PATSPO

Provision of adequate tree seed portfolios

World Agroforestry Centre

Environment , Forest and Climate Change Commission
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Norway's International Climate and Forest Initiative (NICFI)

Preparation for species distribution modelling

Consultancy report

25th January 2018

TECHNICAL

Provision of Adequate Tree Seed Portfolios: Preparation for species distribution modelling

Consultancy Report, 25th January 2018

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Contents

1. Abbreviations

AOCC	African Orphan Crops Consortium
BPC(T)	Breeding Plans Consultancy (Team)
CE-EFRC	Central Ethiopia Environment and Forest Research Center (Forest Research Centre before July 2015)
EEFRI	Ethiopian Environment and Forest Research Institute
FRC	Forest Research Centre, since July 2015 the EEFRI Central Ethiopia Environment and Forest Research Center
HDM	Habitat Distribution Map(s) / Mapping
PATSPO	Provision of Adequate Tree Seed Portfolios
PNV	Potential Natural Vegetation
SDM	Species Distribution Model(s) / Modeling
SoW-FGR	State of the World's Forest Genetic Resources
ToR	Terms of Reference
UTSE	Useful Trees and Shrubs of Ethiopia

2. Expected deliverables from the consultancy

From the Terms of Reference (ToR) for the consultancy, the following deliverables were distilled:

1. In collaboration with the Breeding Plans Consultancy Team (BPCT), review of species prioritization in Ethiopia
2. Define a process action plan for a consolidated list of 150 species
3. In collaboration with the BPCT, define criteria to identify up to 25 species to be included in the breeding programmes
4. Prepare guidelines for species distribution modelling for indigenous tree species (including candidate species for breeding)
5. Prepare guidelines for species distribution modelling for exotic tree species (including candidate species for breeding)
6. Review species with respect to available information

Each of these deliverables is addressed in a separate section (3-8).

3. Review of species prioritization in Ethiopia

The main list of priority tree species that was consulted during the formulation of the PATSPO project was the list of priority tree species of the Ethiopian country report for the *State of the World's Forest Genetic Resources* (SoW-FGR, Institute of Biodiversity Conservation 2012). Given that this report was relatively recent and a key reference for PATSPO, the same report was used as the main source to select a wider set of candidate tree species for breeding and for suitability modelling.

This main list of priority tree species is shown in Annex 5 of the PATSPO project and lists 24 priority species. However, when cross-checking with the original SoW-FGR priority list (Table 4 in that report), it transpired that three species were omitted in the PATSPO priority list: *Cordeauxia edulis*, *Moringa stenopetala* and *Prunus africana*. Moreover, two species were included in the SoW-FGR priority list (and maintained in the PATSPO priority list) as invasive species to be removed: *Acacia drepanolobium* and *Prosopis juliflora*. The 25 priority species are given in the next section of this report and its various appendices.

The manual of the *Useful Trees and Shrubs of Ethiopia* (UTSE, Bekele-Tesemma *et al.* 2007) can be considered as a priority listing of *useful tree species*, which could serve as a 'long list' of species that could be used by PATSPO. With the main objective of PATSPO of mosaic restoration, it makes sense to focus on species with utilitarian values that restore livelihoods in tandem with landscapes. As PATSPO proposes to support tree portfolios consisting of indigenous and exotic species, UTSE seems to provide a list of species that provides a good balance between exotic and indigenous species. A similar information source is an interactive tool for species selection (Kuria *et al.* 2017), but this tool is expected to list subset of the UTSE species list as the second tool is an output of a project that focused on two sites in Ethiopia. Yet other tools are the *AgroforesTree* database (Orwa *et al.* 2009), PROTA or other web-databases listed by the *Agroforestry Species Switchboard* (Kindt *et al.* 2018), but with specific focus on Ethiopia, UTSE seems a good starting point for a long list of priority species.

The World Agroforestry Centre (ICRAF) developed priority setting guidelines for selecting species to be domesticated (Franzel *et al.* 1996; Franzel and Kindt 2012), but these have never been applied to priority setting in Ethiopia. As application of these guidelines in other ICRAF regions resulted in selecting tree species for a particular product of high market value (the 'product prioritization' step that selected fruit in West and Central Africa and timber in Peru), it could have been possible that a previous priority setting exercise would have resulted in species for a particular product and therefore of lesser relevance for the portfolio of species required for PATSPO. A priority list of fruit species for Eastern African drylands is available from Teklehaimanot 2008, but obviously these only are fruit species.

