre (MPCC), EPTRI, Hyderabad. c. Personal observations and my field knowledge on various phyto-vegetations & tribal interactions from 1995 onwards.	

Section 6. Additional remarks or information

6a.	Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

Proper taxonomical exploration studies on *Boswellia serrata* population in Forest division wise, District wise & State wide are needed before making a decision. As per IUCN proposal, for consideration even under threat Category, the species should meet at least one of the following, 1) the **Population reduction size** should not **decline > 30%,** where as country wise only below10% trees are exploited commercially, 2) the estimated **Extent of Occurrence should be < 20,000 Sq. Km,** whereas, more than 2-3 lakh Sq.km occurrence in India., 3) the estimated **Area of Occupancy should be < 2,000 Sq. Km** (more than 20,000 Sq.km in India), 4) **Population size estimated should be < 10,000 mature individuals** (more than 10,00,000 mature individuals), etc. Based on the foregoing information, *Boswellia serrata* plant species should not be recommended for CITES Listing.

Thank you very much for your responses!

Annex

Questionnaireon Boswelliatrees (*Boswellia*spp.)

Section 1: Contact information

1a.	Party: India	
1b.	Institution: Ex Botanical Survey of India (BSI), Government of India & Ex Central Council for research in Ayurvedic Sciences (CCRAS), Govt. of India.	
1c.	Contact information of the representative who responded to the questionnaire:	Name: Koppula Hemadri
		Phone: +919848296865
		Email:koppula.hemadri@gmail.com
		Other: Vijayawada – 520 008

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

1. *Boswellia serrata*, 2. *Boswellia ovalifoliolata*

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
• *Boswellia serrata*	✓ ☐	☐	☐		☐
• *Boswellia ovalifoliolata*	☐	☐	✓ ☐		☐
•	☐	☐	☐		☐

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• Boswellia serrata	☐	✓ ☐	☐		☐
• *Boswellia ovalifoliolata*	☐	☐	☐	Endemic Restricted to 4 Districts in Andhra Pradesh, India	☐
•	☐	☐	☐		☐

2d.	For each species occurring in your country, please provide its habitat trends. Add rows if needed.						
	Species	Increasing	Stable		Decreasing	Other, please specify	Unknown
	• *Boswellia serrata*	☐	✓	☐	☐		☐
	• *Boswellia ovalifoliolata*	☐	✓	☐	☐		☐
	•	☐	☐		☐		☐

2e. Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.

Boswellia serrata: in general the species grows in Eastern ghats, Western ghats & Central Inida. In some areas it forms pure colonies or grows in association with *Tectona*, *Terminalia* & *Anogeissus.*

Boswellia ovalifoliolata: It is endemic to 4 districts of Andhra Pradesh only. How the presence of this species helps the Ecosystem is not seriously studied. Being endemic, it deserves a special status and needs to be protected.

2f. Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.

As indicated above.

2g. Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.

Boswellia serrata: The Gum resin is tapped from the main trunk. A few decades ago the trunk was deeply injured including cambial region to tap the gum resin. Now a day this practice is avoided to save the tree from death. The stakeholders are taking affective measures.

Boswellia ovalifoliolata: The tree is not generally disturbed as the gum quality is of poor quality. Other parts are also not used.

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Being a Field Taxonomist the above data is based on purely personal observations.	

Section 3: Harvest and exploitation (paragraph b), c)and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use? *Boswellia serrata*
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)? Gum resin : Medicinal properties
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors. So far as Andhra Pradesh & Telangana states are concerned no gum resin tapping is undertaken.
3d. ---	What volume is exported (approximate annual export)?
3e. --	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations.
3f. --	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations.
3g.	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries.

Various State governments included in their forest working plans to propagate *Boswellia serrata*.

3h.	What are the challenges to artificially propagate/cultivate *Boswellia* species in your country?	
No difficulty in propagation of both *Boswellia serrata* and *Boswellia ovalifoliolata*.		
3i.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Not available	

Section 4: Supply chains and international trade (paragraph a), b)and f) of Decision 18.205)

4a.	Who are the predominant legal or customary owners / custodians of *Boswellia*? Government-owned ✓ Local communities ☐ Individual ownership ☐ Community-based or individual land tenure ☐ Please describe the land ownership structure where *Boswellia* spp.occur, including harvest rights.
4b.	If known, please specify who are the main harvesters of *Boswellia*specimens? ✓ Individual collectors ☐ ✓ Collector associations ☐ Private companies ☐ Other ☐ Please provide further details on the types of harvesters. --
4c.	Is there any in-country processing capacity for *Boswellia* specimens? Please describe. Not Available
4d.	Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones. Not Available
4e.	What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)? Gum Resin

4f.	Which are the main known importing countries of *Boswellia* specimens sourced from your country? Not Aware
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported. Not aware
4h.	What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)? Not Aware
4i.	What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen. Not Aware
4j.	Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries. Not aware
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded.

Not Applicable	
4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade.
Not aware	
4m.	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206.
Botanical Survey of India,(Government of India) & Dr. N. Venugopal, Field Botanist, Expert in *Boswellia* & other Gum & Resins, working with Tribals of Central India. drnvenugopal@gmail.com, mobile. +91 9440280054.	

4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Not Available	

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a. Please describe any regulations or management measures in place or in preparation concerning

i. The conservation of *Boswellia* populations and/or habitats?

Cyclic harvests are in place for *Boswellia serrata* in Central India managed by the Forest departments.

ii. The sustainable harvest of *Boswellia* specimens?

Boswellia serrata: - The Tribal people of Central India harvest Gum Resin for their livelihood. Most of them are trained in sustainable tapping methods. Hence the species is generally safe in their habitat.

iii. The export of *Boswellia* specimens?

Data not available

iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.

Ecological restoration efforts *in situ* to be planned.

5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Not available at present	

Section 6. Additional remarks or information

6a. Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

In India there are only 2 *Boswellia* species. One *Boswellia ovalifoliolata* is endemic covering small area and the other one *Boswellia serrata* is a common species almost throughout the country except temperate Himalayas.

The livelihood of the Tribal people of Central India in particular, is based on sustainable tapping of gum resin of *Boswellia serrata*. They adopt these trees, care them well as their own property and transfer the same to their Kit & Kin. Thus, sustenance of *Boswellia serrata* is taken care of.

Thank you very much for your responses!

Annex

Questionnaire on Boswellia trees (*Boswellia*spp.)

Section 1: Contact information

1a.	Party: INDFRAG BIOSCIENCES PRIVATE LIMITED	
1b.	Institution:	
1c.	Contact information of the representative who responded to the questionnaire:	Name: DIMPLE WADHER
		Phone: +91-9916144427
		Email: dimple@indfragbiosciences.com
		Other:

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

BOSWELLIA SERRATA

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
• Boswellia Serrata	√	☐	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• Boswellia Serrata	√	☐	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2d. For each species occurring in your country, please provide its habitat trends. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• Boswellia Serrata	☐	√	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2e. Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.

Boswellia serrata is a moderate-sized to large, deciduous tree with a light, spreading crown and somewhat drooping branches. It usually has a short bole, 3-5 m in height, sometimes can be more taller, if grown in a fully stocked forest. Ordinarily, it attains a girth of 1.2-1.8 m and a height of 9-15 m. Bark is very thin, greyish-green, ashy or reddish in colour with a chlorophyll layer beneath the thin outer layer, which peels off in thin, papery flakes.

Boswellia serrata is a species characteristic of the tropical dry deciduous forests and occurs in very dry teak forests or in dry mixed deciduous forests.

It is characteristically found on the slopes and ridges of hills, as well as on flat terrain, attaining a larger size on fertile soils. It is resistant to drought and resists fire better than other species in its zone of occurrence. The tree is also frost hardy and serves as a nurse tree for other species.

Boswellia, also known as Indian frankincense, is an herbal extract taken from the Boswellia serrata tree. Resin made from boswellia extract has been used for centuries in Asian and African folk medicine. It's believed to treat chronic inflammatory illnesses as well as a number of other health and skin conditions.

2f. Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.

Boswellia serrata is a multiple-use tree species used for fodder, timber and is tapped for an oleo-resin known internationally as Indian frankincense or Indian olibanum. The main commercial uses of B. serrata oleo-resin are medicinal, religious, and in cosmetics and perfumery. B. serrata, like other frankincense species, is an important source of boswellic acid used in the pharmaceutical industry. India is the only producer of B. serrata oleo-resin, mainly from the states of Madhya Pradesh, Andhra Pradesh, Gujarat and Jharkhand.

The estimated population is around 2000-3000 collectors in Madhya Pradesh. It is wildly distributed all over forest range from 2000-2500 square metres.

2g. Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.

Unknown. It is not exploited and is freely available with no constraints. There is no shortage of supply.

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	https://www.medicalnewstoday.com/articles/326599#how-to-take	
	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3309643/	
	https://www.hindawi.com/journals/omcl/2018/2504305/	

Section 3: Harvest and exploitation (paragraph b), c)and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use?
Boswellia Serrata	
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)?
It is majorly harvested for Pharmaceutical, Supplements, incense, and Cosmetics	
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)?Please include an estimate of the number of trees harvested and/or volume of harvested material.If available, provide conversion factors.
200-300 tons (Total)	
3d.	What volumeis exported (approximate annual export)?
Unknown	
3e.	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations.
Unknown	
3f.	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations.
Unknown	
3g.	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries.
We have artificially planted 100 trees last year. We have conducted trainings for cultivation of Boswellia. Each collector plants trees during rainy season as it is easily cultivated during that time. The branch of the Boswellia tree can be cut and planted in the soil during rainy season.	

3h.	Whatare the challenges to artificially propagate/cultivate *Boswellia* species in your country? None	
3i.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 4: Supply chains and international trade (paragraph a), b)and f) of Decision 18.205)

4a. Who are the predominant legal or customary owners / custodians of*Boswellia*?

Government-owned √ Local communities ☐ Individual ownership ☐ Community-based or individual land tenure ☐

Please describe the land ownership structure where *Boswellia* spp.occur, including harvest rights.

4b. If known, please specify who are the main harvesters of *Boswellia*specimens?

Individual collectors √ Collector associations ☐ Private companies ☐ Other ☐

Please provide further details on the types of harvesters.

4c. Is there any in-country processing capacity for *Boswellia*specimens? Please describe.

Each individual company processes its own /boswellia extract in their facility.

4d. Approximately how many companies or institutions in your country are known to process and / or trade*Boswellia*specimens? Please list the main ones.

Indfrag Biosciences

4e. What are the main *Boswellia*specimens known to be exported from your country (e.g. extract, woodchips, other)?

Major is Extract only.

4f.	Which are the main knownimporting countries of*Boswellia*specimenssourced fromyour country? Europe, USA, China, Japan
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported. Somalia, North Africa
4h.	What are the main*Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)? Extracts, Medicines
4i.	What is the approximate volume of *Boswellia*specimens being imported? Please specify for each type of specimen. Unknown
4j.	Is there any re-export of *Boswellia*specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries. Unknown
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded. SOOTHEX

4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia*specimens in trade.
Unknown	
4m.	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206.
GWALIOR BOSWELLIA SERRATA PRODUCER COMPANY LIMITED Darpan Colony, Karondi Road Ward No.39, Near St. Benedict School, Gate No.2 473551 India Contact – Mr. Sachin Kumar Verma (Managing Director) Email - gwaliorboswelliapcl@gmail.com Mobile - 9630597010	

4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

<table>
<tr><td colspan="3">5a. Please describe any regulations or management measures in place or in preparation concerning

i. The conservation of Boswelliapopulations and/or habitats?

By planting more trees

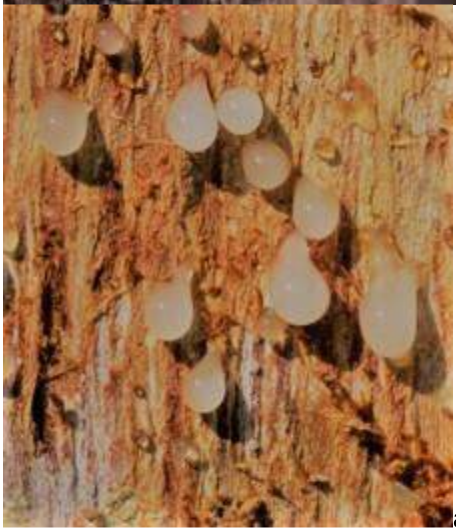
ii. The sustainable harvest of Boswelliaspecimens?

By preventing less damage to the trees. This is done by giving trainings to all the wild collectors. Initially, they used to make incisions on the whole tree which would cause damage to the tree and may not survive for a longer time. After training, they only make incision on one part/portion of the tree, which doesn't affect the tree as it used to. This helps the tree to survive for a longer period of time.

iii. The export of Boswelliaspecimens?

Unknown

iv. Ecological restoration efforts in situ, planned or underway, including the timeframe, source of propagation specimen, and outcomes.</td></tr>
<tr><td>5b.</td><td colspan="2">Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.</td></tr>
<tr><td></td><td>File/attachment</td><td>Comments (if</td></tr>
</table>

		  any)

Section 6. Additional remarks or information

6a.	Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

Thank you very much for your responses!

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party: India	
1b.	Institution: Freelance Ethno-botanist	
1c.	Contact information of the representative who responded to the questionnaire:	Name: Dr. Venugopal Nainala
		Phone: +91 9440280054
		Email: drnvenugopal@gmail.com
		Other: D. No. 6 – 108A, Sri DattaNilayam, Kolavennu Road, Punadipadu, Nr. Kankipadu Vijayawada – 521 151, Andhra Pradesh, India

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

1. *Boswellia ovalifoliolata* Balakr. & A. N. Henry 2. *Boswellia serrata* Roxb. ex Colebr.

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
• *Boswellia ovalifoliolata*	☐	✓ ☐	☐		☐
• *Boswellia serrata*	✓ ☐	☐	☐		☐
•	☐	☐	☐		☐

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• *Boswellia ovalifoliolata*	☐	✓ ☐	☐	Endemic to Seshachalam hills	☐
• *Boswellia serrata*	✓ ☐	☐	☐		☐
•	☐	☐	☐		☐

2d. For each species occurring in your country, please provide its habitat trends. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• *Boswellia ovalifoliolata*	☐	✓ ☐	☐		☐
• *Boswellia serrata*	☐	✓ ☐	☐		☐
•	☐	☐	☐		☐

2e. Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.

Plants of the species of *Boswellia* can withstand the severe desertification and survive in hot summer above 50 degree Celsius as learnt from the local tribes and is a great ecological service
.
Boswellia ovalifoliolata: This is medium sized tree, endemic to the foot hills of 'Seshachalam hill' ranges. Found mostly on red sandy to rocky soils of dry deciduous forest at an altitude of 600 to 900 m. It's found to be associated with *Lagerstroemia parviflora, Anogeissus latifolia, Tectona grandis, Mitragyna parvifolia, Terminalia tomentosa, Ziziphus xylopyrus, Wrightia tinctoria* etc.

Boswellia serrata: This is a moderate to large size tree found in tropical dry deciduous forests at an altitude up to 1500 m, on hot exposed hilltops, rocky slopes, ridges, flat terrain sandy soils mixed with stones and on nutrient poor shallow soils, over limestone, sand stone etc.
It's found associated with *Acacia catechu, Anogeissus latifolia, Lannea coromandelica, Buchanania lanzan, Ziziphus xylopyrus, Butea monosperma, Diospyros melanoxylon, Lagerstroemia parviflora, Tectona grandis, Mitragyna parvifolia, Terminalia tomentosa, Wrightia tinctoria, Ziziphus spinosa, Ziziphus oenoplia* etc.

2f. Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.

Boswellia ovalifoliolata: This species, limited to 'Seshachalam hills' hill ranges of the Eastern Ghats spreading to 5 districts of southern Andhra Pradesh in India *viz.,* Prakasham, Nellore, Chittoor, Kadapa, and Kurnool.
The population status is stable. Over 15 – 40 trees per ha is the population density.

Boswellia serrata: It's a common species across dry deciduous forests over 16 Indian states like Andhra Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Orissa, Jharkhand, Karnataka, Punjab, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh and West Bengal.

In most of the locations it forms predominant lush pure forests. The older trees measures over 2 to 2.5 m girth at breast height (gbh) with an age class of over 70 – 80 years.
Local people who rely on this species for their livelihood say the tree gives gum resin for 3 to 4 generations to them. They own the resource for generations and a traditional right of oleoresin collection from their fore fathers.

The population is found increasing and its size broadly varied. In Madhya Pradesh during our recent survey from September to November 2019 in about 100 forest ranges we could locate all age classes of the species from seedlings, saplings, middle age trees to old trees. The seed germination is good and the seedlings were recorded from all the forests. At very rare cases it was 10 to 15 trees/ha and most commonly it varied from 40 to 100 trees per ha and even more in some forests.

We have broadly estimated the presence of **20 million *Boswellia serrata* trees in 23 forest divisions** of Madhya Pradesh (Dewas, Jhabua, Alirajpur, Dhar, Indore, Burhanpur, Sendhwa, Barwani, Khargone, Khandwa, Gwalior, Kuno- Palpur, Shivpuri, Sheopur, Morena, Guna, Ashoknagar, Tikamgarh, Chhatarpur, Panna North, Panna South, Sagar, Damoh).
The population size is due for survey and estimation in about 15 other Indian states where *Boswellia serrata* is found distributed.

2g. Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.

Boswellia ovalifoliolata: Currently there is no such threat to the sustenance of this species except the human interventions like land encroachments & highway expansions at few places.
Earlier a decade ago the gum resin was collected by the local ‘Yanadi and Chenchu’ Tribes for their subsistence. During 90s gum resin collection is known from this species in this area.

These local ‘Yanadi and Chenchu’ Tribes shifted to alternative source of income due to 2 reasons.
1)The academicians, NGOs and the media created uproar about the endemism and unscientific exploitation of gum resin by the poor tribes.
2) The shift of the pro-tribal officials linking the market in the Tribal welfare administration of the state of Andhra Pradesh put the locals in a helpless situation and thereby the local poor lost their livelihood and shifted to alternative source of income. Simultaneously the markets too found alternative sources for gum ‘KondaSambrani/AdiviSambrani/Guggilamu/Gum-Olibanum.

Some artificial propagation initiatives are in place by the State Forest department. Therefore, as on today we strongly believe that there are no such threats effecting its conservation and sustainability. The older hale and healthy population is witnessed with over 60 – 70 years. Natural regeneration is found good there.

Boswellia serrata: The oleoresin is collected from about 20% trees in central Indian states from this species. While in several other states the oleoresin collection is not known even to the local populations. We don’t find any impeding drivers affecting the conservation of *Boswellia serrata*. While in open forests the animal grazing at times affecting the regeneration.

Fortunately the gum resin producing ducts formed from parenchyma tissues of outer cortical layers are situated superficially on the bole without affecting the regenerative cambium meri-stems. Therefore, the trees are found surviving for 3 to 4 generations in favor of the relying communities for their subsistence.

During trainings the technical information on scientific tapping methods is transformed in to the local dialect and tactfully imparted duly intermingling with the local Saharia, Gond, Bhils and other relying communities, on *Boswellia serrata* Oleoresin harvest and ensures the sustainable supply chain for decades.

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	http://www.sphinxsai.com/2016/ch_vol9_no1/1/(95-104)V9N1CT.pdf	
	Flora of Andhra Pradesh – Volume 1. T.Pullaiah, E.Chennaiah and S.Sandhya Rani	Based on Floristic work and field survey
	Flora of Eastern Ghats volume 1 – T.Pullaiah and D.Muralidhara Rao	Based on field data
	As a field ethno-botanist and my personal experience with Tribal welfare Department as consultant to Govt. of Andhra Pradesh during 1992 to 1995 and later.	The author trained over 17000 Tribals families on scientific tapping of various gums & resins across India for their sustained Livelihood.
	PCCF MP ORD 17 09 2019.jpg	The author works for MP state forest Department on invitation.
	BOSWELLIA SURVEY MP Sep. 2019.docx Unpublished survey report on *Boswellia serrata* – 2019	Report for one state out of 16 states of India

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use?
	Boswellia serrata is harvested for commercial use. *Boswellia serrata* provides subsistence to over 20 thousand Saharia, Gond and other Tribal families in the states of Madhya Pradesh, Maharashtra. The trees are adored by local communities like a member of their family protect and transfer to their siblings. Salai Guggul, Shallaki, Salai, Cheed, Cheed gond, Salar, Sale, Saley, Salaiya, Saleda, Luban, Dhoop, Anduga banka, Parangi Sambrani, Kundur & Ashwamutri, Gaja-bhakshya, Indian Frankincense, Gum Olibanum, Boswellia oleoresin are the local and trade names. Out of the total Indian population less than 10% is commercially exploited for its Oleoresin collection.
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)?
	Boswellia serrata – Salai Guggul oleoresin is used as a substitute for *Commiphora wightii* - Gum Guggul resin as an arthritic pain reliever in local and overseas medicine market and is also used for Incense and Hawan (holy fire) purposes also.
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)?Please include an estimate of the number of trees harvested and/or volume of harvested material.If available, provide conversion factors.
	Approximate annual harvest from India is 1000 tons roughly from 340 000 trees @ 3 kg oleoresin yield per tree. Close to 50% goes to domestic market and rest is exported. Volatile essential oil is extracted through distillation process and goes to incense, aromatherapy and cosmetics market.
3d.	What volumeis exported (approximate annual export)?

An estimated volume of over 500 tons of oleoresin is exported from India.

3e. Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations.

Boswellia serrata: The sustainability is not affecting because of the time to time interactions, awareness camps and trainings programs to the local relying Tribes from the M. P. State Minor forest produce federation and the Forest departments on sustainable collection of Gum resin are conducted. .
In Madhya Pradesh the State MFP Federation provides tools and other conservation tits, plantation inputs to the member Tribal families of the federation who are into *Boswellia serrata* oleoresin collection. The training and awareness programs are a continuous process. Moreover the Oleoresin from *Boswellia serrata* is not collected from several of Indian states. Hence threat to the sustenance is out of call.

3f. Please specify if harvest or export reduce or otherwise affect the regeneration capacityof *Boswellia* populations.

Boswellia serrata: During our very recent survey we could notice lot of natural regeneration occur on the forest floor especially in the protected and reserve forests. The regeneration is very little affected where the oleoresin taping is on. The reports relating to regeneration are connected to the animal grazing and forest fires in the open forests. The forest department working plans are included with the plantation programs on *Boswellia serrata* and are monitored in the stipulated intervals by the working plan departments under the guidance of a CCCF cadre official of each Forest circle.

3g. Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries.

Boswellia serrata: It's significantly addressed by the forest department in the form of propagation measures through seed nurseries, root suckers, stem cuttings (pole plants) & patch plantations duly involving local communities relying on this resource.
In the current season the oleoresin collector groups are entrusted with the collection of seed in the months of March & April for propagation of *Boswellia serrata* on large scale. Earmarked planation area @ 50 ha per forest ranges in about 100 forest ranges of the traditional *Boswellia* areas of 23 forest divisions is underway through gum resin collector groups. The groups are willing to go for plantations and protect the plantations as their responsibility.

3h. Whatare the challenges to artificially propagate/cultivate *Boswellia* species in your country?

The challenges are very limited and the plant is known for propagation through seeds, root suckers and pole plants in patches. 80% success rate is available in some of the Forest divisions like Burhanpur, Barwani, and Jhabua etc. The proven results and experiences are available on hand in case of both *Boswellia* species from India.

3i. Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.

	File/attachment	Comments (if any)
1	Our recent survey report with forest department.	The outcome of the recent survey 2019.
2	Flora of Andhra Pradesh – Volume 1. T.Pullaiah, E.Chennaiah and S.Sandhya Rani	
3	Flora of Eastern Ghats volume 1 – T.Pullaiah and D.Muralidhara Rao	

Section 4: Supply chains and international trade (paragraph a), b)and f) of Decision 18.205)

4a. Who are the predominant legal or customary owners / custodians of*Boswellia*?

Government-owned ☐ Local communities ✓ Individual ownership ☐ Community-based or individual land tenure ☐

Please describe the land ownership structure where *Boswellia* spp.occur, including harvest rights.

The Bio-resources & Tribal Rights acts in India are in favour of the community. The forest Rights act 2006, The PESA act 1996 and the Bio-diversity acts 2002 are ensuring the ownership of the resource by the local community. Even prior to these acts the Saharia Tribes traditionally passes on the right of collection of gum resin to their siblings is a practice in the state of Madhya Pradesh.

4b. If known, please specify who are the main harvesters of *Boswellia*specimens?

✓ Individual collectors ☐ ✓ Collector associations ☐ Private companies ☐ Other ☐

Please provide further details on the types of harvesters.

The collector groups are there in the villages but their earmarked property share of trees in the forest floor is a property transfer from family hood is an undisputed right among the tribes. The individual families own the stipulated count of trees shared traditionally from their family hood and they collect the Oleoresin (NWFP) for their survival in the respective seasons.

4c. Is there any in-country processing capacity for *Boswellia*specimens? Please describe.

Yes in-country processing available. *Boswellia serrata* oleoresin is procured by the export companies from the regular Herbal markets and makes extracts.

4d. Approximately how many companies or institutions in your country are known to process and / or trade*Boswellia*specimens? Please list the main ones.

M/s Gwalior Forest products, Shivpuri, M/s Laila Impex Vijayawada, M/s Chemiloids Life sciences Private Limited, Vijayawada, M/s Sami labs, Bangalore, M/s Uma Laxmi, Jodhpur, M/s Rakesh Sandal, Kanpur are the known players. These companies make extract and exports.
Ayurvedic industries like Dabur and others consume some volumes. Essential oil is also extracted and goes to perfume industry. 100 kg oleoresin yields 10 kg essential oil.
The Gum also goes to incense and Agarbatti industries.

4e. What are the main *Boswellia*specimens known to be exported from your country (e.g. extract, woodchips, other)?

Boswellia serrata oleoresin, Essential oil & extract like Boswellic acids.

4f.	Which are the main knownimporting countries of*Boswellia*specimenssourced fromyour country? USA, Japan, Germany, UAE etc.
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported. Not aware
4h.	What are the main*Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)? Not Known
4i.	What is the approximate volume of *Boswellia*specimens being imported? Please specify for each type of specimen. Not aware
4j.	Is there any re-export of *Boswellia*specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries. Not aware
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded. Not aware

4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade. No information
4m.	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206. **Dr** M**. Ahmedullah,** Chair, Indian Subcontinent Plant Conservation Network (ISPCN) President/CEO, Centre for Environmental Resources Assessment (CERA) Dharma Vana Arboretum (DVA), Plot 95/1, Phase 2, IDA Cherlapally, Hyderabad – 500 051 Telangana, INDIA Mob.: +91 9000176434, 9030078628 www.ceraispcn.org dr_ahmed@hotmail.com. **Dr. PC Dubey,** Additional PCCF, Research & Extension, Forest Department, Government of Madhya Pradesh, Satpura Bhavan, Bhopal, India, pcdubey2007@gmail.com , +91 9424790016.

4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	https://pesadarpan.gov.in/en	PESA act 1996
	http://nbaindia.org/uploaded/Biodiversityindia/Legal/31.%20Biological%20Diversity%20%20Act,%202002.pdf	National Biodiversity act 2002

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a. Please describe any regulations or management measures in place or in preparation concerning

i. The conservation of *Boswellia*populations and/or habitats?

A Gums & Resins policy of Madhya Pradesh covering all regulations concerned to the Silvics, Conservation, Tribal Ownership, Access Benefit Sharing (ABS), Resource management, R&D on Trainings and Harvesting methodologies, Skill development, Value addition, marketing strategies, better governance and partnering with all the stakeholders, utilization of indigenous knowledge and local knowhow etc. over 15 gum & resin yielding species including *Boswellia serrata* in the state of Madhya Pradesh is on cards. We are part of developing the document. This is underway with the Government.

ii. The sustainable harvest of *Boswellia*specimens?

iii. The export of *Boswellia*specimens?

iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.

5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Policy document is underway.	

Section 6. Additional remarks or information

6a.	Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

Boswellia trees from Burseraceae family did great human service in the history.
But natural and human actions across globe contribute to destruction and deterioration of certain *Boswellia* species and push them to the verge of extinction in certain parts of the world is not to ignore.

Out of 28 *Boswellia* species we have 2 species in India.
Our observation across several states in India as a Botanist we found the following. *Boswellia serrata* being a very strong component of forest ecosystem, preferring very special agro-climate spreads predominantly in its native domain, is its unique character
We would strongly state that the predominant presence of vast stretches of *Boswellia serrata* in many Indian states proves that it is abundant and uncountable numbers. We found that if forms its own forest and we are unable to notice dearth of its existence.

In parallel it offers subsistence to over 20000 poorest of the poor families of India who solely rely on gathering the gum resin for their livelihood.

The gathered Oleoresin is in turn contributing to the global human health care and it is an undeniable fact. The local administration is truly keen on developing policies to make it sustainable and conserve it for future human needs is a clever action in the context of sustenance of *Boswellia serrata*.

Hence, it is out opinion that enlisting our *Boswellia* species the *B. serrata* in particular under CITES is not justified and we appeal to the secretariat that *Boswellia serrata* to be exempted from listing under CITES.

Thank you very much for your responses!

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party: Somaliland	
1b.	Institution: neo botanika	
1c.	Contact information of the representative who responded to the questionnaire:	Name: Zahra Osman Guelle
		Phone: +41 79 9641416
		Email: zahra.osman@ogfgroup.com
		Other: guelle.osman@ogfgroup.com moktar.osman@ogfgroup.com

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

Frereana; carteri/sacra; rivae

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
• frereana	☒	☐	☐		☐
• carteri	☒	☐	☐		☐
• rivae	☒	☐	☐		☐

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• frereana	☐	☒	☐		☐
• carteri	☐	☒	☐		☐
• rivae	☐	☒	☐		☐

2d. For each species occurring in your country, please provide its habitat trends. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• frereana	☐	☒	☐		☐
• carteri	☐	☒	☐		☐
• rivae	☐	☒	☐		☐

2e. Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.

2f. Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.

2g. Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.

Any species can be affected by natural disasters (climate change, fire, etc.).
Extreme and sustained destructive tapping by inexperienced tappers.

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use? All: frereana, carteri, rivae
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)? Frereana: chewing gum, aromatherapy, medicine Carteri: fragrances, cosmetics, medicine, aromatherapy, incense Rivae: incense
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors. Frereana: maybe about a maximum of 500 metric tons (about 60,000 trees) Carteri: maybe about a maximum of 500 metric tons (about 60,000 trees) Rivae: maybe about a maximum of 50 metric tons (about 6,000 trees)
3d.	What volume is exported (approximate annual export)? All the above. Local consumption is minimal compared to the volumes that are exported.
3e.	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations. It does not as long as the harvesting protocol is followed.
3f.	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations. Regeneration is plentiful.
3g.	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries. Inititiatives have just begun. They are still in their 100s of seedlings.

3h.	What are the challenges to artificially propagate/cultivate *Boswellia* species in your country? No challenge.	
3i.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 4: Supply chains and international trade (paragraph a), b) and f) of Decision 18.205)

4a. Who are the predominant legal or customary owners / custodians of *Boswellia*?

Government-owned ☐ Local communities ☐ Individual ownership ☒ Community-based or individual land tenure ☐

Please describe the land ownership structure where *Boswellia* spp. occur, including harvest rights.

Frereana & carteri: the right to tap trees in specific areas belong to an individual of family.

Rivae: the right to tap trees belong to the members of whichever sub-tribe is ancestrally settled in the area where the trees grow

4b. If known, please specify who are the main harvesters of *Boswellia* specimens?

Individual collectors ☒ Collector associations ☐ Private companies ☐ Other ☐

Please provide further details on the types of harvesters.

They are the owners of the land themselves OR men who work for the owners OR men who rent the land

4c. Is there any in-country processing capacity for *Boswellia* specimens? Please describe.

In Somaliland, neo botanika has established the only essential oil extraction facility

4d. Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones.

neo botanika
Allah Magan
Salaama Trading
Asli Maydi
Rahiiq
Riyaad Trading Company
Maydi Frankincense
Abdillahi Yusuf Saleiman Trading Company

4e. What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)?

For all 3 species, the gum resin and the distilled essential oils are exported

4f.	Which are the main known importing countries of *Boswellia* specimens sourced from your country? France, Germany, UK, Bulgaria, India, Turkey, Spain, Morocco, UA Emirates, Oman, Yemen, Kenya, Saudi Arabia, China, USA
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported. /
4h.	What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)? /
4i.	What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen. /
4j.	Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries. /
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded. Frereana: maydi Carteri: sacra, olibanum, frankincense, beyo Rivae: qadhoon

4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade.	
4m.	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206.	
4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a. Please describe any regulations or management measures in place or in preparation concerning

i. The conservation of *Boswellia* populations and/or habitats?

ii. The sustainable harvest of *Boswellia* specimens?

iii. The export of *Boswellia* specimens?

For all above: organic certification, fairwild certification

iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.

Still at an early stage

5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 6. Additional remarks or information

6a.	Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

The situation in Somaliland is not of concern for 2 main reasons:

1) There is private ownership of the trees and this represents a protection for the trees. Owners and harvesters are conscious that their future livelihoods depend on the trees survival.
2) The resource base is massive and spans across the country. The areas of overtapping are relatively very limited and do not constitute a threat to the Boswellia frereana and Boswellia carteri population in Somaliland.

Thank you very much for your responses!

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party: **India**	
1b.	Institution: Sri Krishnadevaraya University	
1c.	Contact information of the representative who responded to the questionnaire:	Name: Prof. T.Pullaiah
		Phone:+91-9440505664
		Email: pullaiah.thammineni@gmail.com
		Other:

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

i. *Boswellia serrata* Roxb. ex Colebr. ii. *Boswellia ovalifoliolata* N.P.Balakr. & An.Henry

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
• *Boswellia serrata*	x	☐	☐		☐
• *Boswellia ovalifoliolata*	☐	☐	x		☐
•	☐	☐	☐		☐

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• *Boswellia serrata*	☐	x	☐		☐
• *Boswellia ovalifoliolata*	☐	x		Endemic to five districts of Andhra Pradesh, India	☐
•	☐	☐	☐		☐

2d. For each species occurring in your country, please provide its habitat trends. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• *Boswellia serrata*	☐	x	☐		☐
• *Boswellia ovalifoliolata*	☐	x	☐		☐
•	☐	☐	☐		☐

2e. Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.

Boswellia serrata – Common in rocky areas of dry forests of Andhra Pradesh, Assam, Bihar, Chhattisgarh, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Odisha, Punjab, Rajasthan. In some areas it forms pure stands.

Boswellia ovalifoliolata - Narrow Endemic to foot hills of Seshachalam hill ranges in Chittoor, Kadapa, Kunrool, Prakasam and Nellore districts up to an altitude of about 600 – 900 m.

2f. Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.

2g. Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.

As such there are no threats. Gum Olibanum, also known as Indian frankincense is extracted from *Boswellia serrata*. Tribals are protecting and adopting scientific methods of extraction of gum through the intervention of Government Forest Department. They are also protecting the plats.

Although *Boswellia ovalifoliolata* is endemic, there is no threat for its survival.

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	1. Flora of Andhra Pradesh – Volume 1. T.Pullaiah, E.Chennaiah and S.Sandhya Rani	Based on Floristic work and field survey
	2. Flora of Eastern Ghats volume 1 – T.Pullaiah and D.Muralidhara Rao	Based on field data

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use? Boswellia serrata
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)? Gum Resin for medicine, incense
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors. Tapping is done mainly in Madhya Pradesh, Maharashtra, Chhattisgarh
3d.	What volume is exported (approximate annual export)?
3e.	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations.
3f.	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations.
3g.	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries. There are no initiatives for propagation of the plants of these two species. There is a necessity for the same.

3h.	What are the challenges to artificially propagate/cultivate *Boswellia* species in your country? There is no problem for propagating these two species in India	
3i.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	1. Flora of Andhra Pradesh – Volume 1. T.Pullaiah, E.Chennaiah and S.Sandhya Rani	
	2. Flora of Eastern Ghats volume 1 – T.Pullaiah and D.Muralidhara Rao	

Section 4: Supply chains and international trade (paragraph a), b) and f) of Decision 18.205)

4a.	Who are the predominant legal or customary owners / custodians of *Boswellia*? Government-owned x Local communities x Individual ownership ☐ Community-based or individual land tenure ☐ Please describe the land ownership structure where *Boswellia* spp. occur, including harvest rights.
4b.	If known, please specify who are the main harvesters of *Boswellia* specimens? Individual collectors x Collector associations x Private companies ☐ Other ☐ Please provide further details on the types of harvesters.
4c.	Is there any in-country processing capacity for *Boswellia* specimens? Please describe. Not aware of anything on this
4d.	Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones. No data available
4e.	What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)? Gum resin from *Boswellia serrata*

4f.	Which are the main known importing countries of *Boswellia* specimens sourced from your country? Not known to me
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported. No data available
4h.	What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)? No data available with me
4i.	What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen. No data available with me
4j.	Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries. No data available with me
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded. Gum Olibanum, Indian frankincense

4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade. Not aware	
4m	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206. Forest Department, Government of Mahdya Pradesh, Maharashtra, Chhattisgarh, Jarkhand	
4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a. Please describe any regulations or management measures in place or in preparation concerning

i. The conservation of *Boswellia* populations and/or habitats?

Cyclic harvests are in place for *Boswellia serrata* in managed by the Forest departments.

ii. The sustainable harvest of *Boswellia* specimens?

No information with me

iii. The export of *Boswellia* specimens?

Not known to me

iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.

Ecological restoration efforts *in situ* needed

5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 6. Additional remarks or information

6a. Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

I am author of Flora of Andhra Pradesh, Flora of Telangana and Flora of Eastern Ghats. I worked in the forests of above said regions for floristic survey. My student-Colleague and his team also surveyed these two species in Eastern Ghats by carrying out population studies. For these studies we infer that there is no threat for these two species – *Boswellia serrata* and *Boswellia ovalifoliolata.*
Hence, from my 35 years of field experience I strongly feel that there is no necessity for keeping these species in CITES list.

Thank you very much for your responses!

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party: India	
1b.	Institution: Kakatiya University, Warangal	
1c.	Contact information of the representative who responded to the questionnaire:	Name: Dr Sateesh Suthari
		Phone: +91-9441712719
		Email: suthari.botany@gmail.com
		Other: suthari.botany@uohyd.ac.in

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

Boswellia serrata
Boswellia ovalifoliata

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
• *Boswellia serrata*	☐	☐	☐	Not rare available	☐
• *Boswellia ovalifoliata*	☐	☐	☐	Available	☐
•	☐	☐	☐		☐

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• *Boswellia serrata*	☐	Stable	☐		☐
• *Boswellia ovalifoliata*	Increasing	☐	☐		☐
•	☐	☐	☐		☐

2d. For each species occurring in your country, please provide its habitat trends. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
• *Boswellia serrata*	☐	Stable	☐		☐
• *Boswellia ovalifoliata*	☐	Stable	☐		☐
•	☐	☐	☐		☐

2e. Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.

Boswellia serrata is mainly found in Telangana i.e. Deccan plateau of India, and abundantly available in erstwhile Adilabad, Warangal and Khammam districts and there is no threat to this species in the region due to there is no tapping of any resin from the plant species. It is abundantly found along the gradient of Godavari valley region, especially on hilly tops and its associates in the region are *Tectona grandis, Terminalia alta, Hardwickia binata, Cleistanthus collinus, Xylia xylocarpa*, etc.

Boswellia ovalifoliata majorly found in the districts of Andhra Pradesh and associated states. There is no extraction of resin from the species.

2f. Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.

The population of *Boswellia* species are very high without any disturbance though they perform little seedling growth. I have been observing these both species since a decade in various districts of the two states, namely, Telangana, and Andhra Pradesh, I cannot found a single gram of tapping of resin from the stem of the species. They have distributed abundantly in various hilly regions of two states.

2g. Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.

At present, there are no threats to these plant species, due to neither they destroy for gum/resin collection nor timber purpose. Though they have little germination, natural survival, growth rate, etc. they have good number of populations in the two states without any disturbance or anthropogenic pressures.

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)
	Diversity of NTFPs and Their Utilization in Adilabad District of Andhra Pradesh, India	With these field based articles, we have given conservation priorities other than *Boswellia* species in the region.
	Conservation Priorities of NTFP Species in Dry Deciduous Forests of Adilabad District, Telangana, India	Due to anthropogenic pressures, we have prioritized for conservation of *Firmiana simplex, Givotia moluccana, Madhuca, Dendrocalamus*, etc. but not *Boswellia* due to there is no such type of pressure on them.

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use?
I have found only two species in our region, i.e. Boswellia serrata, B. ovalifoliata. There is no harvesting of any material from these species in the region for commercial purpose.	
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)?
No uses were identified in the study area.	
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors.
Not applicable	
3d.	What volume is exported (approximate annual export)?
Not applicable	
3e.	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations.
Not applicable	
3f.	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations.
Not applicable	
3g.	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries.
In recent times, the Govt. of Telangana has taken initiation programmes to improve its saplings through 'HARITHA HAARAM' since 2015. It is expected to be good results in the improvement of the saplings of native species along with *Boswellia*.	

3h.	What are the challenges to artificially propagate/cultivate *Boswellia* species in your country? The Forest department is taking all the safety measurements to improve the population at present.	
3i.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 4: Supply chains and international trade (paragraph a), b) and f) of Decision 18.205)

4a. Who are the predominant legal or customary owners / custodians of *Boswellia*?

Government-owned ☐ Local communities ☐ Individual ownership ☐ Community-based or individual land tenure ☐

Please describe the land ownership structure where *Boswellia* spp. occur, including harvest rights.

State Governments.

4b. If known, please specify who are the main harvesters of *Boswellia* specimens?

Individual collectors ☐ Collector associations ☐ Private companies ☐ Other ☐

Please provide further details on the types of harvesters.

No harvesting… this is not applicable.

4c. Is there any in-country processing capacity for *Boswellia* specimens? Please describe.

No

4d. Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones.

Not applicable

4e. What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)?

Not applicable

4f.	Which are the main known importing countries of *Boswellia* specimens sourced from your country? Not applicable.
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported. ~~Not applicable.~~
4h.	What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)? Not applicable.
4i.	What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen. Not applicable.
4j.	Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries. Not applicable.
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded. No trade of *Boswellia* from the region.

4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade. Not applicable	
4m.	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206. Not applicable	
4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a. Please describe any regulations or management measures in place or in preparation concerning

i. The conservation of *Boswellia* populations and/or habitats?

At present, there are proper conservation methods are practicing in the two states.

ii. The sustainable harvest of *Boswellia* specimens?

No harvesting of Boswellia resin.

iii. The export of *Boswellia* specimens?

Not applicable.

iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.

The Govt. of Telangana has taken initiation programmes to improve its saplings through 'HARITHA HAARAM' since 2015. It is expected to be good results in the improvement of the saplings of native species along with *Boswellia*.

5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 6. Additional remarks or information

6a.	Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)
	All the necessary precautions and measurements have been taking by the Governments to improve the populations of Boswellia species.

Thank you very much for your responses!

MAPROW Species Data Fact Sheet

Medicinal and Aromatic Plant Resources of the World

Edited by Dr Uwe Schippmann

Boswellia neglecta S.Moore 6333 Burseraceae

Nomenclatural reference 1148 The Plant List. - http://www.theplantlist.org/

Remarks Taxonomy

Remarks Taxonomy	Reference	
genus: "17 species in rather dry areas from the Ivory Coast to India and southwards to north-eastern Tanzania and northern Madagascar"	8889	Thulin, M. (1999): Flora of Somalia. Volume 2. Angiospermae (Ericaceae-Asteraceae). Royal Botanic Gardens, Kew, Kew.
genus: "c. 20 dry trop. Afr. (esp. NE; Socotra 8 endemics) & As."	3753	Mabberley, D.J. (2017): The plant-book. 4th edition. Cambridge University Press, Cambridge.
Flora Somalia treats this species in a wider sense and includes B. microphylla Chiov. as a synonym which is an accepted species in TPL.	8889	Thulin, M. (1999): Flora of Somalia. Volume 2. Angiospermae (Ericaceae-Asteraceae). Royal Botanic Gardens, Kew, Kew.

Summary

Distribution	Boswellia neglecta is native to Ethiopia, Somalia, Kenya, Tanzania, and Uganda.
Legislation	The species is not protected by CITES.
Threat Category	Not assessed globally by IUCN. Not found in recent national red lists.
Threat	Several threat causes exist: (i) continuous tapping through the year with no rest periods; (ii) grazing of livestock; (iii) cutting branches for fodder in times of drought. Severe drought also affects the trees directly.
Abundance	Locally common in Kenya; unknown for rest of range.
Habitat	Boswellia neglecta is found in Acacia-Commiphora bushland at altitudes from 130 to 1350m.
Regeneration	It may be inferred from another species (B. papyrifera) that propagation from rooted cuttings and the production of root suckers are possible.
Reproduction	Flowers bisexual.
Lifeform	Shrub or small tree, up to 8m high.
Plant Parts	Gum-resin as an exudate from the bark is used.
Use	B. neglecta resin is of lower quality as that yielded by B. sacra and B. frereana. In general, the gum-resins are used for burning as incense, they distilled to yield volatile oils in perfumery, used for chewing, and to a lesser degree in the preparation of traditional medicines.
Use Fields	Material; Social use; Medicine; Food.
Trade Trend	Demand seems to be stable or perhaps even decreasing.

Vulnerability Matrix

Threat Cat	2	Threat	3	Regeneration	2,1	Total Value	20
Distribution	3	Abundance	2	Reproduction	2,1		
Plant Parts	2	Habitat	3	Trade Trend	1	**Vulnerability**	**2 Medium**

Synonyms

Synonym	Eval	Ref	
Boswellia elegans Engl.		8914	Gillett, J.B. (1991): Burseraceae. In: Flora of Tropical East Africa.
Boswellia hildebrandtii Engl.		8889	Thulin, M. (1999): Flora of Somalia. Volume 2. Angiospermae (Ericaceae-
Boswellia microphylla Chiov.		8889	
Boswellia multifoliata Engl.		8914	Gillett, J.B. (1991): Burseraceae. In: Flora of Tropical East Africa.

Common Names

Common Name	Typ	Language	Country	Ref	
Frankincense	tra			8730	Brendler, T., Eloff, J.N., Gurib-Fakim, A. &
Olibanum	tra			8730	

Distribution Range

Distribution Range	Ref	
Native: Ethiopia, Somalia, Kenya, Tanzania, Uganda	1100	GRIN Database (Germplasm Resources Information Network). USDA-ARS. Retrieved from www.ars-grin.gov

"Found in northern and eastern Uganda, northern Tanzania, eastern Ethiopia and in most drier parts of Kenya, e.g. in southern Turkana, Mutha (Kitui), northern Baringo"	8749	Maundu, P.M., Ngugi, G.W. & C.H.S. Kabuye (1999): Traditional food plants of Kenya. National Museum of Kenya, Nairobi. Retrieved from http://www.cd3wd.com/cd3wd_40/cd3wd/AGRIC/H1093E/EN/B567_7.HTM, viewed: 12.09.2011.

Abundance

ICC	Abundance	Reference	
KE	"May be locally common"	8749	Maundu, P.M., Ngugi, G.W. &

Ecology

TypeEc	ICC	Ecology	Ref	
alti		200-1350m	8914	Gillett, J.B. (1991): Burseraceae
alti	SO	130-990m	8889	Thulin, M. (1999): Flora of Soma
habit		"Acacia, Commiphora bushland"	8914	Gillett, J.B. (1991): Burseraceae
habit	SO	"Acacia-Commiphora bushland"	8889	Thulin, M. (1999): Flora of Soma
repro		"Flowers bisexual"	8914	Gillett, J.B. (1991): Burseraceae

Life Form

Duration	Lifeform	Woodiness	Height	LF_free_txt	Ref	
	shrub or small tree		up to 8m	"shrub or small tree"	8914	Gillett, J.B. (1991): Burseracea
	shrub or tree		up to 6m	"tree or shrub"	8919	Moges, Y. (2004): Gum and in
	shrub or tree		up to 5m	"shrub or, less often, a tree"	8749	Maundu, P.M., Ngugi, G.W. &
	shrub or tree		up to 8m	"shrub or Tree"	8889	Thulin, M. (1999): Flora of Som

Population Status / Threat Causes

ICC	PopulationStatus	Remark	Ref	
ET	"B. neglecta was found in all the districts with densities ranging between 600 and 95 trees/ha."		3787	Gachathi, F.N. & Eriksen, S. (2
ET	[non-species-specific information for Boswellia]: „Under best practice, a tree is tapped for no more than 3 consecutive years, and should be rested so it can recover and regain vigour. However, in most cases, Boswellia trees are repeatedly tapped at intervals of 15 days throughout the dry season for up to 7 or more years. This causes premature death and production of poor-quality seeds that are unable to regenerate		8898	Lemenih, M. & Kassa, L. (2010
ET	[non-species-specific information for Boswellia and Commiphora]: „Drivers of dryland degradation include population growth and farmland expansion, lack of regeneration, human-induced fires, improper use of woodlands, improper tapping, overgrazing and bush encroachment"		8898	
SO	[non-species-specific information for Boswellia and Commiphora]: "It is impossible to prevent grazing of livestock and in times of drought nomads cut branches for fodder. Severe drought also affects the trees directly, slowing their growth and causing problems of regeneration. The more accessible trees are often tapped continuously through the year, with no rest periods, and this puts them under further stress."		4187	Coppen, J.J.W. (1995): Flavou

Threat Categories

Purpose: Fields of Use

Purpose: Fields uf Use		Frequency
food	sweets industry	1
material	colouring & dye	1
	general	3
medicine	used traditionally as herbal remedy	1
social use	cosmetics industry	1
	general	2

Purpose: Free text

Purpose		Ref	
medicine - used traditionally as herbal remedy	[non-species-specific information] "The main use for olibanum, myrrh and opopanax imported into the People's Republic of China is in the preparation of traditional medicines."	4187	Coppen, J.J.W. (1995): Flavou
social use - general	[non-species-specific information] "The major fragrance use is for burning as incense in religious ceremonies."	4187	Coppen, J.J.W. (1995): Flavou
	"The gum-resin is used locally as incense"	8889	Thulin, M. (1999): Flora of Som
social use - cosmetics industry	[non-species-specific information] "Small amounts of resin are distilled to yield volatile oils [...] which find use in perfumery."	4187	Coppen, J.J.W. (1995): Flavou
food - sweets industry	[non-species-specific information] "The 'clean', distinctive flavour of certain types of olibanum makes them highly valued for chewing and this constitutes an important use in some markets."	4187	Coppen, J.J.W. (1995): Flavou
material - general	"[used] for making containers water-proof"	8889	Thulin, M. (1999): Flora of Som

	Materials: essential oils (fide Başer et al., Flav Fragr J 18:153-156. 2003)	1100	GRIN Database (Germplasm R
	Materials: gum/resin (fide Başer et al., Flav Fragr J 18:153-156. 2003)	1100	GRIN Database (Germplasm R
material - colouring & dye	"The bark is used for tanning."	8889	Thulin, M. (1999): Flora of Som

Plant Parts Used

Plant Part (standardized)	Plant Part (free text)	Remark	Ref	
exudate	gum-resin		8889	Thulin, M. (1999): Flora of Som

Scale and Trend of Trade

ICC	Trade Trend	Remark	Ref	
	[non-species-specific information for Boswellia and Commiphora]: "Demand today is believed to be less than was current in the late 1970s/early 1980s."		4187	Coppen, J.J.W. (1995): Flavou

Trade

Type	ICC	Utilization	Ref	
com		"Olibanum of Middle Eastern origin is said by some sources to come principally from three species of Boswellia: B. carteri and B. frereana in Somalia and B. sacra in southern Arabia. Some other Boswellia spp. are minor sources of resin and these include B. bhau-dajiana and B. neglecta in Somalia and B. papyrrfera in Ethiopia."	4187	Coppen, J.J.W. (1995): Flavou
com		"The Ogaden type is gum-resin type produced in the east and south-eastern parts of the country. [...] However, some of the sources indicated that resins from B. rivae (Engl.), B. ogadensis (Vollesen) (Somali name 'Gended'), B. neglecta (S. moore) (Somali name 'Murufur') and B. microphylla (Chior.) (Somali name 'Muqlay') are collected and traded as frankincense in this area"	3786	Lemenih, M. &Teketay, D. (20(
com	KE	"The species is the commonest source of frankincense in Kenya."	8749	Maundu, P.M., Ngugi, G.W. &
exp		[non-species-specific information for Boswellia and Commiphora]: "Somalia and Ethiopia are by far the biggest producers of the three resins [...]. Somalia is the only source of maidi-type olibanum, exports of which were estimated at 800-900 tonnes in 1987. Smaller quantities of the "beyo" type of olibanum are produced. Ethiopia and Sudan produce the most widely traded olibanum, the Eritrean type, and in 1987 this was reckoned to amount to some 2,000 tonnes."	4187	Coppen, J.J.W. (1995): Flavou
har	ET	[non-species-specific information for Boswellia and Commiphora]: „estimates for olibanum and myrrh show yields in the range of 0.07–1.0 kg per tree per year, with the average being 0.50 kg [...], whereas another report provides an estimate as high as 3.0 kg per tree per year	8898	Lemenih, M. & Kassa, L. (201(
har	ET	[non-species-specific information for Boswellia: Estimated potential and annual production of gum and incense in Ethiopia: Gum olibanum 2,284,000 ha and 57,100 tonnes	8898	
har	ET	„Ogaden and Borana types are gum resins produced from Boswellia species found in the dry forests of the eastern and southeastern lowlands. [...] gum resins from B. rivae, B. ogadensis, B. neglecta and B. microphylla are collected from these areas and traded as frankincense"	8898	
har	KE	"Annual production estimate: 100 tonnes for frankincense"	3787	Gachathi, F.N. & Eriksen, S. (2
har	SO	[non-species-specific information for Boswellia]: "In some cases, as in Somalia, the wild Boswellia stands belong to extended families who live in the resin-producing areas. There is therefore some incentive on the part of those who tap the trees not to do it in such a way as to damage the trees and jeopardise their livelihoods."	4187	Coppen, J.J.W. (1995): Flavou
har	SO	[non-species-specific information for Boswellia]: "It is not possible from official records alone to estimate how much resin, on average, is obtained from a tree. Figures of 1-3 kg per tree per year have been cited for olibanum in Somalia."	4187	
imp		[non-species-specific information for Boswellia and Commiphora]: "The Middle East and the People's Republic of China are seen to be the major consumers. Germany has imported significant amounts of Ethiopian incense gum."	4187	
imp		[non-species-specific information for Boswellia and Commiphora]: "The People's Republic of China is the largest market for all three resins, mainly for use in traditional medicines. Imports of olibanum (mainly the Eritrean type from Ethiopia and Sudan) and myrrh were each significantly in excess of 1,000 tonnes in 1984. [...] In Europe and Latin America, substantial amounts of Eritrean-type olibanum are used as incense by the Orthodox and Roman Catholic Churches (approaching 500 tonnes in 1987). Similar quantities are imported into North African countries where it is used for chewing. The Middle East, particularly Saudi Arabia, is another important market for the chewing grade of olibanum, this time the higher quality "maidi" type from Somalia (approximately 500 tonnes in 1987). [...] Of the order of 50 tonnes pa [...] of olibanum [...] are used in Europe (mainly France) for the production of essential oils and extracts."	4187	
rem	KE	"True frankincense is resin of a more superior quality yielded by Boswellia carteri Birdw. and B. frereana Birdw. both occurring in northern Somalia."	8749	Maundu, P.M., Ngugi, G.W. &
tra		"There are six most common Boswellia species whose gum-resins are widely traded and these are: B. frereana Birdw. known only from Somalia; B. sacra Flueck. (syn. B. carteri) from Somalia, Yemen and Oman; B. papyrifera Hochst. from Ethiopia and Sudan; B. rivae Engl. from Ethiopia; B. neglecta S.Moore from Ethiopia and Kenya; and B. serrata Roxb. from India. They are all known as frankincense or olibanum."	8730	Brendler, T., Eloff, J.N., Gurib-
tra	ET	[non-species-specific information for Boswellia and Commiphora]: „The production and trade volumes of gums and resins in Ethiopia have been increasing since the 1990s. Between 1998 and 2007, Ethiopia exported about 25 192 tonnes – an average of approximately 2519 tonnes per year – of natural gums and resins with a value of [...] 34 138 670 USD [...]. The export volume increased on average by 12% each year from 1998 to 2007"	8898	Lemenih, M. & Kassa, L. (201(
tra	KE	"The species is the commonest source of frankincense in Kenya."	8749	Maundu, P.M., Ngugi, G.W. &

Legislation

Regulation

Bibliography

1100 GRIN Database (Germplasm Resources Information Network). USDA-ARS. Retrieved from www.ars-grin.gov

2095 Iwu, M.M. (1993): Handbook of African medicinal plants. CRC Press, Boca Raton.

3753 Mabberley, D.J. (2017): The plant-book. 4th edition. Cambridge University Press, Cambridge.

3786 Lemenih, M. &Teketay, D. (2003): Frankincense and myrrh resources of Ethiopia. I. Distribution, production, opportunities for dryland development and research needs. Ethiopian Journal of Science 26 (1): 63-72. Retrieved from https://www.ajol.info/index.ph

3787 Gachathi, F.N. & Eriksen, S. (2011): Gums and resins. The potential for supporting sustainable adaptation in Kenya's drylands. Climate and Development 3: 59-70. Retrieved from https://www.tandfonline.com/doi/abs/10.3763/cdev.2010.0066, viewed: 04.07.2018.

3799 Vollesen, K. (1989): Burseraceae. In: Hedberg, I. & Edwards, S. (ed.): Flora of Ethiopia. Volume 3. Pittosporaceae to Araliaceae. pp. 442-478. - National Herbarium Ethiopia & Uppsala University, Addis Ababa, Asmara & Uppsala.

4187 Coppen, J.J.W. (1995): Flavours and fragrances of plant origin. FAO, Rome (Non-wood Forest Products 1). Retrieved from http://www.fao.org/docrep/V5350E/V5350e00.htm, viewed: 07.11.2012.

8350 Farnsworth, N.R., Graham, J. & Quinn-Beattie, M.L. (2.6.2009): NAPRALERT data-base export. Data obtained through the courtesy of Professor Norman R. Farnsworth, University of Illinois at Chicago.

8730 Brendler, T., Eloff, J.N., Gurib-Fakim, A. & Phillips, L.D. (ed.) (2010): African Herbal Pharmacopoeia. Graphic Press, Mauritius.

8749 Maundu, P.M., Ngugi, G.W. & C.H.S. Kabuye (1999): Traditional food plants of Kenya. National Museum of Kenya, Nairobi. Retrieved from http://www.cd3wd.com/cd3wd_40/cd3wd/AGRIC/H1093E/EN/B567_7.HTM, viewed: 12.09.2011.

8889 Thulin, M. (1999): Flora of Somalia. Volume 2. Angiospermae (Ericaceae-Asteraceae). Royal Botanic Gardens, Kew, Kew.

8898 Lemenih, M. & Kassa, L. (2010): Opportunities and challenges for sustainable production and marketing of gums and resins in Ethiopia. CIFOR, Bogor. Retrieved from http://www.cifor.org/publications/pdf_files/Books/BKassa1102.pdf, viewed: 12.06.2012.

8914 Gillett, J.B. (1991): Burseraceae. In: Flora of Tropical East Africa. Balkema, Rotterdam.

8919 Moges, Y. (2004): Gum and incense. Recommendations for improved production and income generation. Consultancy sub-report no. 6. FARM Africa / SOS Sahel, sine loco. Retrieved from http://www.pfmp-farmsos.org/Docs/gum_incense_borana.pdf, viewed: 23.09.2012.

Abbreviations and Standards

ICC = ISO Country Codes   Ref = literature reference

Altitude: Low / High = minimum and maximum limits of altitude range [m]

Legislation: Source Taxon = name of taxon as contained in legislation

Utilization: TypeUtil

TypeUtil	*TypeUtilLong*
com	commodity
cul	cultivation
exp	export
har	harvest
imp	import
price	price
pur	purpose
rem	remark
sus	sustainability
tra	trade
trend	trend and scale of trade

Distribution Status: Standard

Status	*Explanation*
chk	check entry
nat	native
int	introd., established
adv	introduced, not established
ocd	occurrence doubtful
unc	status unclear
ext	extinct
cul	cultivated
sou	source doubtful
ica	introduced (casual or naturalized)
don	doubtfully native
pex	(presumably) extinct
ali	casual alien
nzd	naturalized
nna	not native
dpn	status doubtful, possibly native
abs	absent but reported in error

Common names: Type

TypeShort	*Type*
?	<unknown>
ayn	ayurvedic name
hom	homoeopathic name
pha	pharmaceutical name
scn	standardized common name
tra	trade name
ver	vernacular name

Ecology: TypeEcol

TypeEcol	*Explanation*
alti	altitude
grow	growth rate
habit	habitat
morph	morphology
regen	regeneration
repro	reproduction
soil	soil

Boswellia papyrifera (Caill. ex Delile) Hochst. 4252 Burseraceae

Nomenclatural reference 1148 The Plant List. - http://www.theplantlist.org/

Remarks Taxonomy

Remarks Taxonomy	Reference	
genus: "17 species in rather dry areas from the Ivory Coast to India and southwards to north-eastern Tanzania and northern Madagascar"	8889	Thulin, M. (1999): Flora of Somalia. Volume 2. Angiospermae (Ericaceae-Asteraceae). Royal Botanic Gardens, Kew, Kew.
genus: "c. 20 dry trop. Afr. (esp. NE; Socotra 8 endemics) & As."	3753	Mabberley, D.J. (2017): The plant-book. 4th edition. Cambridge University Press, Cambridge.
genus: "19-20 species extending from the Ivory Coast to India and south to NE Tanzania and N Madagascar; most numerous in NE tropical Africa"	8914	Gillett, J.B. (1991): Burseraceae. In: Flora of Tropical East Africa. Balkema, Rotterdam.
"The affinity of B. sacra appears to be closest to B. papyrifera"	8793	Thulin, M. & Warfa, A.M. (1987): The francinsense trees (Boswellia spp., Burseraceae) of northern Somalia and southern Arabia. Kew Bulletin 42 (3): 487-500.

Summary

Distribution	Boswellia papyrifera has a disjunct distribution between northeast tropical Africa (Chad, Eritrea, Ethiopia, Sudan, Uganda) and west tropical Africa (Cameroon, Central African Republic, Nigeria).
Legislation	The species is not protected by CITES.
Threat Category	Not assessed globally by IUCN. Not found in recent national red lists.
Threat	The species is declining at an alarming rate. Populations are facing degradation due to (i) agricultural expansion, (ii) overgrazing, (iii) fire, and (iv) poor incense harvesting practices. There has been increased population pressure in the B. papyrifera growing parts of Eastern Africa, which has resulted in the conversion of Boswellia woodlands to agricultural lands. Unregulated free range grazing has damaged natural regeneration of B. papyrifera. Tapping may potentially reduce natural regeneration of the species. More accessible trees are often tapped continuously with no resting periods and it is possible that this affects the reproductive capability of the trees. Eritrea: During the last few decades the abundance of exploitable Boswellia trees has decreased mainly owing to intensification of land use practices, such as land clearing for agriculture, grazing by livestock and extraction of resin. The population structure analysis showed that there was an overall absence of juvenile trees. Natural regeneration was found only in two areas in which trees were not tapped for resin and inaccessible to livestock. Ethiopia: Four direct factors affecting Boswellia forests are: (i) clearance for crop production by commercial farmers and resettled smallholder farmers; (ii) overgrazing; (iii) intensive and improper tapping; and (iv) increasing forest fire. Declining regeneration and spatial shrinkage of B. papyrifera woodlands have been observed in much of the natural range of this species. Remaining population consists of mainly mature trees, thus highlighting the problems for natural regeneration. Sudan: Lack of natural regeneration is primarily caused by livestock grazing pressure and the absence of recruitment is largely caused by lack of seed production by mother trees as the result of intensive tapping of the frankincense.
Abundance	1.7 million ha of woodlands holding B. papyrifera as their main species occur in 3 administrative regions of Ethiopia; unknown for rest of range.
Habitat	B. papyrifera occurs in dry Acacia–Commiphora woodlands, on steep rocky slopes, in sandy river valleys, among lowland semi-desert and desert vegetation, and on degraded sites with shallow soils at altitudes from 200 to 1800m.
Regeneration	Propagates from rooted cuttings. Exposed root of a mature tree can initiate root suckers.
Reproduction	Monoecious, with bisexual flowers. Normally it produces seeds in abundance which germinate readily. However, survival rate of seedlings is poor due to draught periods, browsing and trampling by lifestock.
Lifeform	Tree, 10-20m high.
Plant Parts	Gum-resin as an exudate from the bark is used.
Use	In general, the gum-resins are used for burning as incense, they are distilled to yield volatile oils in perfumery, used fro chewing, and to a lesser degree in the preparation of traditional medicines.
Use Fields	Medicina; material; social use; food; food additive.
Trade Trend	In Ethiopia, exports seem to have increased between 2000 and 2007.

Vulnerability Matrix

Threat Cat	2	Threat	3	Regeneration	1	Total Value	19
Distribution	2	Abundance	2	Reproduction	2	**Vulnerability**	**2 Medium**
Plant Parts	2	Habitat	3	Trade Trend	2		

Synonyms

Synonym	Eval	Ref	
Amyris papyrifera Delile ex Caill.		1100	GRIN Database (Germplasm Resources Information Network). USDA-
Boswellia chariensis Guillaumin		8914	Gillett, J.B. (1991): Burseraceae. In: Flora of Tropical East Africa.
Boswellia occidentalis Engl.		8914	

Common Names

Common Name	Typ	Language	Country	Ref	
frankincense	tra			8730	Brendler, T., Eloff, J.N., Gurib-Fakim, A. &
itan-zaf		Amharic (ET)		3795	Engels, J.M.M., Hawkes, J.G. & Worede,
olibanum	tra			8730	Brendler, T., Eloff, J.N., Gurib-Fakim, A. &

Distribution Range

Distribution Range	Ref	
Native: Chad, Eritrea, Ethiopia, Sudan, NE Uganda, N Cameroon, Central African Republic, NE Nigeria	1100	GRIN Database (Germplasm Resources Information Network). USDA-ARS. Retrieved from www.ars-grin.gov
"found in Ethiopia, Nigeria, Cameroon, Central African Republic, Chad, Sudan, Uganda and Eritrea"	8891	Gebrehiwot, K., Muys, B., Haile, M. & Mitloehner, R. (2003): Introducing Boswellia papyrifera (Del.) Hochst and its non-timber forest product, frankincense. International Forestry Review 5 (4): 348-353. Retrieved from http://www.eap.lehagere.com/sites/default/files/Introducing%20Boswellia%20papyrifera%20%28Del.%29%20Hochst%20and%20its%20non-timber%20forest%20product,%20frankincense.pdf, viewed: 12.06.2012.
"dry parts of Africa from Nigeria to Eritrea and Ethiopia (Ogbazghi)"	2258	Tree Database, Forest Ecology and Forest Management Group, University Wageningen. http://www.wageningenur.nl/en/Expertise-Services/Chair-groups/Environmental-Sciences/Forest-Ecology-and-Forest-Management-Group/Education/Tree-database.htm
"B. papyrifera is the most common species [...]. It is found [in ET] in the lowland areas of Gojam, Shewa, Gondar, Tigray and Eritrea"	3795	Engels, J.M.M., Hawkes, J.G. & Worede, M. (ed.) (1991): Plant genetic resources of Ethiopia. Cambridge University Press, Cambridge. Retrieved from https://www.researchgate.net/publication/241778257_Plant_Genetic_Resources_of_Ethiopia, viewed: 04.07.2018.
"widely distributed in Ethiopia, Eritrea, Nigeria, Cameron, Central Africa Republic, Sudan, Chad and North East Uganda "	3792	Tadesse, W., Desalegn, G. & Alia, R. (2007): Natural gum and resin bearing species of Ethiopia and their potential applications. Investigación Agraria, Producción y Protección Vegetales 16 (3): 211-221. Retrieved from https://www.researchgate.net/publication/263748402_Potential_applications_of_Ethiopian_natural_gums_as_Pharmaceutical_Excipients_A_Review, viewed: 04.07.2018.
Uganda, NE Nigeria to N Ethiopia	8914	Gillett, J.B. (1991): Burseraceae. In: Flora of Tropical East Africa. Balkema, Rotterdam.

Abundance

ICC	Abundance	Reference	
ET	"about 1.7 million ha of woodlands holding B. papyrifera as their main species occur in 3 administrative regions"	8899	Lemenih, M. & Kassa, L. (2010

Ecology

TypeEc	ICC	Ecology	Ref	
alti		1200-1500m	8914	Gillett, J.B. (1991): Burseraceae
alti		220-1800m	8899	Lemenih, M. & Kassa, L. (2010)
alti	ET	950-1800 m	3792	Tadesse, W., Desalegn, G. & Al

alti	ET	950-1800m	8891	Gebrehiwot, K., Muys, B., Haile,
habit		"Stony hillsides in dry wooded grassland"	8914	Gillett, J.B. (1991): Burseraceae
habit		"highland dry forest"	2258	Tree Database, Forest Ecology
habit		"predominantly found in the Terminalia–Combretum broad-leaved deciduous woodlands, the Acacia–Commiphora small-leaved deciduous woodlands, and among lowland semi-desert and desert vegetation."	8899	Lemenih, M. & Kassa, L. (2010)
habit		"restricted to the Terminalia–Combretum broad-leaved deciduous woodlands of the north, north-west and some of the northern major river gorges."	8899	
habit	ET	"found in dry Acacia-Commiphora woodland and wooded grassland usually dominant on steep rocky slopes, lava flows or sandy valleys"	3792	Tadesse, W., Desalegn, G. & Al
habit	ET	"occurs in dry Acacia-commiphora woodlands[...] on degraded sites with very shallow soils, steep rocky slopes, lava flows or sandy river valleys"	8891	Gebrehiwot, K., Muys, B., Haile,
habit	SD	"The survival of the species in such marginal areas makes it a key stone species that can provide plant cover and protect the soil and provide shade. It also plays an important role in desertification control since it acts as defense line against desert creeping southwards."	8900	Abtew, A., Pretzsch, J., Elsheikh
regen	ET	"known to propagate via several means: from natural seed germination (wildings), nursery seedling production and transplanting, rooted cuttings and root sprouts/suckers."	8899	Lemenih, M. & Kassa, L. (2010)
regen	ET	"can also be reproduced using root suckers. This method appears to play a considerable propagation role in the natural environment of the species. In this type of B. papyrifera propagation, the exposed root of a mature tree can initiate a root sprout."	8899	
regen	ET	"propagates from branch cuttings"	8899	
repro		"Flowers bisexual"	8914	Gillett, J.B. (1991): Burseraceae
repro		"can be propagated from seeds and cuttings"	3792	Tadesse, W., Desalegn, G. & Al
repro		monoecious	8891	Gebrehiwot, K., Muys, B., Haile,
repro		"propagation - natural by seed"	2258	Tree Database, Forest Ecology
repro		"many insect species and fungi cause huge mortality of seeds"	2258	
repro	ET	"most of the seedlings fail to survive during the dry season. This has resulted in minimal recruitment in natural stands to replace old and dying trees. Boswellia papyrifera is highly palatable for livestock and wild herbivores, and the seedlings are frequently browsed and trampled due to uncontrolled grazing in Boswellia forests."	8899	Lemenih, M. & Kassa, L. (2010)
repro	ET	"Normally, B. papyrifera bears seeds in abundance, with 44 000–64 000 seeds per kilogram. [...] seeds germinate readily and have a high germination rate. They require no pre-treatment nor do they exhibit dormancy."	8899	

Life Form

Duration	Lifeform	Woodiness	Height	LF_free_txt	Ref	
			12m	"deciduous tree"	3792	Tadesse, W., Desalegn, G. &
	tree		up to 12m		8891	Gebrehiwot, K., Muys, B., Hail
	tree		up to 20m		8899	Lemenih, M. & Kassa, L. (2010
	tree		up to 10m		8914	Gillett, J.B. (1991): Burseracea

Population Status / Threat Causes

ICC	PopulationStatus	Remark	Ref	
	"threatened; declining in numbers"		2258	Tree Database, Forest Ecology
ET	[Acacia, Boswellia and Commiphora species in ET]: “declining at an alarming rate due to degradation due to agricultural expansion, overgrazing, fire, poor incense harvesting practices, shifting cultivation, termite and other infestations"		3792	Tadesse, W., Desalegn, G. &
ET	„in Metema district, B. papyrifera on average accounts for 51% of the woody plant density [...] A similar population structure for B. papyrifera has been reported in Eritrea [...] and Tigray, Ethiopia. [...] The density of B. papyrifera in the Metema area ranges from 64 to 225 stems/ha, similar to reports from Tigray"		8898	Lemenih, M. & Kassa, L. (2010
ET	[non-species-specific information for Boswellia and Commiphora]: "Although reliable information on the distribution and abundance of the resin-yielding species is not available, and the scattered occurrence of the trees makes detailed surveys a difficult and expensive option, it is believed that the total size of the natural resource and its potential productivity significantly outweigh demand for the products. Coulter (1987) cites official estimates in 1981 of 23,000 tonnes pa for the potential production of olibanum in Ethiopia."		4187	Coppen, J.J.W. (1995): Flavou
	"The production is declining as a result of poor natural regeneration of the Boswellia woodlands, possibly as a result of the low production of viable seeds. [...] non-tapped trees produced three times as many healthy and filled seeds as tapped trees. Germination success was highest in stands with non-tapped trees (> 80%) and lowest for those with tapped trees (< 16%)."		8007	Rijkers, T., Woldeselassie, O.,
	"The species is declining at an alarming rate and thus needs priority in conservation. Populations are facing degradation due to agricultural expansion, overgrazing, fire, poor incense harvesting practices, shifting cultivation, termite and other infestations and urgent conservation measures are required to save the species. Conservation strategies could include promotion of natural regeneration through closed areas and enrichment planting."		8891	Gebrehiwot, K., Muys, B., Hail
	"There has been increased population pressure in the B. papyrifera growing parts of Eastern Africa, which has resulted in the conversion of Boswellia woodlands to agricultural lands. Unregulated free range grazing has damaged natural regeneration of B. papyrifera as its seeds and seedlings are preferred by goats and other livestock for grazing and browsing."		8891	

	"Tapping for frankincense results in limited flower and fruit production, and low production of mainly non-viable seeds in B. papyrifera. We argue that tapping causes competition for carbohydrates between frankincense production, and fruit and seed setting. Consequently, the current tapping regimes will cause tree exhaustion and eventually a decline in vitality. Tapping may potentially reduce natural regeneration of the species."	8007	Rijkers, T., Woldeselassie, O.,
	"Many populations of B. papyrifera are threatened by conversion into agricultural land [...] and present a hump-shaped population distribution, dominated by small seedlings and adult trees but lacking the sapling and treelet stages."	8892	Groenendijk, P., Eshete, A., St
ER	"More accessible trees are often tapped continuously with no resting periods and it is possible that this affects the reproductive capability of the trees. Seeds from tapped stands in Eritrea have a low germination rate (14% and 16%) when compared to seeds from un-tapped stands (94% and 80%)."	8891	Gebrehiwot, K., Muys, B., Hail
ER	"During the last few decades the abundance of exploitable Boswellia trees has decreased mainly owing to intensification of land use practices, such as land clearing for agriculture, grazing by livestock and extraction of resin"	8895	Ogbazghi, W., Bongers, F., Rij
ER	"experiencing population declines, and [...] harvested for a variety of non-medicinal purposes, including for fodder, fuel, and fencing"	5589	Marshall, N. (1998): Searching
ER	"The population structure analysis showed that there was an overall absence of juvenile trees between 1 and 8 cm DBH. Natural regeneration was found only in two areas in which trees were not tapped for resin and inaccessible to livestock."	8895	Ogbazghi, W., Bongers, F., Rij
ET	"The decline in the population of B. papyrifera in eastern Africa has become an ecological concern [...] In Tigray (northern Ethiopia) more than 177,438 ha of B. papyrifera forests have been destroyed in the last 20 years."	8891	Gebrehiwot, K., Muys, B., Hail
ET	"Under the ‘business as usual’ scenario, population models projected a 90%decline in the size of tapped and untapped populations within 50 years and a 50% decline in frankincense yield within 15 years. Model simulations for restoration scenarios revealed that populations and frankincense production could only be sustained with intensive management leading to full sapling recruitment and a 50–75%reduction in adult mortality."	8892	Groenendijk, P., Eshete, A., St
ET	"Excessive tapping of individual trees, expansion of crop and grazing land and forest fire threaten stands of B. papyrifera. [...] Declining regeneration and spatial shrinkage of B. papyrifera woodlands have been observed in much of the natural range of this species."	8899	Lemenih, M. & Kassa, L. (2010
ET	"Increasing the number of tapping spots in a tree increases the overall annual yield of frankincense per tree, but it affects the tree’s vitality and interferes with its reproductive biology."	8899	
ET	"Boswellia papyrifera forests are facing several challenges. Four direct factors affecting Boswellia forests are: (1) clearance for crop production by commercial farmers and resettled smallholder farmers; (2) overgrazing; (3) intensive and improper tapping; and (4) increasing forest fire."	8899	
ET	"Tapping can cause damage to trees if done at high intensity or by inexperienced tappers. Damage arises because tapping exposes trees to infectious attack by insects and other pathogens [...], reduces tree vigour and increases susceptibility to windfall. Moreover, increased tapping intensity of B. papyrifera trees reduces their sexual reproduction by affecting the carbon allocation between frankincense production, healing of wounds and fruit and seed setting."	8899	
ET	"intensively tapped stands produce less viable seeds, which can negatively affect natural regeneration."	8899	
ET	"Due to this exploitation the potential range of forest communities with Boswellia is greatly reduced, the population of the species is declining continuously, and the species is classified as endangered."	8896	Abiyu, A., Vacik, H. & Glatzel,
ET	"any deep tapping beyond the bark is unnecessary, and damages the plant"	8891	Gebrehiwot, K., Muys, B., Hail
ET	[non-species-specific information for Boswellia and Commiphora]: „Drivers of dryland degradation include population growth and farmland expansion, lack of regeneration, human-induced fires, improper use of woodlands, improper tapping, overgrazing and bush encroachment"	8898	Lemenih, M. & Kassa, L. (2010
ET	"remaining population consists of mainly mature trees (e.g. more than 76% of the existing Boswellia trees in northern Ethiopia have a DBH greater than 30 cm DBH [...]), thus highlighting the problems for natural regeneration. As a result of declining populations in Eritrea, frankincense export dropped from 2,000 tonnes in 1974 to 400 tonnes in 1998."	8891	Gebrehiwot, K., Muys, B., Hail
ET	"the most common factors observed causing damage to the trees, in North Gonder Zone, were windfall, insect attack (unidentified whitish worm), termite, fire, improper tapping, clearing and de-branching by local farmers and trampling and browsing by cattle"	3792	Tadesse, W., Desalegn, G. &
ET	[non-species-specific information for Boswellia]: „Under best practice, a tree is tapped for no more than 3 consecutive years, and should be rested so it can recover and regain vigour. However, in most cases, Boswellia trees are repeatedly tapped at intervals of 15 days throughout the dry season for up to 7 or more years. This causes premature death and production of poor-quality seeds that are unable to regenerate"	8898	Lemenih, M. & Kassa, L. (2010
ET	„The population structure of B. papyrifera shows the presence of a large proportion of individuals in the medium diameter classes, and few individuals in the smaller (seedling and sapling) diameter classes [...] This high seedling mortality is a major obstacle for this species and is currently threatening the population"	8898	

ET	„B. papyrifera need[s] some fire-free years to allow enough regeneration and the development of seedlings into saplings and poles to maintain the populations [...]. However, in most cases, woodland vegetation is exposed to annual burning, which severely affects not only delicate seedlings but also mature trees [...].Furthermore, tapped trees (e.g. B. papyrifera) are more susceptible to fire damage than untapped trees, because the resin they exude is highly inflammable, intensifying the fire and causing tree death"	8898	
ET	"existence of the species in the country is seriously threatened by accelerated deforestation rate mainly through land clearing for more agricultural land, frequent wildfires and overgrazing"	3792	Tadesse, W., Desalegn, G. &
ET	„Boswellia papyrifera in the Combretum-Terminalia deciduous woodlands is an example of a poorly regenerating species [...] The major population obstacle for this species is not seedling emergence but the high mortality of seedlings"	8898	Lemenih, M. & Kassa, L. (2010
ET	"Regeneration bottlenecks and high adult mortality are causing rapid decline in frankincense-producing tree populations in Ethiopia. This decline is unlikely to be a consequence of harvesting and is probably driven by fire, grazing and beetle attacks."	8892	Groenendijk, P., Eshete, A., St
ET	"assessments of B. papyrifera population in the north and northwestern parts of Ethiopia showed lack of natural regeneration leading to the listing of the species as one of the endangered species in Ethiopia"	3792	Tadesse, W., Desalegn, G. &
SD	"natural regeneration is lacking in all two study areas. Additionally, the population of Boswellia in the study areas is unstable and under threat due to lack of recruitments through regeneration. Based on the stands structure analysis, it is hypothesized that lack of natural regeneration is primarily caused by livestock grazing pressure and the absence of recruitment is largely caused by lack of seed production by mother trees as the result of intensive tapping of the frankincense."	8900	Abtew, A., Pretzsch, J., Elshei
SD	"some concem voiced about over-harvest of Boswellia papyrifera, as unskilled gum collectors have caused frequent and excessive wounds to trees, thereby contributing to their death or ill-health"	5589	Marshall, N. (1998): Searching

Threat Categories

Glo	ICC	Region	Categ	Criteria	Year / Version	Ref	
	UG		Rare (R)			1109	UNEP-WCMC Threatened Species Database. Download of 1997 regional threat assessments sent 15.6.2011 by H. Gillett. Cambridge, UK (cf. Walter & Gillett, 1997 IUCN Red List of threatened plants)

Purpose: Fields of Use

Purpose: Fields uf Use		Frequency
food	sweets industry	1
food additive	flavouring & spice	1
material	general	2
medicine	general	1
	used traditionally as herbal remedy	2
social use	cosmetics industry	1
	general	1

Purpose: Free text

Purpose		Ref	
medicine - general	Used medicinally	8350	Farnsworth, N.R., Graham, J.
medicine - used traditionally as herbal remedy	[non-species-specific information] "The main use for olibanum, myrrh and opopanax imported into the People's Republic of China is in the preparation of traditional medicines."	4187	Coppen, J.J.W. (1995): Flavou
	"traded for its gum, known as Olibanum. Olibanum is used as a traditional medicine in Sudan [...]. In Europe, it is used to relieve nasal congestion, and is widely available in the form of waxed sticks [...]. It is also used for aromatic purposes, and is used in the preparation of traditional medicines in China."	5589	Marshall, N. (1998): Searching
social use - general	[non-species-specific information] "The major fragrance use is for burning as incense in religious ceremonies."	4187	Coppen, J.J.W. (1995): Flavou
social use - cosmetics industry	[non-species-specific information] "Small amounts of resin are distilled to yield volatile oils [...] which find use in perfumery."	4187	Coppen, J.J.W. (1995): Flavou
food additive - flavouring & spice	Food additives: flavoring (probably used as spice fide L Edible Pl)	1100	GRIN Database (Germplasm R
food - sweets industry	[non-species-specific information] "The 'clean', distinctive flavour of certain types of olibanum makes them highly valued for chewing and this constitutes an important use in some markets."	4187	Coppen, J.J.W. (1995): Flavou
material - general	Materials: essential oils (fide HerbSpices)	1100	GRIN Database (Germplasm R
	Materials: gum/resin (fide F Ethiop)	1100	GRIN Database (Germplasm R

Plant Parts Used

Plant Part (standardized)	Plant Part (free text)	Remark	Ref	
exudate	resin		8891	Gebrehiwot, K., Muys, B., Hail

Scale and Trend of Trade

ICC	Trade Trend	Remark	Ref	
	[non-species-specific information for Boswellia and Commiphora]: "Demand today is believed to be less than was current in the late 1970s/early 1980s."		4187	Coppen, J.J.W. (1995): Flavou
ET	"Trade liberalisation has helped increase commercialisation of frankincense in Ethiopia. For instance, the frankincense trade volume increased from 2183 tons in the 2000/2001 Ethiopian fiscal year to 3834 tons in 2007/08."		8899	Lemenih, M. & Kassa, L. (2010
ER	"gradual decline in the annual export production from about 2000 tons in 1974 to about 400 in 1999"		8895	Ogbazghi, W., Bongers, F., Rij

Trade

Type	ICC	Utilization	Ref	
com		"Eritrean/Tigray type olibanum is the most widely traded frankincense in the world [...], and is the gum-resin obtained from Boswellia papyrifera (Del.) Hochst."	3786	Lemenih, M. &Teketay, D. (20(
com		"Olibanum of Middle Eastern origin is said by some sources to come principally from three species of Boswellia: B. carteri and B. frereana in Somalia and B. sacra in southern Arabia. Some other Boswellia spp. are minor sources of resin and these include B. bhau-dajiana and B. neglecta in Somalia and B. papyrrfera in Ethiopia."	4187	Coppen, J.J.W. (1995): Flavou
cul	ET	"has not yet been domesticated in Ethiopia."	8899	Lemenih, M. & Kassa, L. (201(
cul	ET	"Little or no efforts have been made to domesticate the species."	3792	Tadesse, W., Desalegn, G. &
exp	ET	[non-species-specific information for Boswellia]: "Frankincense is still exported from Ethiopia to the EU, Poland, Middle East, and Asian countries particularly to Japan and China [...] In recent times China has been the largest market for frankincense, while in Europe and Latin America, a significant amount is used by the Orthodox and Roman Catholic churches. High quality frankincense is imported into North African countries and Saudi Arabia where it is used for chewing, while lower grade olibanum is used for burning in the Middle East, although its use has declined in favour of other fragrant materials, such as sandalwood."	8891	Gebrehiwot, K., Muys, B., Hail
exp	ET	[non-species-specific information] "In the 2007/2008 Ethiopian fiscal year, the country exported 3834 tons of gums and resins, earning US$ 5.2 million."	8899	Lemenih, M. & Kassa, L. (201(
exp	ET	Production/ export of Tigray/Eritrean type olibanum [= Boswellia papyrifera]: 1992/18004; 1993/25266; 1994/30637; 1995/-; 1996/-; 1997/11923; 1998/7178; 1999/14223 [yr/quintals; 1 quintal = 100 kg]	3786	Lemenih, M. &Teketay, D. (20(
har		"1–3 kg of frankincense can be collected from a tree in a year"	8891	Gebrehiwot, K., Muys, B., Hail
har	ET	"Estimates of annual frankincense yield per B. papyrifera tree vary considerably. For instance, Tadesse et al. (2004) reported a range of 6.7–451.4 g frankincense per tree per year. Eshet and Alem (unpub.) reported a frankincense yield of 207–352 g per tree per year."	8899	Lemenih, M. & Kassa, L. (201(
har	ET	"One-third of those involved in frankincense collection in northern Ethiopia are women. Men are mainly involved in tapping and collecting the incense from the forest while women undertake sorting and grading it. A taper can collect about 1,000–1,500 kg of incense per annum and receives a net income of US $ 100 to 150."	8891	Gebrehiwot, K., Muys, B., Hail
har	ET	"The drylands of Ethiopia contain numerous tree and shrub species that produce commercial gums and gum resins. The most important of these species is Boswellia papyrifera (Del.) Hochst."	8899	Lemenih, M. & Kassa, L. (201(
har	ET	[non-species-specific information for Boswellia and Commiphora]: „estimates for olibanum and myrrh show yields in the range of 0.07–1.0 kg per tree per year, with the average being 0.50 kg [...], whereas another report provides an estimate as high as 3.0 kg per tree per year"	8898	Lemenih, M. & Kassa, L. (201(
har	ET	[non-species-specific information for Boswellia]: Estimated potential and annual production of gum and incense in Ethiopia: Gum olibanum 2,284,000 ha and 57,100 tonnes	8898	
har	ET	B. papyrifera in the Metema, source 1: annual yield 6.7-451.4 g per tree; source 2: 207-352 g per tree; „These variations in incense yield are attributed to tree size and tapping intensity"	8898	
har	SO	[non-species-specific information for Boswellia]: „In some cases, as in Somalia, the wild Boswellia stands belong to extended families who live in the resin-producing areas. There is therefore some incentive on the part of those who tap the trees not to do it in such a way as to damage the trees and jeopardise their livelihoods. On the other hand, it is impossible to prevent grazing of livestock and in times of drought nomads cut branches for fodder. Severe drought also affects the trees directly, slowing their growth and causing problems of regeneration. The more accessible trees are often tapped continuously through the year, with no rest periods, and this puts them under further stress.	4187	Coppen, J.J.W. (1995): Flavou
har	SO	[non-species-specific information for Boswellia]: „It is not possible from official records alone to estimate how much resin, on average, is obtained from a tree. Figures of 1-3 kg per tree per year have been cited for olibanum [= Boswellia] in Somalia."	4187	
imp		"exported to Europe, North America and Asia, with exports averaging 760t per year for the period 1992-1996"	5589	Marshall, N. (1998): Searching
imp		[non-species-specific information for Boswellia and Commiphora]: "The Middle East and the People's Republic of China are seen to be the major consumers. Germany has imported significant amounts of Ethiopian incense gum."	4187	Coppen, J.J.W. (1995): Flavou

imp		[non-species-specific information for Boswellia and Commiphora]: "The People's Republic of China is the largest market for all three resins, mainly for use in traditional medicines. Imports of olibanum (mainly the Eritrean type from Ethiopia and Sudan) and myrrh were each significantly in excess of 1,000 tonnes in 1984. [...] In Europe and Latin America, substantial amounts of Eritrean-type olibanum are used as incense by the Orthodox and Roman Catholic Churches (approaching 500 tonnes in 1987). Similar quantities are imported into North African countries where it is used for chewing. The Middle East, particularly Saudi Arabia, is another important market for the chewing grade of olibanum, this time the higher quality "maidi" type from Somalia (approximately 500 tonnes in 1987). [...] Of the order of 50 tonnes pa [...] of olibanum [...] are used in Europe (mainly France) for the production of essential oils and extracts."	4187	
sus		"New tapping regimes are suggested that include periods of time in which tapping is prohibited in order for trees to recover and replenish their stored carbon pool, and a reduction in the number of tapping points per tree."	8807	Dickson, B., Mathew, P., Mickl
sus	ER	"some resting period is necessary for wound healing following tapping. Ogbazghi (2001) has advised a healing period of between 4 and 14 years in order to attain the full potential for viable seed production in Eritrea. Murphy and Shiva (1977) found that the original thickness of B. serrata Roxb. was regained three years after tapping was stopped."	8891	Gebrehiwot, K., Muys, B., Hail
sus	ET	"allow [...] a sufficient resting period of 3–5 years after trees/stands are consecutively tapped for a couple of years can enable the trees to regain vigour and vitality."	8899	Lemenih, M. & Kassa, L. (201(
sus	ET	"forestry is a long-term investment; it therefore requires secure ownership and clearly defined property rights, as well as appropriate law enforcement that is effective, efficient and suited to local conditions. Indeed, sustainable management of B. papyrifera requires a policy environment that grants local communities rights to access and benefit from dry forests"	8899	
sus	ET	"Rotational harvesting involves rotating production centres to allow some sites to sufficiently rest while production is taking place in other sites."	8899	
sus	ET	"The recommended tapping intensity per tree is a total of 6 spots for trees of < 20 cm diameter at breast height (DBH), a total of 12 spots (3 spots on each of the 4 sides) for trees of medium DBH (20–30 cm) and a total of 16 spots (4 spots on each of the 4 sides) for trees > 30 cm DBH."	8899	
tra		"There are six most common Boswellia species whose gum-resins are widely traded and these are: B. frereana Birdw. known only from Somalia; B. sacra Flueck. (syn. B. carteri) from Somalia, Yemen and Oman; B. papyrifera Hochst. from Ethiopia and Sudan; B. rivae Engl. from Ethiopia; B. neglecta S.Moore from Ethiopia and Kenya; and B. serrata Roxb. from India. They are all known as frankincense or olibanum."	8730	Brendler, T., Eloff, J.N., Gurib-
tra		[non-species-specific information for Boswellia and Commiphora]: "Somalia and Ethiopia are by far the biggest producers of the three resins [...]. Somalia is the only source of maidi-type olibanum, exports of which were estimated at 800-900 tonnes in 1987. Smaller quantities of the "beyo" type of olibanum are produced. Ethiopia and Sudan produce the most widely traded olibanum, the Eritrean type, and in 1987 this was reckoned to amount to some 2,000 tonnes."	4187	Coppen, J.J.W. (1995): Flavou
tra	ET	"a chief gum resin producing tree species in Ethiopia"	3792	Tadesse, W., Desalegn, G. &
tra	ET	[non-species-specific information for Boswellia and Commiphora]: „The production and trade volumes of gums and resins in Ethiopia have been increasing since the 1990s. Between 1998 and 2007, Ethiopia exported about 25 192 tonnes – an average of approximately 2519 tonnes per year – of natural gums and resins with a value of [...] 34 138 670 USD [...]. The export volume increased on average by 12% each year from 1998 to 2007"	8898	Lemenih, M. & Kassa, L. (201(
tra	SD	traded in Karthoum in large volumes	5589	Marshall, N. (1998): Searching

Legislation

Regulation

Bibliography

1100 GRIN Database (Germplasm Resources Information Network). USDA-ARS. Retrieved from www.ars-grin.gov

1109 UNEP-WCMC Threatened Species Database. Download of 1997 regional threat assessments sent 15.6.2011 by H. Gillett. Cambridge, UK (cf. Walter & Gillett, 1997 IUCN Red List of threatened plants)

2258 Tree Database, Forest Ecology and Forest Management Group, University Wageningen. http://www.wageningenur.nl/en/Expertise-Services/Chair-groups/Environmental-Sciences/Forest-Ecology-and-Forest-Management-Group/Education/Tree-database.htm

3753 Mabberley, D.J. (2017): The plant-book. 4th edition. Cambridge University Press, Cambridge.

3786 Lemenih, M. &Teketay, D. (2003): Frankincense and myrrh resources of Ethiopia. I. Distribution, production, opportunities for dryland development and research needs. Ethiopian Journal of Science 26 (1): 63-72. Retrieved from https://www.ajol.info/index.ph

3792 Tadesse, W., Desalegn, G. & Alia, R. (2007): Natural gum and resin bearing species of Ethiopia and their potential applications. Investigación Agraria, Producción y Protección Vegetales 16 (3): 211-221. Retrieved from https://www.researchgate.net/publicat

3795 Engels, J.M.M., Hawkes, J.G. & Worede, M. (ed.) (1991): Plant genetic resources of Ethiopia. Cambridge University Press, Cambridge. Retrieved from https://www.researchgate.net/publication/241778257_Plant_Genetic_Resources_of_Ethiopia, viewed: 04.07.2018.

3799 Vollesen, K. (1989): Burseraceae. In: Hedberg, I. & Edwards, S. (ed.): Flora of Ethiopia. Volume 3. Pittosporaceae to Araliaceae. pp. 442-478. - National Herbarium Ethiopia & Uppsala University, Addis Ababa, Asmara & Uppsala.

4187 Coppen, J.J.W. (1995): Flavours and fragrances of plant origin. FAO, Rome (Non-wood Forest Products 1). Retrieved from http://www.fao.org/docrep/V5350E/V5350e00.htm, viewed: 07.11.2012.

5525 Penso, G. & Proserpio, G. (1997): Index plantarum medicinalium totius mundi eorumque synonymorum. 2nd edition. OEMF, Milano.

5589 Marshall, N. (1998): Searching for a cure. Conservation of medicinal wildlife resources in east and southern Africa. Traffic International, Cambridge (Species in Danger). Retrieved from http://www.traffic.org/general-reports/traffic_pub_gen46.pdf, viewed:

7279 van Wyk, B.-E. & Wink, M. (2004): Medicinal plants of the world. Timber Press, Portland.

8007 Rijkers, T., Woldeselassie, O., Wessel, M. & Bongers, F. (2006): The effect of tapping for frankincense on sexual reproduction in Boswellia papyrifera. Journal of Applied Ecology 43 (6): 1188-1195. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111

8350 Farnsworth, N.R., Graham, J. & Quinn-Beattie, M.L. (2.6.2009): NAPRALERT data-base export. Data obtained through the courtesy of Professor Norman R. Farnsworth, University of Illinois at Chicago.
8730 Brendler, T., Eloff, J.N., Gurib-Fakim, A. & Phillips, L.D. (ed.) (2010): African Herbal Pharmacopoeia. Graphic Press, Mauritius.
8793 Thulin, M. & Warfa, A.M. (1987): The francinsense trees (Boswellia spp., Burseraceae) of northern Somalia and southern Arabia. Kew Bulletin 42 (3): 487-500.
8807 Dickson, B., Mathew, P., Mickleburgh, S., Oldfield, S., Pouakouyou, D. & Suter, J. (2005): PC15 Inf. 2. An assessment of the conservation status, management and regulation of the trade in Pericopsis elata. Retrieved from http://www.cites.org/common/com/PC
8889 Thulin, M. (1999): Flora of Somalia. Volume 2. Angiospermae (Ericaceae-Asteraceae). Royal Botanic Gardens, Kew, Kew.
8891 Gebrehiwot, K., Muys, B., Haile, M. & Mitloehner, R. (2003): Introducing Boswellia papyrifera (Del.) Hochst and its non-timber forest product, frankincense. International Forestry Review 5 (4): 348-353. Retrieved from http://www.eap.lehagere.com/sites/def
8892 Groenendijk, P., Eshete, A., Sterck, F.J., Zuidema, P.A. & Bongers, F. (2011): Limitations to sustainable frankincense production. Blocked regeneration, high adult mortality and declining populations. Journal of Applied Ecology 49 (1): 164-174. Retrieved
8895 Ogbazghi, W., Bongers, F., Rijkers, T. & Wessel, M. (2006): Population structure and morphology of the frankincense tree Boswellia papyrifera along an altitude gradient in Eritrea. Journal of the Drylands 1 (1): 85-94. Retrieved from http://www.metafro.be
8896 Abiyu, A., Vacik, H. & Glatzel, G. (2006): Population Viability Risk Management applied to Boswellia papyrifera (Del.) Hochst in North-eastern Ethiopia. Journal of the Drylands 1 (2): 98-107. Retrieved from http://www.metafro.be/Members/rafaerts/JDrylands
8898 Lemenih, M. & Kassa, L. (2010): Opportunities and challenges for sustainable production and marketing of gums and resins in Ethiopia. CIFOR, Bogor. Retrieved from http://www.cifor.org/publications/pdf_files/Books/BKassa1102.pdf, viewed: 12.06.2012.
8899 Lemenih, M. & Kassa, L. (2010): Management guide for sustainable production of frankincense. CIFOR, Bogor. Retrieved from http://www.cifor.org/publications/pdf_files/Books/BKassa1101.pdf, viewed: 12.06.2012.
8900 Abtew, A., Pretzsch, J., Elsheikh Mohmoud, T. &. Omar Adam, Y. (2011): Population structure, density and natural regeneration of Boswellia papyrifera (Del.) Hochst in dry woodlands of Nuba Mountains, South Kordofan State, Sudan. Retrieved from http://www.
8914 Gillett, J.B. (1991): Burseraceae. In: Flora of Tropical East Africa. Balkema, Rotterdam.

Abbreviations and Standards

ICC = ISO Country Codes **Ref = literature reference**

Altitude: Low / High = minimum and maximum limits of altitude range [m]

Legislation: Source Taxon = name of taxon as contained in legislation

Utilization: TypeUtil

TypeUtil	*TypeUtilLong*
com	commodity
cul	cultivation
exp	export
har	harvest
imp	import
price	price
pur	purpose
rem	remark
sus	sustainability
tra	trade
trend	trend and scale of trade

Distribution Status: Standard

Status	*Explanation*
chk	check entry
nat	native
int	introd., established
adv	introduced, not established
ocd	occurrence doubtful
unc	status unclear
ext	extinct
cul	cultivated
sou	source doubtful
ica	introduced (casual or naturalized)
don	doubtfully native
pex	(presumably) extinct
ali	casual alien
nzd	naturalized
nna	not native
dpn	status doubtful, possibly native
abs	absent but reported in error

Common names: Type

TypeShort	*Type*
?	<unknown>
ayn	ayurvedic name
hom	homoeopathic name
pha	pharmaceutical name
scn	standardized common name
tra	trade name
ver	vernacular name

Ecology: TypeEcol

TypeEcol	*Explanation*
alti	altitude
grow	growth rate
habit	habitat
morph	morphology
regen	regeneration
repro	reproduction
soil	soil

Boswellia sacra Flueck. 250 Burseraceae

Nomenclatural reference 1148 The Plant List. - http://www.theplantlist.org/

Remarks Taxonomy	*Reference*	
genus: "17 species in rather dry areas from the Ivory Coast to India and southwards to north-eastern Tanzania and northern Madagascar"	8889	Thulin, M. (1999): Flora of Somalia. Volume 2. Angiospermae (Ericaceae-Asteraceae). Royal Botanic Gardens, Kew, Kew.
genus: "c. 20 dry trop. Afr. (esp. NE; Socotra 8 endemics) & As."	3753	Mabberley, D.J. (2017): The plant-book. 4th edition. Cambridge University Press, Cambridge.
genus: "19-20 species extending from the Ivory Coast to India and south to NE Tanzania and N Madagascar; most numerous in NE tropical Africa"	8914	Gillett, J.B. (1991): Burseraceae. In: Flora of Tropical East Africa. Balkema, Rotterdam.
"The affinity of B. sacra appears to be closest to B. papyrifera"	8793	Thulin, M. & Warfa, A.M. (1987): The francinsense trees (Boswellia spp., Burseraceae) of northern Somalia and southern Arabia. Kew Bulletin 42 (3): 487-500.

Summary

Distribution	Boswellia sacra is native to parts of the Arabian peninsula (Yemen, Oman) and northeastern Africa (Somalia).
Legislation	The species is not protected by CITES.
Threat Category	The species has been globally assessed by IUCN as "Lower Risk / Near Threatened" (LR/NT) in 1998; needs updating. Not found in recent national red lists.
Threat	Gum and resin producing vegetation is severely deteriorating in most producing countries, mainly as a result of four major processes of over exploitation: (i) clearing and conversion of woodlands to arable farming; (ii) excessive wood harvesting for fuelwood; (iii) improper harvesting and tapping of gums and resins; (iv) overgrazing by livestock. In Oman the tree is so heavily browsed that it rarely flowers or sets seeds. Several improper harvesting procedures are used to temporarily increase resin yields: precipitate tapping before the resin is mellowed and ready for harvest; administering two deep parallel cuts on the surface of the ordinary tapping incision; burning of the white peel that covers the bark of the tree. Perhaps no less than one half of the entire Boswellia population in Somalia is to some degree damaged.
Abundance	Large and dominant population size in some places.
Habitat	B. sacra is found in Acacia-Commiphora bushland, on hills, gullies and cliffs, at altitudes from sea level to 1230m.
Regeneration	It may be inferred from another species (B. papyrifera) that propagation from rooted cuttings and the production of root suckers are possible.
Reproduction	Flowers bisexual and self-fertile. Reproduction is by seed, fruit production rates are low. Therefore poor recruitment from seed, even in the absence of commercial seed collection, fodder harvests and browsing by livestock.
Lifeform	Small tree, up to 8m high.
Plant Parts	Gum-resin as an exudate from the bark is used.
Use	The gum-resin produced from B. sacra is used for burning as incense, it is distilled to yield volatile oils in perfumery, and to a lesser degree in the preparation of traditional medicines as an anti-inflammatory agent and for wound healing.
Use Fields	Medicine; social use; food; food additive; animal poison; material
Trade Trend	Despite significant trade in this species, international demand seems to be stable or perhaps even decreasing. From general trade data it can inferred that demand today is less than in the 1970s and 1980s.

Synonyms

Synonym	Eval	Ref	
Boswellia bhau-dajiana Birdw.		1148	The Plant List. - http://www.theplantlist.org/
Boswellia carteri Birdw.		1148	

Common Names

Common Name	Typ	Language	Country	Ref	
äkta rökelseträd		Swedish		1100	GRIN Database (Germplasm Resources I
árbol del incensio	ver	Spanish		1100	
arbre à encens	ver	French		1100	
Beeyo	tra	Somali		8894	Hall, A. (12.2.2005): Viability of a sustaina
beyo	tra	Somali		4187	Coppen, J.J.W. (1995): Flavours and fragr
Beyo	tra	Somali		8730	Brendler, T., Eloff, J.N., Gurib-Fakim, A. &
frankincense	tra	English		1100	GRIN Database (Germplasm Resources I
Frankincense	ver	English		1100	
frankincense tree	ver			3751	van Wyk, B.-E. & Wink, M. (2017): Medicin
mogar	ver	Arabic		4187	Coppen, J.J.W. (1995): Flavours and fragr
mogar		transliterated Arabi		1100	GRIN Database (Germplasm Resources I
Mohor		Somali		1101	Hänsel, R. & al. (1992-1998): Hagers Han
mohor	ver	Somali		4187	Coppen, J.J.W. (1995): Flavours and fragr
Mohor maddow		Somali		1101	Hänsel, R. & al. (1992-1998): Hagers Han
Mohur meddhu		Somali		1101	
Moxor	ver	Somali		8894	Hall, A. (12.2.2005): Viability of a sustaina
moxor		Somali		1100	GRIN Database (Germplasm Resources I
Moxor		Somali		1101	Hänsel, R. & al. (1992-1998): Hagers Han
oliban	tra	French		1100	GRIN Database (Germplasm Resources I
olibán	tra	Spanish		1100	
olibano	tra	Italian		1100	
Olibanum	pha	Latin		1101	Hänsel, R. & al. (1992-1998): Hagers Han
olibanum-tree	ver	English		1100	GRIN Database (Germplasm Resources I
Olibanum-tree	ver	English		1100	
ru xiang shu		Chinese		1100	
shajerat al-luban		transliterated Arabi		1100	
sheehaz	tra	Arabic		4187	Coppen, J.J.W. (1995): Flavours and fragr
Weihrauchbaum	ver	German		1100	GRIN Database (Germplasm Resources I
Weihrauchpflanze	tra	German		1100	

Distribution Range

Distribution Range	Ref	
"Oman, Somalia, Yemen (Former South Yemen). The largest and most widespread occurence of the species is in northern Somalia."	5520	Oldfield, S., Lusty, C. & MacKinven, A. (1998): The world list of threatened trees. World Conservation Press, Cambridge.
"Native: Africa: NORTHEAST TROPICAL AFRICA: Somalia. Asia-Temperate: ARABIAN PENINSULA: Oman, Yemen"	1100	GRIN Database (Germplasm Resources Information Network). USDA-ARS. Retrieved from www.ars-grin.gov
"N Somalia, South Yemen (Hadhramaut) and Oman (Dhofar)"	8793	Thulin, M. & Warfa, A.M. (1987): The francinsense trees (Boswellia spp., Burseraceae) of northern Somalia and southern Arabia. Kew Bulletin 42 (3): 487-500.
"northern Somalia, Ethiopia, south Yemen and Oman"	6493	Svoboda, K., Hampson, J.B. & Hall, L. (2001): Boswellia from Somalia, a source of high quality frankincense. Medicinal Plant Conservation 7: 16-19.
N.E. Trop. Afr.; Arabian Pen.; also cult.	1180	GRIN (17.3.2015): Download World Economic Plants report from GRIN Taxonomy for the query. Medizin = 'Alle Nutzungen'. Retrieved from http://www.ars-grin.gov/cgi-bin/npgs/html/taxecon.pl?language=de
"restricted to north-eastern Somalia and the southern Arabian Peninsula (the Sultanate of Oman and the United Republic of Yemen)"	9915	Brendler, T., Brinckmann, J. & Cunningham, A.B. (2015): Boswellia sacra. Unpublished report for BfN, s.loc.

Abundance

ICC	Abundance	Reference	
	"Using the Rabinovitz seven forms of rarity assessment format Boswellia sacra has large (multinational) geographical spread, narrow habitat and a large and dominant population size in some places"	9915	Brendler, T., Brinckmann, J. &

Ecology

TypeEc	ICC	Ecology	Ref	
alti		0-1230m	6493	Svoboda, K., Hampson, J.B. & H
alti	SO	up to 1230m	8793	Thulin, M. & Warfa, A.M. (1987):
alti	SO	5-1230m	8889	Thulin, M. (1999): Flora of Soma
habit		"dominant component of desert-woodland on the escarpment mountains in Dhofar in Oman, extending into Yemen"	5520	Oldfield, S., Lusty, C. & MacKinv

habit		"characteristic tree of xeric woodland on the escarpment of mountains in Dhofar in Oman, extending into Yemen. In Oman, B. sacra occurs mainly along the arid leeward areas of the Qamar, Qara and Samhan mountains [...], away from the influence of monsoon rains"	9915	Brendler, T., Brinckmann, J. & C
habit		"It grows on hills, gullies and cliffs up to an altitude of 1230 metres, and for 200 kilometres inland from the coast."	6493	Svoboda, K., Hampson, J.B. & H
habit	SO	"Acacia-Commiphora woodland in subcoastal zone"	8793	Thulin, M. & Warfa, A.M. (1987):
habit	SO	"Rocky slopes and gullies on limestone, often on cliffs or large boulders"	8889	Thulin, M. (1999): Flora of Soma
repro		"Although reproduction is by seed, fruit production rates are low [...] Germination rates are low (less than 8%), with flowering and seed set both affected by browsing. These factors result in poor recruitment from seed, even in the absence of commercial seed collection, fodder harvests and browsing by livestock."	9915	Brendler, T., Brinckmann, J. & C
repro		Flowers bisexual	8914	Gillett, J.B. (1991): Burseraceae
repro	KE	"bisexual and self-fertile", "sparsely distributed and cross-pollination seldom takes place"	8915	Eslamieh, J. (2011): Cultivation

Life Form

Duration	Lifeform	Woodiness	Height	LF_free_txt	Ref	
	tree		1,5-8m		8889	Thulin, M. (1999): Flora of So
	tree			"small tree"	3751	van Wyk, B.-E. & Wink, M. (20
	tree		1,5-8m		1149	African Plants Database. - http
	tree			"Wenige Meter hoher Baum oder kräftiger Busch ohne zentralen Stamm"	1101	Hänsel, R. & al. (1992-1998):

Population Status / Threat Causes

ICC	PopulationStatus	Remark	Ref	
ET	[non-species-specific information for Boswellia & Commiphora]: "Although reliable information on the distribution and abundance of the resin-yielding species is not available, and the scattered occurrence of the trees makes detailed surveys a difficult and expensive option, it is believed that the total size of the natural resource and its potential productivity significantly outweigh demand for the products. Coulter (1987) cites official estimates in 1981 of 23,000 tonnes pa for the potential production of olibanum in Ethiopia."		4187	Coppen, J.J.W. (1995): Flavou
OM	"so heavily browsed that it rarely flowers or sets seeds. Trees appear to be dying an regeneration is poor"		5520	Oldfield, S., Lusty, C. & MacKi
	"Owing to the lack of proper forest management practices, the stock of gum and resin producing vegetation, their ecosystem and the benefits expected of them is severely deteriorating in most producing countries, mainly as a result of four major processes of over exploitation: clearing and conversion of woodlands to arable farming; resettlement programs; excessive wood harvesting for fuelwood; improper harvesting/tapping of gums and resins; overgrazing by livestock."		8897	Anon. (2010): Expanding inves
OM	"In Oman the tree is so heavily browsed that it rarely flowers or sets seeds."		1127	IUCN Red List of Threatened
SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: „Even worse for the trees, illegal harvesters also collect resin by making additional cuts onto the bark after the 5-month legal harvesting season has ended. Desperate and irresponsible harvesters are reported as making too many cuts on the trees to drain resin as well as cutting in ways that can and does kill the trees. Thus across the interviewees almost everyone reported over harvesting leading to decline of the trees and in some cases pleaded that without intervention the most valuable species could be lost within the decade."		3784	DeCarlo, A. & Ali, S.H. (2014):
SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: „The economic situation is having a devastating effect on the trees themselves and, subsequently, the long-term sustainability of the resin market. Illegal harvesting is rampant. Youth with few opportunities are reported to sneak into these remote areas during the harvesting season and take the resin before the legitimate harvesters reach it."		3784	
SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: „As stated by a harvester: ‚The health of the trees now is not the best thing. It is not the best because there are a lot of thieves who are cutting and doing damage. By the way, if it continues as it is, then maybe we could lose them in a short time.'"		3784	
SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: „It is not the case that harvesters are ignorant in their practices; usually they know what they are doing will damage the tree. [...] many harvesters cannot afford to sustainably harvest resin"		8894	Hall, A. (12.2.2005): Viability of
SO	[non-species-specific information for Boswellia & Commiphora]: "It is impossible to prevent grazing of livestock and in times of drought nomads cut branches for fodder. Severe drought also affects the trees directly, slowing their growth and causing problems of regeneration. The more accessible trees are often tapped continuously through the year, with no rest periods, and this puts them under further stress."		4187	Coppen, J.J.W. (1995): Flavou

SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "Precipitate tapping, which is locally known as ceyriin sarc or "harvesting raw resin" is a noxious form of exploitation. 'Avaricious' collectors who think they can increase output by administering tappings before the resin is mellowed and ready for harvest end up taxing the tree and lowering the quality of the resin [...]. Most damaging is an illicit tapping technique called jaqeyn, literally "stabbing the tree". Two deep parallel cuts are administered on the surface of the ordinary tapping incision. Rewarding in the short term, this increases resin production, though the effects of damaging their internal organs are disastrous. The tree may die, and even those which withstand the noxious deep cuts take a long time to recover. Deep incisions are also thought to act as a medium which permits wood borers to infect the weakened tree [...]. Another tactic to increase yield is to burn the white peel that covers the bark of the tree. The trees whose resin is milked out this way are known to die eventually. Perhaps no less than one half of the entire Boswellia population in Somalia is to some degree damaged."	8894	Hall, A. (12.2.2005): Viability of
SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "A variety of procedures are used to temporarily increase resin yields of frankincense trees. It is not the case that harvesters are ignorant in their practices; usually they know what they are doing will damage the tree."	8894	

Threat Categories

Glo	ICC	Region	Categ	Criteria	Year / Version	Ref	
x			LR/NT		1998	3619	Thulin, M. (1998): Boswellia sacra. The IUCN Red List of Threatened Species 1998. e.T34533A9874201. Retrieved from http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T34533A9874201.en, viewed: 07.10.2016.
x			LR/nt			1127	IUCN Red List of Threatened Species. www.iucnredlist.org/
x			LR/nt			1104	2007 IUCN Red List of threatened species. Download of plant data from IUCN website in April 2008
x			LR/nt			5520	Oldfield, S., Lusty, C. & MacKinven, A. (1998): The world list of threatened trees. World Conservation Press, Cambridge.

Purpose: Fields of Use

Purpose: Fields uf Use		Frequency
animal poison	general	1
food	sweets industry	3
food additive	flavouring & spice	1
material	general	1
medicine	general	2
	homoeopathy	1
	traditional Chinese medicine	1
	used traditionally as herbal remedy	5
social use	cosmetics industry	4
	general	6

Purpose: Free text

Purpose		Ref	
	"resin provides incense, perfume and medicine"	5520	Oldfield, S., Lusty, C. & MacKi
medicine - general	"Boswellia resin has been used as a major anti-inflammatory agent and for wound healing for centuries."	8730	Brendler, T., Eloff, J.N., Gurib-
	[non-species-specific information] "pharmaceutical applications"	8897	Anon. (2010): Expanding inves
medicine - homoeopathy	Used in homoeopathy	6198	Lange, D. (1996): MAPCIS. M
medicine - traditional Chinese medicine	Used in traditional Chinese medicine	6198	Lange, D. (1996): MAPCIS. M
medicine - used traditionally as herbal remedy	Medicines: folklore (fide CRC MedHerbs ed2; Herbs Commerce ed2)	1100	GRIN Database (Germplasm
	[non-species-specific information] "The main use for olibanum, myrrh and opopanax imported into the People's Republic of China is in the preparation of traditional medicines."	4187	Coppen, J.J.W. (1995): Flavou
	"The aromatic resin [...] has been used since ancient times for religious and medicinal purposes. It stimulates circulation and is antiseptic, analgesic, expectorant and sedative."	3751	van Wyk, B.-E. & Wink, M. (20
	"in traditional medicine"	8889	Thulin, M. (1999): Flora of So
	Medic. (folklore)	1180	GRIN (17.3.2015): Download
social use - general	[non-species-specific information] "Weihrauch wurde seit alters von verschiedenen Völkern in erster Linie für kultisch-religiöse Zwecke verwendet; die als Arzneimittel gebrauchten Mengen dürften im Verhältnis sehr gering gewesen sein."	8360	Schönfelder, I. & P. (2004): Da

	[non-species-specific information] "The major fragrance use is for burning as incense in religious ceremonies."	4187	Coppen, J.J.W. (1995): Flavou
	religious purposes	7279	van Wyk, B.-E. & Wink, M. (20
	Räucherwerk	8888	Bown, D. (2005): Die neue Krä
	"The gum-resin of B. sacra is the frankincense most valued for use in churches, mosques etc."	8889	Thulin, M. (1999): Flora of So
	[non-species-specific information] "fragrance (chiefly for incense use – either in religious ceremonies or around the home – but with some fine fragrance applications)"	8897	Anon. (2010): Expanding inves
social use - cosmetics industry	[non-species-specific information] "Small amounts of resin are distilled to yield volatile oils [...] which find use in perfumery."	4187	Coppen, J.J.W. (1995): Flavou
	"In Antifaltencremes [...] und Parfüms verwendet.	8888	Bown, D. (2005): Die neue Krä
	"used in the perfume industry"	8889	Thulin, M. (1999): Flora of So
	Used in the cosmetics industry (including perfumes)	6198	Lange, D. (1996): MAPCIS. M
food additive - flavouring & spice	[non-species-specific information] "flavour (principally 'maidi' for chewing but with some minor uses of the oils as flavouring agents)"	8897	Anon. (2010): Expanding inves
food - sweets industry	"It is used widely as a type of chewing gum"	6493	Svoboda, K., Hampson, J.B. &
	[non-species-specific information] "The 'clean', distinctive flavour of certain types of olibanum makes them highly valued for chewing and this constitutes an important use in some markets."	4187	Coppen, J.J.W. (1995): Flavou
	"Das ätherische Öl aromatisiert industriell erzeugte Süßwaren."	8888	Bown, D. (2005): Die neue Krä
material - general	"Materials: gum/resin"	1100	GRIN Database (Germplasm
animal poison - general	"The fumes also repel mosquitoes and other insects."	8889	Thulin, M. (1999): Flora of So

Plant Parts Used

Plant Part (standardized)	Plant Part (free text)	Remark	Ref	
exudate	"Droge: Das aus Einschnitten in die Bäume ausgetretene erstarrte Gummiharz"		1101	Hänsel, R. & al. (1992-1998):
exudate	resin		3751	van Wyk, B.-E. & Wink, M. (20
exudate	gum-resin		8889	Thulin, M. (1999): Flora of So
exudate	resin		7279	van Wyk, B.-E. & Wink, M. (20

Scale and Trend of Trade

ICC	Trade Trend	Remark	Ref	
	[non-species-specific information for Acacia, Boswellia & Commiphora]: "Importers state that there are no supply problems and, with no new uses on the horizon which might lead to a significant increase in demand for any of the resins, there are no grounds for attempting to increase production."		8897	Anon. (2010): Expanding inves
	[non-species-specific information for Boswellia & Commiphora]: "Demand today is believed to be less than was current in the late 1970s/early 1980s."		4187	Coppen, J.J.W. (1995): Flavou

Trade

Type	ICC	Utilization	Ref	
com		"frankincense produced from Boswellia sacra species (Somali name 'Moxor') is called Somali type olibanum in the international trade"	3786	Lemenih, M. &Teketay, D. (20
com		"In den Erzeugerländern werden drei 'beeyo'-Qualitäten, die von Boswellia carteri stammen, und acht 'maydi'-Qualitäten, die von Boswellia frereana stammen, unterschieden"	1101	Hänsel, R. & al. (1992-1998):
com		"Olibanum of Middle Eastern origin is said by some sources to come principally from three species of Boswellia: B. carteri and B. frereana in Somalia and B. sacra in southern Arabia. Some other Boswellia spp. are minor sources of resin and these include B. bhau-dajiana and B. neglecta in Somalia and B. papyrrfera in Ethiopia."	4187	Coppen, J.J.W. (1995): Flavou
com	SO	"Boswellia sacra, with the Somali name moxor, yields the beeyo type incense. This is known as Somali type olibanum in the international trade market. Boswellia frereana, with the Somali name yagcar, yields instead the prized meydi incense."	8894	Hall, A. (12.2.2005): Viability of
com	SO	"This resin [B. frereana] is of superior quality due to its lemon-scent, sweet taste and pale topaz-yellow colour and is known locally as meydi. [...] it is much less bitter than B. sacra. On the open market it commands twice the price of beeyo [B. sacra]."	6493	Svoboda, K., Hampson, J.B. &
cul		"Ein Anbau scheint nicht stattzufinden. Seit Ende der 70er Jahre werden in Nordsomalia Versuchspflanzungen angelegt."	1101	Hänsel, R. & al. (1992-1998):
cul		also cult.	1180	GRIN (17.3.2015): Download
exp	SO	"It is a major export commodity from Somalia."	8889	Thulin, M. (1999): Flora of So
exp	SO	"Somalia does export Frankincense Boswellia sacra to China for medicinal purposes. Official export records are largely unavailable; however, it is estimated that exports are approximately 150t per year"	5589	Marshall, N. (1998): Searching
har		"Die Bewirtschaftung eines Baumes dauert maximal drei Jahre an, dann folgt eine mehrjährige Ruhepause."	1101	Hänsel, R. & al. (1992-1998):

har		"Gewinnung erfolgt durch künstliches Einschneiden des Baumes an ca. I 0 bis 30 Wundstellen an Stamm und dickeren Ästen"	1101	
har	SO	"there are usually two periods when B. sacra (B. carteri) is tapped, each lasting 3-4 months and involving successive tappings at approximately 15-day intervals."	4187	Coppen, J.J.W. (1995): Flavou
har	SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "Officials of the Frankincense and Gums Development and Sales Agency reasonably estimate the number of families which primarily depend upon incense gathering to be 10,000."	8894	Hall, A. (12.2.2005): Viability of
har	SO	[non-species-specific information for Boswellia & Commiphora]: "It is not possible from official records alone to estimate how much resin, on average, is obtained from a tree. Figures of 1-3 kg per tree per year have been cited for olibanum in Somalia."	4187	Coppen, J.J.W. (1995): Flavou
har	SO	[non-species-specific information for Boswellia]: "In some cases, as in Somalia, the wild Boswellia stands belong to extended families who live in the resin-producing areas. There is therefore some incentive on the part of those who tap the trees not to do it in such a way as to damage the trees and jeopardise their livelihoods."	4187	
har	SO	[non-species-specific information re B.sacra & B.frereana in Somaliland]: „Boswellia trees grow in territorially-bound collection areas [...] Characteristically they belong to a core of agnatic families [...] The land tenure system is fundamentally based on the principle of clan systems.“	8894	Hall, A. (12.2.2005): Viability of
imp		[non-species-specific information for Acacia, Boswellia, Commiphora]: "Within Europe Germany is the biggest importer (and re-exporter) of the resins."	8897	Anon. (2010): Expanding inves
imp		[non-species-specific information for B.sacra & B.frereana in Somaliland]: "Current EEC imports are estimated at 190 tons per year."	8894	Hall, A. (12.2.2005): Viability of
imp		[non-species-specific information for Boswellia & Commiphora]: "The Middle East and the People's Republic of China are seen to be the major consumers. Germany has imported significant amounts of Ethiopian incense gum."	4187	Coppen, J.J.W. (1995): Flavou
imp		[non-species-specific information for Boswellia & Commiphora]: "The People's Republic of China is the largest market for all three resins, mainly for use in traditional medicines. Imports of olibanum (mainly the Eritrean type from Ethiopia and Sudan) and myrrh were each significantly in excess of 1,000 tonnes in 1984. [...] In Europe and Latin America, substantial amounts of Eritrean-type olibanum are used as incense by the Orthodox and Roman Catholic Churches (approaching 500 tonnes in 1987). Similar quantities are imported into North African countries where it is used for chewing. The Middle East, particularly Saudi Arabia, is another important market for the chewing grade of olibanum, this time the higher quality "maidi" type from Somalia (approximately 500 tonnes in 1987). [...] Of the order of 50 tonnes pa [...] of olibanum [...] are used in Europe (mainly France) for the production of essential oils and extracts."	4187	
imp		[non-species-specific information re B.sacra & B.frereana in Somaliland] „Today, the chief markets are the [EU] countries where it is entirely consumed by the perfume industry, and China where it is used in alternative medicine. Saudi Arabia imports more than 80% of the total export value with a high proportion of the most valuable chewing grades.“	8894	Hall, A. (12.2.2005): Viability of
imp	SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "Today, the chief markets are the EEC (European Economic Community) countries where it is entirely consumed by the perfume industry, and China where it is used in alternative medicine. Saudi Arabia imports more than 80% of the total export value with a high proportion of the most valuable chewing grades. [...] Other significant markets are Egypt and Yemen."	8894	
sus	SO	"Ideally, to reduce damaging the tree, it should be rested every 5 to 6 years."	6493	Svoboda, K., Hampson, J.B. &
sus	SO	"Specifically yagcar trees [= B. frereana] are ideally exploited for a period of about ten months, starting from the end of August or early September until June of the following year. During this period, the trees are visited or tapped 12-13 times."	8894	Hall, A. (12.2.2005): Viability of
sus	SO	"Two species important for their essential oils are found growing in Somalia, Boswellia sacra [...] and Boswellia frereana. The territories where these trees grow are divided up into xiji (Somalian term indicating an area of land controlled by one specific family for the purpose of harvesting the resin). Traditionally, these areas belong to one family group, and are handed down through the generations."	6493	Svoboda, K., Hampson, J.B. &
sus	SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "Regulation of tapping cycles is extremely important. Failure to conform to the rhythm could adversely affect production. The initial five or three tapping cycles in the exploitation of yagcar and moxor species are known as the preparatory cycles. Yield is relatively low, and the resin quality is poor compared to later cycles. Nevertheless, these cycles are necessary to stimulate the trees for increased production in succeeding peak cycles."	8894	Hall, A. (12.2.2005): Viability of
tra		[non-species-specific information for Boswellia & Commiphora]: "Somalia and Ethiopia are by far the biggest producers of the three resins [...]. Somalia is the only source of maidi-type olibanum, exports of which were estimated at 800-900 tonnes in 1987. Smaller quantities of the "beyo" type of olibanum are produced. Ethiopia and Sudan produce the most widely traded olibanum, the Eritrean type, and in 1987 this was reckoned to amount to some 2,000 tonnes."	4187	Coppen, J.J.W. (1995): Flavou
tra		[non-species-specific information for Boswellia]: "There are six most common Boswellia species whose gum-resins are widely traded and these are: B. frereana Birdw. known only from Somalia; B. sacra Flueck. (syn. B. carteri) from Somalia, Yemen and Oman; B. papyrifera Hochst. from Ethiopia and Sudan; B. rivae Engl. from Ethiopia; B. neglecta S.Moore from Ethiopia and Kenya; and B. serrata Roxb. from India. They are all known as frankincense or olibanum."	8730	Brendler, T., Eloff, J.N., Gurib-
tra	SO	[non species specific information] „The best figures currently available on global trade of Frankincense resin were released by the Food and Agriculture Organization (FAO). FAO estimates world trade in 1987, for Somali Boswellia as: 800 tones of B. frereana and 200 tones of B. carterii. Thus Somaliland produces approximately 1,000 tons of resin per year."	3784	DeCarlo, A. & Ali, S.H. (2014):

tra	SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "The natural gum industry [...] is officially the third most important source of foreign exchange through exports, following livestock and bananas."	8894	Hall, A. (12.2.2005): Viability of
tra	SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "The total estimated value for frankincense and gums annually exported from Somalia in 1994 was USD 15.6 million [..]. The estimated overall production was 1,000 tons per annum. Export volume, including no less than 500 tons of valuable chewing grades, is estimated at 800-900 tons."	8894	

Legislation

Regulation

Bibliography

1100 GRIN Database (Germplasm Resources Information Network). USDA-ARS. Retrieved from www.ars-grin.gov

1101 Hänsel, R. & al. (1992-1998): Hagers Handbuch der pharmazeutischen Praxis. 5. Auflage.5 volumes [4179, 4180, 4181, 6097, 6098]

1104 2007 IUCN Red List of threatened species. Download of plant data from IUCN website in April 2008

1109 UNEP-WCMC Threatened Species Database. Download of 1997 regional threat assessments sent 15.6.2011 by H. Gillett. Cambridge, UK (cf. Walter & Gillett, 1997 IUCN Red List of threatened plants)

1127 IUCN Red List of Threatened Species. www.iucnredlist.org/

1148 The Plant List. - http://www.theplantlist.org/

1149 African Plants Database. - http://www.ville-ge.ch/musinfo/bd/cjb/africa/recherche.php?langue=an. 2009 Conservatoire et Jardin botaniques & South African National Biodiversity Institute.

1180 GRIN (17.3.2015): Download World Economic Plants report from GRIN Taxonomy for the query. Medizin = 'Alle Nutzungen'. Retrieved from http://www.ars-grin.gov/cgi-bin/npgs/html/taxecon.pl?language=de

2200 World Conservation Monitoring Centre (ed.) (1995): Medicinal plants in trade. Taxa in BG-BASE matching names on dBase file medplant.dbf from Dagmar Lange-Osten. Compiled from the WCMC Plants Database. Unpublished report, Cambridge.

3619 Thulin, M. (1998): Boswellia sacra. The IUCN Red List of Threatened Species 1998. e.T34533A9874201. Retrieved from http://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T34533A9874201.en, viewed: 07.10.2016.

3751 van Wyk, B.-E. & Wink, M. (2017): Medicinal plants of the world. 2nd edition. CABI, Wallingford & Boston.

3753 Mabberley, D.J. (2017): The plant-book. 4th edition. Cambridge University Press, Cambridge.

3784 DeCarlo, A. & Ali, S.H. (2014): Sustainable sourcing of phytochemicals as a development tool. The case of Somaliland's Frankincense industry. Institute for Environmental Diplomacy and Security, s.loc. Retrieved from

3786 Lemenih, M. &Teketay, D. (2003): Frankincense and myrrh resources of Ethiopia. I. Distribution, production, opportunities for dryland development and research needs. Ethiopian Journal of Science 26 (1): 63-72. Retrieved from https://www.ajol.info/index.ph

4187 Coppen, J.J.W. (1995): Flavours and fragrances of plant origin. FAO, Rome (Non-wood Forest Products 1). Retrieved from http://www.fao.org/docrep/V5350E/V5350e00.htm, viewed: 07.11.2012.

5520 Oldfield, S., Lusty, C. & MacKinven, A. (1998): The world list of threatened trees. World Conservation Press, Cambridge.

5525 Penso, G. & Proserpio, G. (1997): Index plantarum medicinalium totius mundi eorumque synonymorum. 2nd edition. OEMF, Milano.

5589 Marshall, N. (1998): Searching for a cure. Conservation of medicinal wildlife resources in east and southern Africa. Traffic International, Cambridge (Species in Danger). Retrieved from http://www.traffic.org/general-reports/traffic_pub_gen46.pdf, viewed:

6198 Lange, D. (1996): MAPCIS. Medicinal and Aromatic Plant Conservation Information System. - Database (dBaseIV). Compiled for the Bundesamt für Naturschutz, Bonn.

6369 McGuffin, M., Kartesz, J.T., Leung, A.Y. & Tucker, A.O. (2000): Herbs of commerce. 2nd edition. AHPA, Silver Spring, USA.

6493 Svoboda, K., Hampson, J.B. & Hall, L. (2001): Boswellia from Somalia, a source of high quality frankincense. Medicinal Plant Conservation 7: 16-19.

7279 van Wyk, B.-E. & Wink, M. (2004): Medicinal plants of the world. Timber Press, Portland.

8350 Farnsworth, N.R., Graham, J. & Quinn-Beattie, M.L. (2.6.2009): NAPRALERT data-base export. Data obtained through the courtesy of Professor Norman R. Farnsworth, University of Illinois at Chicago.

8360 Schönfelder, I. & P. (2004): Das neue Handbuch der Heilpflanzen. Botanik. Arzneidrogen. Wirkstoffe. Anwendungen. Kosmos, Stuttgart.

8378 United States Pharmacopeia (ed.) (2008): Food Chemicals Codex. 6th edition. U.S. Pharmacopeia.

8389 Anon. (2002): The Korean Herbal Pharmacopoeia (English edition). Korea Food and Drug Administration, s.loc.

8394 Therapeutic Goods Administration (ed.) (2007): Substances that may be used in listed medicines in Australia. Therapeutic Goods Administration, Symonston. Retrieved from http://www.tga.gov.au/cm/listsubs.pdf, viewed: 25.01.2009.

8450 Homoeopathic Pharmacopoeia of the United States (s.dat.): HPUS Online Database. Retrieved from http://www.hpus.com, viewed: 26.10.2009.

8545 Anon. (2009): International Standard ISO 4720. Third edition 2009-08-15. Essential oils. Nomenclature (in English and French). International Organization for Standardization, Geneva.

8547 Ved, D.K. & Goraya, G.S. (2008): Demand and supply of medicinal plants in India. FRLHT, Bangalore.

8730 Brendler, T., Eloff, J.N., Gurib-Fakim, A. & Phillips, L.D. (ed.) (2010): African Herbal Pharmacopoeia. Graphic Press, Mauritius.

8793 Thulin, M. & Warfa, A.M. (1987): The francinsense trees (Boswellia spp., Burseraceae) of northern Somalia and southern Arabia. Kew Bulletin 42 (3): 487-500.

8871 China Pharmacopoeia Commission (ed.) (2010): Pharmacopoeia of the People's Republic of China. English edition. Ed. 9. Stationery Office Books, .

8888 Bown, D. (2005): Die neue Kräuter-Enzyklopädie. Anbau und Verwendung. The Royal Horticultural Society. Dorling Kindersley, Starnberg.

8889 Thulin, M. (1999): Flora of Somalia. Volume 2. Angiospermae (Ericaceae-Asteraceae). Royal Botanic Gardens, Kew, Kew.

8894 Hall, A. (12.2.2005): Viability of a sustainable frankincense market in Somaliland. A historical and economical analysis. Retrieved from http://www.uvm.edu/giee/publications/FrankincenseViability.pdf, viewed: 12.06.2012.

8897 Anon. (2010): Expanding investment finance in Northern Kenya and other arid lands. Market assessment. Annex 3. Sector profiles. Reformconsult & Pipal, Nairobi. Retrieved from http://typo3.fao.org/fileadmin/user_upload/drought/docs/Final_Report_Annex_3_-_s

8914 Gillett, J.B. (1991): Burseraceae. In: Flora of Tropical East Africa. Balkema, Rotterdam.

8915 Eslamieh, J. (2011): Cultivation of Boswellia. Sacred trees of frankincense. A Book's Mind, Phoenix.

9915 Brendler, T., Brinckmann, J. & Cunningham, A.B. (2015): Boswellia sacra. Unpublished report for BfN, s.loc.

Abbreviations and Standards

ICC = ISO Country Codes   Ref = literature reference

Altitude: Low / High = minimum and maximum limits of altitude range [m]

Legislation: Source Taxon = name of taxon as contained in legislation

Utilization: TypeUtil

TypeUtil	*TypeUtilLong*
com	commodity
cul	cultivation
exp	export
har	harvest
imp	import
price	price
pur	purpose
rem	remark
sus	sustainability
tra	trade
trend	trend and scale of trade

Distribution Status: Standard

Status	*Explanation*
chk	check entry
nat	native
int	introd., established
adv	introduced, not established
ocd	occurrence doubtful
unc	status unclear
ext	extinct
cul	cultivated
sou	source doubtful
ica	introduced (casual or naturalized)
don	doubtfully native
pex	(presumably) extinct
ali	casual alien
nzd	naturalized
nna	not native
dpn	status doubtful, possibly native
abs	absent but reported in error

Common names: Type

TypeShort	*Type*
?	<unknown>
ayn	ayurvedic name
hom	homoeopathic name
pha	pharmaceutical name
scn	standardized common name
tra	trade name
ver	vernacular name

Ecology: TypeEcol

TypeEcol	*Explanation*
alti	altitude
grow	growth rate
habit	habitat
morph	morphology
regen	regeneration
repro	reproduction
soil	soil

Boswellia frereana Birdw. 4251 Burseraceae

Nomenclatural reference 1148 The Plant List. - http://www.theplantlist.org/

Remarks Taxonomy	*Reference*	
genus: "17 species in rather dry areas from the Ivory Coast to India and southwards to north-eastern Tanzania and northern Madagascar"	8889	Thulin, M. (1999): Flora of Somalia. Volume 2. Angiospermae (Ericaceae-Asteraceae). Royal Botanic Gardens, Kew, Kew.
genus: "c. 20 dry trop. Afr. (esp. NE; Socotra 8 endemics) & As."	3753	Mabberley, D.J. (2017): The plant-book. 4th edition. Cambridge University Press, Cambridge.
"B. frereana is a very distinct and fairly uniform species easily distinguised from B. sacra"	8793	Thulin, M. & Warfa, A.M. (1987): The francinsense trees (Boswellia spp., Burseraceae) of northern Somalia and southern Arabia. Kew Bulletin 42 (3): 487-500.

Summary

Distribution	Boswellia frereana is endemic to northern Somalia.
Legislation	The species is not protected by CITES.
Threat Category	Not assessed globally by IUCN. Not found in recent national red lists.
Threat	Several threat causes exist: (i) continuous tapping through the year with no rest periods; (ii) grazing of livestock; (iii) cutting branches for fodder in times of drought. Severe drought also affects the trees directly.
Abundance	Can form large and dominant populations.
Habitat	Boswellia frereana is found on rocky slopes and gullies, often on limestone boulders, even clinging to vertical rock faces at altitudes from sea level to 750m.
Regeneration	Easy to propagate from cuttings. Slow growing.
Reproduction	Flowers bisexual. Reproduction is mostly from seed.
Lifeform	Small tree, up to 8m high.
Plant Parts	Gum-resin as an exudate from the bark is used.
Use	B. frereana resin is of superior quality known as meydi. In general, the gum-resins are used for burning as incense, they are distilled to yield volatile oils in perfumery, used for chewing, and to a lesser degree in the preparation of traditional medicines.
Use Fields	Social use; medicine; food; material
Trade Trend	Despite substantial trade in this species, production and exports seem to have decreased over the years.

Synonyms

Common Names

Common Name	*Typ*	*Language*	*Country*	*Ref*	
African elemi	ver	English		1100	GRIN Database (Germplasm Resources I
elemi frankincense	tra	English		1100	
Frankincense	tra	English		8730	Brendler, T., Eloff, J.N., Gurib-Fakim, A. &
Jagcaar		Somali		1101	Hänsel, R. & al. (1992-1998): Hagers Han
maidi	tra	Somali		8793	Thulin, M. & Warfa, A.M. (1987): The franc
Meydi	tra	Somali		8894	Hall, A. (12.2.2005): Viability of a sustaina
meydi	tra	Somali		8793	Thulin, M. & Warfa, A.M. (1987): The franc
Olibanum	tra			8730	Brendler, T., Eloff, J.N., Gurib-Fakim, A. &
somaliskt rökelseträd		Swedish		1100	GRIN Database (Germplasm Resources I
yagar	ver	Somali		4187	Coppen, J.J.W. (1995): Flavours and fragr
Yagcar		Somali		8894	Hall, A. (12.2.2005): Viability of a sustaina
yagcar	ver	Somali		8793	Thulin, M. & Warfa, A.M. (1987): The franc
yigaartree	ver	English		1100	GRIN Database (Germplasm Resources I

Distribution Range

Distribution Range	Ref	
Native: NE Somalia. Cultivated: Yemen	1100	GRIN Database (Germplasm Resources Information Network). USDA-ARS. Retrieved from www.ars-grin.gov
"Restricted to N Somalia"	8793	Thulin, M. & Warfa, A.M. (1987): The francinsense trees (Boswellia spp., Burseraceae) of northern Somalia and southern Arabia. Kew Bulletin 42 (3): 487-500.
"native to northern Somalia"	6493	Svoboda, K., Hampson, J.B. & Hall, L. (2001): Boswellia from Somalia, a source of high quality frankincense. Medicinal Plant Conservation 7: 16-19.
"Boswellia frereana is native to and distributed in north-eastern Somalia"	9913	Brendler, T., Brinckmann, J. & Cunningham, A.B. (2015): Boswellia frereana Birdw. Unpublished report for BfN, s.loc.

Abundance

ICC	Abundance	Reference	
SO	"Applying the Rabinowitz 'seven forms of rarity assessment', B. frereana has a narrow geographical spread, wide habitat range, and a large and dominant population size."	9913	Brendler, T., Brinckmann, J. &

Ecology

TypeEc	ICC	Ecology	Ref	
alti		0-1000m	1149	African Plants Database. - http:/
alti	SO	5-750(-1000)m	8889	Thulin, M. (1999): Flora of Soma
alti	SO	0-750(-1000)m	8793	Thulin, M. & Warfa, A.M. (1987):
alti	SO	0-750m	6493	Svoboda, K., Hampson, J.B. & H
habit		"rocky slopes and gullies, often on limestone bolders and cliffs, or in holes, even clinging to vertical rock-faces"	1149	African Plants Database. - http:/
habit	SO	"Rocky slopes and gullies, often on limestone boulders, even clinging to vertical rock faces"	8889	Thulin, M. (1999): Flora of Soma
habit	SO	"Found only in coastal sites, often on steep vertical slopes"	6493	Svoboda, K., Hampson, J.B. & H
habit	SO	"grows on coastal mountains at altitude of 200 - 1,100m a.s.l. level on rocky slopes and gullies, limestone boulders and cliffs, or in holes, even clinging to vertical rock faces"	9913	Brendler, T., Brinckmann, J. & C
habit	SO	"rocky slopes and gullies"	8793	Thulin, M. & Warfa, A.M. (1987):
regen		"it is [...] likely that a 3 m B. frereana tree is at least 100 years old"	9913	Brendler, T., Brinckmann, J. & C
regen		"easy to propagate from cuttings"	9913	
regen		"growth is slow"	9913	
repro		"very low rate of germination (<8%) even in hormone treated seeds has been observed"	9913	
repro	SO	"Flowers bisexual"	8914	Gillett, J.B. (1991): Burseraceae
repro	SO	"In common with most re-seeders, natural populations of Boswellia species, including B. frereana trees are generally single stemmed, reflecting their regeneration from seed."	9913	Brendler, T., Brinckmann, J. & C
repro	SO	"studies suggested a very low rate of germination (<8%) even after hormone treatment"	1150	Prota4U. Plant Resources of Tro

Life Form

Duration	Lifeform	Woodiness	Height	LF_free_txt	Ref	
			3-8m		1149	African Plants Database. - http
	tree		up to 8m		8889	Thulin, M. (1999): Flora of So
	tree		3-10m	"Ca. 3 bis I 0 m hoher Baum von schlankem Wuchs mit rel. dünnem Stamm"	1101	Hänsel, R. & al. (1992-1998):

Population Status / Threat Causes

ICC	PopulationStatus	Remark	Ref	
	[non-species-specific information for Boswellia & Commiphora]: "It is impossible to prevent grazing of livestock and in times of drought nomads cut branches for fodder. Severe drought also affects the trees directly, slowing their growth and causing problems of regeneration.		4187	Coppen, J.J.W. (1995): Flavou
	„There is anecdotal evidence of declines in B. frereana populations to a combination of factors, including high intensity, destructive tapping coupled to grazing of seedlings and saplings. Recent field observations in Somaliland give rise for concern. […] the combination of low prices paid locally, combined with rising unemployment of young people and weak tenure result in over-tapping and illegal harvesting leading to decline in the populations of B. frereana in Somaliland […]. It is likely that poor recruitment due to grazing by livestock and habitat loss due to clearing of farmland may also be contributing factors.“		9913	Brendler, T., Brinckmann, J. &
	[non-species-specific information for Boswellia & Commiphora]: „The more accessible trees are often tapped continuously through the year, with no rest periods, and this puts them under further stress."		4187	Coppen, J.J.W. (1995): Flavou

SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: „Even worse for the trees, illegal harvesters also collect resin by making additional cuts onto the bark after the 5-month legal harvesting season has ended. Desperate and irresponsible harvesters are reported as making too many cuts on the trees to drain resin as well as cutting in ways that can and does kill the trees. Thus across the interviewees almost everyone reported over harvesting leading to decline of the trees and in some cases pleaded that without intervention the most valuable species could be lost within the decade."	3784	DeCarlo, A. & Ali, S.H. (2014):
SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: „The economic situation is having a devastating effect on the trees themselves and, subsequently, the long-term sustainability of the resin market. Illegal harvesting is rampant. Youth with few opportunities are reported to sneak into these remote areas during the harvesting season and take the resin before the legitimate harvesters reach it."	3784	
SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: „As stated by a harvester: ‚The health of the trees now is not the best thing. It is not the best because there are a lot of thieves who are cutting and doing damage. By the way, if it continues as it is, then maybe we could lose them in a short time.'"	3784	
SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: „It is not the case that harvesters are ignorant in their practices; usually they know what they are doing will damage the tree. [...] many harvesters cannot afford to sustainably harvest resin“	8894	Hall, A. (12.2.2005): Viability of
SO	„Due to grazing impacts, little or no tree regeneration occurs in much of the natural range of this species and mortality of adult trees is further increased by destructive tapping techniques. In regions where commercial tapping is undertaken by means of slashing the trunks wood boring insect attacks are often experienced. In the Sanaag region where the majority of Somaliland and Puntland Boswellia frereana is found the main causes of land degradation is reported to be charcoal production (31% of the cases), overgrazing (26%) and other natural causes such as the invasion of non-native species.“	9913	Brendler, T., Brinckmann, J. &
SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "Precipitate tapping, which is locally known as ceyriin sarc or 'harvesting raw resin' is a noxious form of exploitation. ‘Avaricious’ collectors who think they can increase output by administering tappings before the resin is mellowed and ready for harvest end up taxing the tree and lowering the quality of the resin [...]. Most damaging is an illicit tapping technique called jaqeyn, literally “stabbing the tree”. Two deep parallel cuts are administered on the surface of the ordinary tapping incision. Rewarding in the short term, this increases resin production, though the effects of damaging their internal organs are disastrous. The tree may die, and even those which withstand the noxious deep cuts take a long time to recover. Deep incisions are also thought to act as a medium which permits wood borers to infect the weakened tree [...]. Another tactic to increase yield is to burn the white peel that covers the bark of the tree. The trees whose resin is milked out this way are known to die eventually. Perhaps no less than one half of the entire Boswellia population in Somalia is to some degree damaged."	8894	Hall, A. (12.2.2005): Viability of
SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "A variety of procedures are used to temporarily increase resin yields of frankincense trees. It is not the case that harvesters are ignorant in their practices; usually they know what they are doing will damage the tree."	8894	

Threat Categories

Purpose: Fields of Use

Purpose: Fields uf Use		Frequency
food	general	2
	sweets industry	2
material	general	2
	varnish industry	1
medicine	used traditionally as herbal remedy	2
social use	cosmetics industry	1
	general	4

Purpose: Free text

Purpose		Ref	
	„widely used in the Coptic Church of Egypt but the majority is sold in Saudi Arabia for use by pilgrims going to Mecca. B. frereana is also used for chewing purposes and for special types of incense. […] It is seldom used for distillation or extraction being generally limited in supply and too expensive. Nonetheless, the essential oil of the resin is used to some extent as a component of perfumes/fragrances and flavours, medicinal products, cosmetic and body care products, soaps and detergents, incense and […]. In the European Union, resin of B. frereana is used as a component of cosmetic products for skin protecting function whilst essential oil of the resin is used for masking […] function.“	9913	Brendler, T., Brinckmann, J. &
medicine - used traditionally as herbal remedy	[non-species-specific information] "The main use for olibanum, myrrh and opopanax imported into the People's Republic of China is in the preparation of traditional medicines."	4187	Coppen, J.J.W. (1995): Flavou
	"used in traditional medicine."	8889	Thulin, M. (1999): Flora of So

social use - general	"In India it [gum-resin] is used as incense."	1122	Mansfeld's World Database of
	[non-species-specific information] "The major fragrance use is for burning as incense in religious ceremonies."	4187	Coppen, J.J.W. (1995): Flavou
	"The gum-resin [...] use[d] as frankincense"	8889	Thulin, M. (1999): Flora of So
	Social: masticatory	1100	GRIN Database (Germplasm
social use - cosmetics industry	[non-species-specific information] "Small amounts of resin are distilled to yield volatile oils [...] which find use in perfumery."	4187	Coppen, J.J.W. (1995): Flavou
food - general	"The flowers, seeds and the gum are edible."	1122	Mansfeld's World Database of
	chewed	8889	Thulin, M. (1999): Flora of So
food - sweets industry	[non-species-specific information] "The 'clean', distinctive flavour of certain types of olibanum makes them highly valued for chewing and this constitutes an important use in some markets."	4187	Coppen, J.J.W. (1995): Flavou
	"It is used widely as a type of chewing gum as it is much less bitter than B. sacra."	6493	Svoboda, K., Hampson, J.B. &
material - general	Materials: essential oils	1100	GRIN Database (Germplasm
	Materials: gum/resin	1100	GRIN Database (Germplasm
material - varnish industry	"The gum-resin (salai-gugul) obtained from the trunk serves the production of paints and varnishes or medicinal purposes.	1122	Mansfeld's World Database of

Plant Parts Used

Plant Part (standardized)	Plant Part (free text)	Remark	Ref	
exudate	gum-resin		8889	Thulin, M. (1999): Flora of So

Scale and Trend of Trade

ICC	Trade Trend	Remark	Ref	
	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "Historically, northern Somalia (now Somaliland and the north-eastern region) had been the world's largest producer and supplier of two species of frankincense, B. sacra […] and B. frereana […]. Although Coulter (1987) estimated an annual production in Somalia of 1000 metric tonnes of B. frereana frankincense and Coppen (1995) suggested 800-900 tonnes were used annually, this had halved to 500 metric tons by 2004 […]. Production and export levels are apparently much lower today."		9913	Brendler, T., Brinckmann, J. &
	[non-species-specific information for Boswellia & Commiphora]: „demand today is believed to be less than was current in the late 1970s / early 1980s. The Middle East and the People's Republic of China are seen to be the major consumers. Germany has imported significant amounts of Ethiopian incense gum"		4187	Coppen, J.J.W. (1995): Flavou

Trade

Type	ICC	Utilization	Ref	
com		"frankincense from Boswellia frereana Birdw species (Somali name 'Yagcar') is known by the name luban lami in Arabia"	3786	Lemenih, M. &Teketay, D. (20
com		"frankincense obtained from B. frereana does not contain appreciable amounts of the characteristic BAs"	3742	Meins, J., Artaria, A., Riva, A.,
com		"In den Erzeugerländern werden drei 'beeyo'-Qualitäten, die von Boswellia carteri stammen, und acht 'maydi'-Qualitäten, die von Boswellia frereana stammen, unterschieden"	1101	Hänsel, R. & al. (1992-1998):
com		[non-species-specific information for Boswellia]: "Olibanum of Middle Eastern origin is said by some sources to come principally from three species of Boswellia: B. carteri and B. frereana in Somalia and B. sacra in southern Arabia. Some other Boswellia spp. are minor sources of resin and these include B. bhau-dajiana and B. neglecta in Somalia and B. papyrifera in Ethiopia."	4187	Coppen, J.J.W. (1995): Flavou
com	SO	"Boswellia sacra, with the Somali name moxor, yields the beeyo type incense. This is known as Somali type olibanum in the international trade market. Boswellia frereana, with the Somali name yagcar, yields instead the prized meydi incense."	8894	Hall, A. (12.2.2005): Viability of
cul	YE	S Yemen	1100	GRIN Database (Germplasm
exp		[non-species-specific information for Boswellia & Commiphora]: "Somalia and Ethiopia are by far the biggest producers of the three resins [...]. Somalia is the only source of maidi-type olibanum, exports of which were estimated at 800-900 tonnes in 1987. Smaller quantities of the "beyo" type of olibanum are produced. Ethiopia and Sudan produce the most widely traded olibanum, the Eritrean type, and in 1987 this was reckoned to amount to some 2,000 tonnes."	4187	Coppen, J.J.W. (1995): Flavou
exp	SO	"It is a major export commodity"	8889	Thulin, M. (1999): Flora of So
exp	SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "The total estimated value for frankincense and gums annually exported from Somalia in 1994 was USD 15.6 million [..]. The estimated overall production was 1,000 tons per annum. Export volume, including no less than 500 tons of valuable chewing grades, is estimated at 800-900 tons."	8894	Hall, A. (12.2.2005): Viability of
har		"all uses are from wild B. frereana populations"	9913	Brendler, T., Brinckmann, J. &
har	SO	"B. frereana is tapped over a single 8-9 month period with a longer, but variable, tapping interval."	4187	Coppen, J.J.W. (1995): Flavou
har	SO	[non-species-specific information for B.sacra & B.frereana in Somaliland] „Boswellia trees grow in territorially-bound collection areas [...] Characteristically they belong to a core of agnatic families [...] The land tenure system is fundamentally based on the principle of clan systems."	8894	Hall, A. (12.2.2005): Viability of

har	SO	[non-species-specific information for B.sacra & B.frereana in Somaliland] „The frankincense region is mostly in the northern part of Somalia.“	8894	
har	SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "Officials of the Frankincense and Gums Development and Sales Agency reasonably estimate the number of families which primarily depend upon incense gathering to be 10,000."	8894	
har	SO	[non-species-specific information for Boswellia & Commiphora]: "It is not possible from official records alone to estimate how much resin, on average, is obtained from a tree. Figures of 1-3 kg per tree per year have been cited for olibanum in Somalia."	4187	Coppen, J.J.W. (1995): Flavou
har	SO	[non-species-specific information for Boswellia: "In some cases, as in Somalia, the wild Boswellia stands belong to extended families who live in the resin-producing areas. There is therefore some incentive on the part of those who tap the trees not to do it in such a way as to damage the trees and jeopardise their livelihoods."	4187	
imp		[non-species-specific information for Boswellia & Commiphora]: "The People's Republic of China is the largest market for all three resins, mainly for use in traditional medicines. Imports of olibanum (mainly the Eritrean type from Ethiopia and Sudan) and myrrh were each significantly in excess of 1,000 tonnes in 1984. [...] In Europe and Latin America, substantial amounts of Eritrean-type olibanum are used as incense by the Orthodox and Roman Catholic Churches (approaching 500 tonnes in 1987). Similar quantities are imported into North African countries where it is used for chewing. The Middle East, particularly Saudi Arabia, is another important market for the chewing grade of olibanum, this time the higher quality "maidi" type from Somalia (approximately 500 tonnes in 1987). [...] Of the order of 50 tonnes pa [...] of olibanum [...] are used in Europe (mainly France) for the production of essential oils and extracts."	4187	
imp	SA	"Saudi Arabia is the largest importer of maydi frankincense"	9913	Brendler, T., Brinckmann, J. &
imp	SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "Current EEC imports are estimated at 190 tons per year."	8894	Hall, A. (12.2.2005): Viability of
imp	SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "Today, the chief markets are the EEC (European Economic Community) countries where it is entirely consumed by the perfume industry, and China where it is used in alternative medicine. Saudi Arabia imports more than 80% of the total export value with a high proportion of the most valuable chewing grades. [...] Other significant markets are Egypt and Yemen."	8894	
price	SO	"This resin [B. frereana] is of superior quality due to its lemon-scent, sweet taste and pale topaz-yellow colour and is known locally as meydi. [...] On the open market it commands twice the price of beeyo [B. sacra]."	6493	Svoboda, K., Hampson, J.B. &
sus		[non-species-specific information for Boswellia]: „Different types of land tenure affect the relative sustainability of frankincense production in Somaliland and Puntland. Under one system the family with customary tenure over the Boswellia woodland will harvest the trees on a rotating basis (gaafeysi). In the other system individuals pay rent (cawaaji) to the owning family and have the right to collect the harvest of the entire season. The former system is more likely to be sustainable than the latter as farmers have a direct incentive not to overharvest their trees. Under the cawaaji system this is not the case.“	9913	Brendler, T., Brinckmann, J. &
sus		„In the past, Boswellia frereana trees were reportedly better managed through a system of customary ownership that was well known. […] tenure and tapping rights are now unclear and over-exploitation is common“	9913	
sus	SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "Regulation of tapping cycles is extremely important. Failure to conform to the rhythm could adversely affect production. The initial five or three tapping cycles in the exploitation of yagcar and moxor species are known as the preparatory cycles. Yield is relatively low, and the resin quality is poor compared to later cycles. Nevertheless, these cycles are necessary to stimulate the trees for increased production in succeeding peak cycles."	8894	Hall, A. (12.2.2005): Viability of
sus	SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: "Specifically yagcar trees are ideally exploited for a period of about ten months, starting from the end of August or early September until June of the following year. During this period, the trees are visited or tapped 12-13 times."	8894	
sus	SO	[non-species-specific information for Boswellia]: "Ideally, to reduce damaging the tree, it should be rested every 5 to 6 years."	6493	Svoboda, K., Hampson, J.B. &
sus	SO	[non-species-specific information for Boswellia]: "Two species important for their essential oils are found growing in Somalia, Boswellia sacra [...] and Boswellia frereana. The territories where these trees grow are divided up into xiji (Somalian term indicating an area of land controlled by one specific family for the purpose of harvesting the resin). Traditionally, these areas belong to one family group, and are handed down through the generations."	6493	
tra	SO	"The autonomous state of Puntland (Somalia) is the most important production area of B. frereana frankincense […] The neighbouring self-declared state of Somaliland […] is the second most important production area of B. frereana. More than 40% of Somalia's total resin production comes from this region."	9913	Brendler, T., Brinckmann, J. &
tra	SO	[non-species-specific information for B.sacra & B.frereana in Somaliland]: „The best figures currently available on global trade of Frankincense resin were released by the Food and Agriculture Organization (FAO). FAO estimates world trade in 1987, for Somali Boswellia as: 800 tones of B. frereana and 200 tones of B. carterii. Thus Somaliland produces approximately 1,000 tons of resin per year."	3784	DeCarlo, A. & Ali, S.H. (2014):
tra	SO	„Current estimates of production in Somaliland vary widely from 200 to 700 tonnes per year […]. The estimated total potential production varies from 1,000 to 2,500 tonnes of olibanum and myrrh combined, of which an estimated 40% of this being B. frereana."	9913	Brendler, T., Brinckmann, J. &

Legislation

Regulation

Bibliography

1100 GRIN Database (Germplasm Resources Information Network). USDA-ARS. Retrieved from www.ars-grin.gov

1101 Hänsel, R. & al. (1992-1998): Hagers Handbuch der pharmazeutischen Praxis. 5. Auflage.5 volumes [4179, 4180, 4181, 6097, 6098]

1122 Mansfeld's World Database of Agricultural and Horticultural Crops. mansfeld.ipk-gatersleben.de/pls/htmldb_pgrc/f?p=185:3:3650108710811243

1149 African Plants Database. - http://www.ville-ge.ch/musinfo/bd/cjb/africa/recherche.php?langue=an. 2009 Conservatoire et Jardin botaniques & South African National Biodiversity Institute.

1150 Prota4U. Plant Resources of Tropical Africa - https://www.prota4u.org/database/

3742 Meins, J., Artaria, A., Riva, A., Morazzoni, P., Schubert-Zsilavecz, M. & Abdel-Tawab, M. (): Survey on the quality of the top-selling European and American botanical dietary supplements containing boswellic acids. Planta Medica 82: 573-579.

3753 Mabberley, D.J. (2017): The plant-book. 4th edition. Cambridge University Press, Cambridge.

3784 DeCarlo, A. & Ali, S.H. (2014): Sustainable sourcing of phytochemicals as a development tool. The case of Somaliland's Frankincense industry. Institute for Environmental Diplomacy and Security, s.loc. Retrieved from

3786 Lemenih, M. &Teketay, D. (2003): Frankincense and myrrh resources of Ethiopia. I. Distribution, production, opportunities for dryland development and research needs. Ethiopian Journal of Science 26 (1): 63-72. Retrieved from https://www.ajol.info/index.ph

4187 Coppen, J.J.W. (1995): Flavours and fragrances of plant origin. FAO, Rome (Non-wood Forest Products 1). Retrieved from http://www.fao.org/docrep/V5350E/V5350e00.htm, viewed: 07.11.2012.

5525 Penso, G. & Proserpio, G. (1997): Index plantarum medicinalium totius mundi eorumque synonymorum. 2nd edition. OEMF, Milano.

6493 Svoboda, K., Hampson, J.B. & Hall, L. (2001): Boswellia from Somalia, a source of high quality frankincense. Medicinal Plant Conservation 7: 16-19.

7279 van Wyk, B.-E. & Wink, M. (2004): Medicinal plants of the world. Timber Press, Portland.

8547 Ved, D.K. & Goraya, G.S. (2008): Demand and supply of medicinal plants in India. FRLHT, Bangalore.

8730 Brendler, T., Eloff, J.N., Gurib-Fakim, A. & Phillips, L.D. (ed.) (2010): African Herbal Pharmacopoeia. Graphic Press, Mauritius.

8793 Thulin, M. & Warfa, A.M. (1987): The francinsense trees (Boswellia spp., Burseraceae) of northern Somalia and southern Arabia. Kew Bulletin 42 (3): 487-500.

8889 Thulin, M. (1999): Flora of Somalia. Volume 2. Angiospermae (Ericaceae-Asteraceae). Royal Botanic Gardens, Kew, Kew.

8894 Hall, A. (12.2.2005): Viability of a sustainable frankincense market in Somaliland. A historical and economical analysis. Retrieved from http://www.uvm.edu/giee/publications/FrankincenseViability.pdf, viewed: 12.06.2012.

8914 Gillett, J.B. (1991): Burseraceae. In: Flora of Tropical East Africa. Balkema, Rotterdam.

9913 Brendler, T., Brinckmann, J. & Cunningham, A.B. (2015): Boswellia frereana Birdw. Unpublished report for BfN, s.loc.

Abbreviations and Standards

ICC = ISO Country Codes   Ref = literature reference

Altitude: Low / High = minimum and maximum limits of altitude range [m]

Legislation: Source Taxon = name of taxon as contained in legislation

Utilization: TypeUtil

TypeUtil	*TypeUtilLong*
com	commodity
cul	cultivation
exp	export
har	harvest
imp	import
price	price
pur	purpose
rem	remark
sus	sustainability
tra	trade
trend	trend and scale of trade

Distribution Status: Standard

Status	*Explanation*
chk	check entry
nat	native
int	introd., established
adv	introduced, not established
ocd	occurrence doubtful
unc	status unclear
ext	extinct
cul	cultivated
sou	source doubtful
ica	introduced (casual or naturalized)
don	doubtfully native
pex	(presumably) extinct
ali	casual alien
nzd	naturalized
nna	not native
dpn	status doubtful, possibly native
abs	absent but reported in error

Common names: Type

TypeShort	*Type*
?	<unknown>
ayn	ayurvedic name
hom	homoeopathic name
pha	pharmaceutical name
scn	standardized common name
tra	trade name
ver	vernacular name

Ecology: TypeEcol

TypeEcol	*Explanation*
alti	altitude
grow	growth rate
habit	habitat
morph	morphology
regen	regeneration
repro	reproduction
soil	soil

Boswellia rivae Engl. 30796 Burseraceae

Nomenclatural reference 1148 The Plant List. - http://www.theplantlist.org/

Remarks Taxonomy	Reference	
genus: "c. 20 dry trop. Afr. (esp. NE; Socotra 8 endemics) & As."	3753	Mabberley, D.J. (2017): The plant-book. 4th edition. Cambridge University Press, Cambridge.
genus: "17 species in rather dry areas from the Ivory Coast to India and southwards to north-eastern Tanzania and northern Madagascar"	8889	Thulin, M. (1999): Flora of Somalia. Volume 2. Angiospermae (Ericaceae-Asteraceae). Royal Botanic Gardens, Kew, Kew.
genus: "19-20 species extending from the Ivory Coast to India and south to NE Tanzania and N Madagascar; most numerous in NE tropical Africa"	8914	Gillett, J.B. (1991): Burseraceae. In: Flora of Tropical East Africa. Balkema, Rotterdam.

Summary

Distribution	Boswellia rivae is native to Somalia, Ethiopia and Kenya.
Legislation	The species is not protected by CITES.
Threat Category	Not assessed globally by IUCN. Not found in recent national red lists.
Threat	No data available.
Abundance	No data available.
Habitat	B. rivae is found in open Acacia-Commiphora bushland, often on rocky ridges, at altitudes from 200 to 920m.
Regeneration	It may be inferred from another species (B. papyrifera) that propagation from rooted cuttings and the production of root suckers are possible.
Reproduction	It may be inferred from another species (B. papyrifera) that it has bisexual flowers and is seed producing.
Lifeform	Shrub or small tree, up to 7m high.
Plant Parts	Gum-resin as an exudate from the bark is used.
Use	B. rivae gum-resin is used locally as incense or for chewing. In general, the gum-resins are used for burning as incense, they are distilled to yield volatile oils in perfumery, used for chewing,and to a lesser degree in the preparation of traditional medicines.
Use Fields	Social use; food
Trade Trend	From general trade data it can inferred that demand today is less than in the 1970s and 1980s.

Synonyms

Synonym	Eval	Ref	
Boswellia boranensis Engl.		8914	Gillett, J.B. (1991): Burseraceae. In: Flora of Tropical East Africa.

Common Names

Common Name	Typ	Language	Country	Ref	
beyo		Somali		8889	Thulin, M. (1999): Flora of Somalia. Volum
frankincense	tra	English		8730	Brendler, T., Eloff, J.N., Gurib-Fakim, A. &
mirafur		Somali		8889	Thulin, M. (1999): Flora of Somalia. Volum
muqlay		Somali		8889	
murchen		Somali		8889	
Olibanum	tra			8730	Brendler, T., Eloff, J.N., Gurib-Fakim, A. &

Distribution Range

Distribution Range	Ref	
"SE Ethiopia, NE Kenya"	8889	Thulin, M. (1999): Flora of Somalia. Volume 2. Angiospermae (Ericaceae-Asteraceae). Royal Botanic Gardens, Kew, Kew.
"mainly found in the hot and dry Kolla zone in southern Ethiopia"	3793	Anon. (2016): Etheral aromas incense company. Complete archive collection. Retrieved from http://www.eaincense.com/complete-archive-collection.html, viewed: 04.07.2018.

Abundance

Ecology

TypeEc	ICC	Ecology	Ref	
alti		270-750m	8914	Gillett, J.B. (1991): Burseraceae
alti		200-920m	1149	African Plants Database. - http:/
alti	ET	250-800m	3795	Engels, J.M.M., Hawkes, J.G. &
alti	ET	250-800m	3783	Bekele-Tesemma, A. (2007): Us
alti	SO	200-920m	8889	Thulin, M. (1999): Flora of Soma
habit		"Open Acacia, Commiphora bushland on limestone hills"	8914	Gillett, J.B. (1991): Burseraceae
habit		"Open Acacia-Commiphora bushland [...]; on rocky ridges, usually on limestone"	1149	African Plants Database. - http:/
habit	ET	"found in Acacia Commiphorawooded grassland in red sandy to stony soils of Dry Kolla agroclimatic zone of Sidamo, Bale and Harerge"	3783	Bekele-Tesemma, A. (2007): Us
habit	SO	"Open Acacia-Commiphora bushland, often on rocky ridges, usually on limestone"	8889	Thulin, M. (1999): Flora of Soma
repro		"Flowers bisexual"	8914	Gillett, J.B. (1991): Burseraceae

Life Form

Duration	Lifeform	Woodiness	Height	LF_free_txt	Ref	
			up to 7m	"shrub or tree"	1149	African Plants Database. - http
	shrub or small tree		up to 7m	"spreading shrub or small tree"	8889	Thulin, M. (1999): Flora of So
	shrub or small tree		up to 7m	"shrub or small tree"	8914	Gillett, J.B. (1991): Burseracea
	shrub or small tree		up to 6m	"deciduous shrub or tree"	3783	Bekele-Tesemma, A. (2007):

Population Status / Threat Causes

ICC	PopulationStatus	Remark	Ref	
ET	[non-species-specific information for Boswellia and Commiphora]: "Although reliable information on the distribution and abundance of the resin-yielding species is not available, and the scattered occurrence of the trees makes detailed surveys a difficult and expensive option, it is believed that the total size of the natural resource and its potential productivity significantly outweigh demand for the products.		4187	Coppen, J.J.W. (1995): Flavou
ET	[non species-specific information for Boswellia]: „Under best practice, a tree is tapped for no more than 3 consecutive years, and should be rested so it can recover and regain vigour. However, in most cases, Boswellia trees are repeatedly tapped at intervals of 15 days throughout the dry season for up to 7 or more years. This causes premature death and production of poor-quality seeds that are unable to regenerate"		8898	Lemenih, M. & Kassa, L. (2010
ET	„in the southern lowlands [...] However, for most of the species, including [...] B. rivae [...], the population structure deviates from this inverted J-shaped pattern, possibly indicating the effects of human-induced disturbances on the species' regeneration ecology"		8898	
ET	[non species-specific information for Acacia, Boswellia & Commiphora]: „Drivers of dryland degradation include population growth and farmland expansion, lack of regeneration, human-induced fires, improper use of woodlands, improper tapping, overgrazing and bush encroachment"		8898	
SO	[non-species-specific information for Boswellia and Commiphora]: "It is impossible to prevent grazing of livestock and in times of drought nomads cut branches for fodder. Severe drought also affects the trees directly, slowing their growth and causing problems of regeneration. The more accessible trees are often tapped continuously through the year, with no rest periods, and this puts them under further stress."		4187	Coppen, J.J.W. (1995): Flavou

Threat Categories

Purpose: Fields of Use

Purpose: Fields uf Use		Frequency
food	sweets industry	1
social use	general	1

Purpose: Free text

Purpose		Ref	
social use - general	"The gum-resin is used locally as incense or for chewing."	8889	Thulin, M. (1999): Flora of So
food - sweets industry	"The gum-resin is used locally as incense or for chewing."	8889	Thulin, M. (1999): Flora of So

Plant Parts Used

Plant Part (standardized)	Plant Part (free text)	Remark	Ref	
exudate	gum-resin		8889	Thulin, M. (1999): Flora of So
exudate	"incense (resin)."		3783	Bekele-Tesemma, A. (2007):

Scale and Trend of Trade

ICC	Trade Trend	Remark	Ref	
	[non-species-specific information for Boswellia and Commiphora]: „demand today is believed to be less than was current in the late 1970s / early 1980s. The Middle East and the People's Republic of China are seen to be the major consumers.		4187	Coppen, J.J.W. (1995): Flavou

Germany has imported significant amounts of Ethiopian incense gum"

Trade

Type	ICC	Utilization	Ref	
com		"The Ogaden type is gum-resin type produced in the east and south-eastern parts of the country. [...] However, some of the sources indicated that resins from B. rivae (Engl.), B. ogadensis (Vollesen) (Somali name 'Gended'), B. neglecta (S. moore) (Somali name 'Murufur') and B. microphylla (Chior.) (Somali name 'Muqlay') are collected and traded as frankincense in this area"	3786	Lemenih, M. &Teketay, D. (20
exp	ET	Production/ export of Borena type olibanum [= Boswellia rivae]: 1992/54; 1993/251; 1994/1168; 1995/2005; 1996/1777; 1997/106; 1998/-; 1999/- [yr/quintals; 1 quintal = 100 kg]	3786	
har	ET	[non species specific information for Boswellia & Commiphora]: „estimates for olibanum and myrrh show yields in the range of 0.07–1.0 kg per tree per year, with the average being 0.50 kg [...], whereas another report provides an estimate as high as 3.0 kg per tree per year"	8898	Lemenih, M. & Kassa, L. (201C
har	ET	[non species-specific information for Boswellia]: Estimated potential and annual production of gum and incense in Ethiopia: Gum olibanum 2,284,000 ha and 57,100 tonnes	8898	
har	ET	„Ogaden and Borana types are gum resins produced from Boswellia species found in the dry forests of the eastern and southeastern lowlands. [...] gum resins from B. rivae, B. ogadensis, B. neglecta and B. microphylla are collected from these areas and traded as frankincense"	8898	
har	SO	[non-species-specific information for Boswellia]: „In some cases, as in Somalia, the wild Boswellia stands belong to extended families who live in the resin-producing areas. There is therefore some incentive on the part of those who tap the trees not to do it in such a way as to damage the trees and jeopardise their livelihoods. On the other hand, it is impossible to prevent grazing of livestock and in times of drought nomads cut branches for fodder. Severe drought also affects the trees directly, slowing their growth and causing problems of regeneration. The more accessible trees are often tapped continuously through the year, with no rest periods, and this puts them under further stress."	4187	Coppen, J.J.W. (1995): Flavou
har	SO	[non-species-specific information for Boswellia]: „It is not possible from official records alone to estimate how much resin, on average, is obtained from a tree. Figures of 1-3 kg per tree per year have been cited for olibanum [= Boswellia] in Somalia."	4187	
tra	ET	[non species-specific information for Acacia, Boswellia & Commiphora]: „The production and trade volumes of gums and resins in Ethiopia have been increasing since the 1990s. Between 1998 and 2007, Ethiopia exported about 25 192 tonnes – an average of approximately 2519 tonnes per year – of natural gums and resins with a value of [...] 34 138 670 USD [...]. The export volume increased on average by 12% each year from 1998 to 2007"	8898	Lemenih, M. & Kassa, L. (201C

Legislation

Regulation

Bibliography

1149 African Plants Database. - http://www.ville-ge.ch/musinfo/bd/cjb/africa/recherche.php?langue=an. 2009 Conservatoire et Jardin botaniques & South African National Biodiversity Institute.

3753 Mabberley, D.J. (2017): The plant-book. 4th edition. Cambridge University Press, Cambridge.

3783 Bekele-Tesemma, A. (2007): Useful trees and shrubs of Ethiopia. Identification, propagation and management for 17 agroclimatic zones. World Agroforestry Centre, Nairobi.

3786 Lemenih, M. &Teketay, D. (2003): Frankincense and myrrh resources of Ethiopia. I. Distribution, production, opportunities for dryland development and research needs. Ethiopian Journal of Science 26 (1): 63-72. Retrieved from https://www.ajol.info/index.ph

3793 Anon. (2016): Etheral aromas incense company. Complete archive collection. Retrieved from http://www.eaincense.com/complete-archive-collection.html, viewed: 04.07.2018.

3795 Engels, J.M.M., Hawkes, J.G. & Worede, M. (ed.) (1991): Plant genetic resources of Ethiopia. Cambridge University Press, Cambridge. Retrieved from https://www.researchgate.net/publication/241778257_Plant_Genetic_Resources_of_Ethiopia, viewed: 04.07.2018.

4187 Coppen, J.J.W. (1995): Flavours and fragrances of plant origin. FAO, Rome (Non-wood Forest Products 1). Retrieved from http://www.fao.org/docrep/V5350E/V5350e00.htm, viewed: 07.11.2012.

8730 Brendler, T., Eloff, J.N., Gurib-Fakim, A. & Phillips, L.D. (ed.) (2010): African Herbal Pharmacopoeia. Graphic Press, Mauritius.

8889 Thulin, M. (1999): Flora of Somalia. Volume 2. Angiospermae (Ericaceae-Asteraceae). Royal Botanic Gardens, Kew, Kew.

8898 Lemenih, M. & Kassa, L. (2010): Opportunities and challenges for sustainable production and marketing of gums and resins in Ethiopia. CIFOR, Bogor. Retrieved from http://www.cifor.org/publications/pdf_files/Books/BKassa1102.pdf, viewed: 12.06.2012.

8914 Gillett, J.B. (1991): Burseraceae. In: Flora of Tropical East Africa. Balkema, Rotterdam.

8919 Moges, Y. (2004): Gum and incense. Recommendations for improved production and income generation. Consultancy sub-report no. 6. FARM Africa / SOS Sahel, s.loc. Retrieved from http://www.pfmp-farmsos.org/Docs/gum_incense_borana.pdf, viewed: 23.09.2012.

Abbreviations and Standards

ICC = ISO Country Codes   Ref = literature reference

Altitude: Low / High = minimum and maximum limits of altitude range [m]

Legislation: Source Taxon = name of taxon as contained in legislation

Utilization: TypeUtil

TypeUtil	*TypeUtilLong*
com	commodity
cul	cultivation
exp	export
har	harvest
imp	import
price	price
pur	purpose
rem	remark
sus	sustainability
tra	trade
trend	trend and scale of trade

Distribution Status: Standard

Status	*Explanation*
chk	check entry
nat	native
int	introd., established
adv	introduced, not established
ocd	occurrence doubtful
unc	status unclear
ext	extinct
cul	cultivated
sou	source doubtful
ica	introduced (casual or naturalized)
don	doubtfully native
pex	(presumably) extinct
ali	casual alien
nzd	naturalized
nna	not native
dpn	status doubtful, possibly native
abs	absent but reported in error

Common names: Type

TypeShort	*Type*
?	<unknown>
ayn	ayurvedic name
hom	homoeopathic name
pha	pharmaceutical name
scn	standardized common name
tra	trade name
ver	vernacular name

Ecology: TypeEcol

TypeEcol	*Explanation*
alti	altitude
grow	growth rate
habit	habitat
morph	morphology
regen	regeneration
repro	reproduction
soil	soil

Annex

Questionnaire on Boswellia trees (*Boswellia* spp.)

Section 1: Contact information

1a.	Party:	
1b.	Institution: TRAFFIC	
1c.	Contact information of the representative who responded to the questionnaire:	Name: Anastasiya Timoshyna
		Phone: +441223331969
		Email: anastasiya.timoshyna@traffic.org
		Other:

Section 2: Biological data on *Boswellia* (paragraphs a) and c) of Decision 18.205)

2a. Please list the *Boswellia* species that are known to occur within the territory of your country:

2b. For each species occurring in your country, please provide its population status. Add rows if needed.

Species	No concern	Vulnerable	Endangered	Other, please specify	Unknown
•	☐	☐	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2c. For each species occurring in your country, please provide information on the population trend. Add rows if needed.

Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
•	☐	☐	☐		☐
•	☐	☐	☐		☐
•	☐	☐	☐		☐

2d.	For each species occurring in your country, please provide its habitat trends. Add rows if needed.					
	Species	Increasing	Stable	Decreasing	Other, please specify	Unknown
•		☐	☐	☐		☐
•		☐	☐	☐		☐
•		☐	☐	☐		☐
2e.	Please provide a short qualitative summary of each species' habitat and role in its ecosystem. Add space if needed.					
2f.	Please provide a short qualitative summary of each species' population status, size, and distribution. Add space if needed.					
2g.	Please list the main threats that are known to affect the conservation and sustainable use of *Boswellia* species and known drivers of these threats.					

2h.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 3: Harvest and exploitation (paragraph b), c) and d) of Decision 18.205)

3a.	Which *Boswellia* species among those occurring in your country are harvested for subsistence or commercial use?
3b.	For what uses are *Boswellia* species mainly harvested (e.g. timber, medicine, incense, other)?
3c.	For each of the above uses, what is the volume of harvest for commercial purposes (approximate annual harvest)? Please include an estimate of the number of trees harvested and/or volume of harvested material. If available, provide conversion factors.
3d.	What volume is exported (approximate annual export)?
3e.	Please specify to what extent (if any) harvest or export affects the sustainability of *Boswellia* populations.
3f.	Please specify if harvest or export reduce or otherwise affect the regeneration capacity of *Boswellia* populations.
3g.	Please summarize any initiatives to artificially propagate/cultivate *Boswellia* species or to grow plantations or nurseries of them, and the scale and size of plantations/nurseries.

3h.	What are the challenges to artificially propagate/cultivate *Boswellia* species in your country?	
3i.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 4: Supply chains and international trade (paragraph a), b) and f) of Decision 18.205)

4a.	Who are the predominant legal or customary owners / custodians of *Boswellia*? Government-owned ☐ Local communities ☐ Individual ownership ☐ Community-based or individual land tenure ☐ Please describe the land ownership structure where *Boswellia* spp. occur, including harvest rights.
4b.	If known, please specify who are the main harvesters of *Boswellia* specimens? Individual collectors ☐ Collector associations ☐ Private companies ☐ Other ☐ Please provide further details on the types of harvesters.
4c.	Is there any in-country processing capacity for *Boswellia* specimens? Please describe.
4d.	Approximately how many companies or institutions in your country are known to process and / or trade *Boswellia* specimens? Please list the main ones.
4e.	What are the main *Boswellia* specimens known to be exported from your country (e.g. extract, woodchips, other)?

4f.	Which are the main known importing countries of *Boswellia* specimens sourced from your country?
4g.	Please list the *Boswellia* species that are imported into your country (whether finished or unfinished specimens) and the countries from which they were imported.
4h.	What are the main *Boswellia* specimens imported into your country (e.g. timber, medicine, incense, other)?
4i.	What is the approximate volume of *Boswellia* specimens being imported? Please specify for each type of specimen.
4j.	Is there any re-export of *Boswellia* specimens from your country? Please specify including approximate volumes of the specimen re-exported and to which countries.
4k.	If known, please provide common trade names and/or product names under which the *Boswellia* specimens are internationally traded.

4l.	If available, please provide information on any reference material, guidance, or tools to identify *Boswellia* specimens in trade.	
4m.	If available, please provide contacts of any known stakeholder groups, specialists, or institutions that might aid the Secretariat in the implementation of Decision 18.206.	
4n.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 5: Regulatory framework and species management (paragraph e) of Decision 18.205)

5a. Please describe any regulations or management measures in place or in preparation concerning

i. The conservation of *Boswellia* populations and/or habitats?

ii. The sustainable harvest of *Boswellia* specimens?

TRAFFIC would like to submit an update on the implementation of the FairWild Standard and certification scheme for the sustainable harvest of *Boswellia sacra*. The harvesting site is Sahil, in the self-declared autonomous region of Somaliland. Producer company neo botanika, which collects wild-harvested aromatic gum resins in areas entirely owned and managed by indigenous tribes, have achieved FairWild certification in 2019. The FairWild-certified *Boswellia sacra* products include dry gum resin, essential oil and hydrosol, all available in international trade. The estimated quantities of FairWild certified *Boswellia sacra* available are 5000 kg of dry gum resin, 300 kg of essential oil and 2400 kg of hydrosol.

The collection permit for the operation is issued by the Ministry of Commerce and Industry. Sustainability of harvesting of *Boswellia sacra*, alongside other resources is covered by the Forestry and Conservation Law of Somaliland. Ten collectors are involved in harvesting of FairWild-certified Boswellia sacra resin. Internal company Good Tapping and Harvesting Practices are established.

FairWild Standard is the international standard providing a worldwide framework for implementing a sustainable, fair and value-added management and trading system for wild-collected natural ingredients and products thereof. In additional to other pathways, it can be implemented as a third-party certification framework, based on the annual independent field audit by accredited certification bodies. Annual field audit by third-party is required as part of the FairWild certification. The certification includes the completion of the target species resource assessment, species and area management plan, demonstrated and documented sustainable collection practices, traceability of goods and finances, and a comprehensive range of requirements around fair trade and social sustainability.

iii. The export of *Boswellia* specimens?

iv. Ecological restoration efforts *in situ*, planned or underway, including the timeframe, source of propagation specimen, and outcomes.

5b.	Please provide citations of relevant literature and any supporting files to the questions above. Please add rows as needed.	
	File/attachment	Comments (if any)

Section 6. Additional remarks or information

6a.	Please provide any additional information or remarks relevant to the implementation of Decisions 18.205 to 18.208 on Boswellia trees (*Boswellia* spp.)

As expressed in the information document to CITES CoP18 Inf53 (https://cites.org/sites/default/files/eng/cop/18/inf/E-CoP18-Inf-053.pdf), TRAFFIC and other collaborators remain interested in conducting the objective, science-based assessment of the conservation and trade of Boswellia genus, should funding be available to support the work.

Thank you very much for your responses!