Reubens *et al.* (2011) developed a multi-criteria decision support system to select priority tree species for rehabilitation of northern Ethiopian highlands, focusing on areas between 2100 and 2800 m above sea level in the Central Zone of Tigray. This tool provides a sophisticated approach to species selection. However, it is focused on one particular region within Ethiopia. The multi-criteria system will give higher ranking to species with higher diversity in products and services that they provide, which may not necessarily result in optimal species mixtures (*i.e.* if species exist that are more specialized that perform better for some of the planting objectives than 'all-round' species; a similar argument can be made for working teams or for the portfolio effect [of biodiversity]).

When searching online for 'priority tree species' + Ethiopia, the list of priority tree species prepared for an earlier report on the state of forest genetic resources in Ethiopia (Million and Leykun 2001) is among the first results. The earlier report provides a list of species that are mainly planted for construction and industrial products. Given that smallholders also select and plant trees for a variety of non-timber tree products (or agroforestry tree products; Simons and Leakey 2004; Leakey *et al.* 2005; Dawson *et al.* 2014), the more recent

SoW-FGR provides a more balanced list in respect to the variety of planting objectives, including different environmental services (see Appendix IV in this report).

Lists of commercial timber and bamboo species for Ethiopia, *i.e.* species with similar planting objectives as those of the earlier SoW-FGR report have been compiled by Desalegn *et al.* (2015[1]). Derero *et al.* (2012) identified fodder and fruit tree species of high importance in the Afar and Somali Regions of Ethiopia.

Searching for priority species for Ethiopia also results in lists of priority tree species for conservation, for example the *Red List of Endemic Trees and Shrubs of Ethiopia and Eritrea* developed for the *Global Trees Campaign* (Vivero *et al.* 2005). With a focus of PATSPO on restoration of landscapes and livelihoods, threats to conservation or endemicity was not considered a valid criterion to prioritize species for this project. This does not imply that none of the selected species are currently threatened. For example, *Hagenia abyssinica* features in the SoW-FGR top-25 priority tree species and was also highlighted in the *Red List* in Box 3 of that report (Vivero *et al.* 2005). Another example that also illustrates the importance of food trees is the top-25 *Cordeauxia edulis*, highlighted in Box 1 of the *Red List* (Vivero *et al.* 2005). As the two species that were mentioned directly above are not endemic to Ethiopia, it also transpires that the listing by Vivero *et al.* (2005) is not comprehensive as it excludes non-endemics.

[1] Getachew Desalegn, Seyoum Kelemwork, Daniel Gebeyehu. 2015. Forest Products Utilization Research in Ethiopia: Highlights on Major Achievements and Contributions. Ethiopian Environment and Forest Research Institute, Addis Ababa. *PDF document shared by Abayneh Derrero.*

4. Definition of a process action plan for a consolidated list of 150 species

The PATSPO project document lists as one of the outputs the development of high resolution habitat suitability maps that delineate species- and provenance-specific recommendation domains for up to 150 priority tree species in Ethiopia.

In a first step of compiling the priority species list (primarily to handle species spelling and synonyms), a master list of botanical names was compiled for all species listed in following resources:

(i) The Useful Trees and Shrubs of Ethiopia (Bekele-Tesemma 2007)
(ii) The Ethiopian country report for the SoW-FGR (Institute of Biodiversity Conservation 2012)
(iii) The vegetationmap4africa species known to occur in Ethiopia
(iv) The seed price list from EEFRI's Central Ethiopia Environment and Forest Research Center obtained on 20th November 2017
(v) The seed price list from the Amhara tree seed centre obtained on 21st November 2017

Information of the vegetationmap4africa was obtained from information that was compiled to produce the map and its documentation. Information was extracted from the database that was also used for the Africa Tree Finder, selecting tree and shrub species that were known to occur in Ethiopia. In addition to species that were included in the Atlas of the Potential Vegetation of Ethiopia (Friis *et al.* 2010), some species were added that were known to occur in Ethiopia and that were documented for other countries of the vegetationmap4africa.

Species names from the master list were checked for spelling errors and current names with the *Taxonstand* package (version 2.1 of 2nd November 2017 run in R version 3.4.0). This package automates standardization of taxonomic names and removal of orthographic errors by checking *The Plant List*. Species names were checked on 21st November 2017 against the newest version of *The Plant List* (version 1.1 of September 2013). Five species names were excluded from the master list as their names could not be confirmed – all these species were from the SOW-FGR report (*Bothuodna schimperi, Tricompetala biachycesas [? Triumfetta brachyceras];* these were species listed for *ex situ* collection) or from the seed price list (*Casuarina matao*, *Leucaena cunninghamiana*).

The final master list of species consisted of 655 entries (Appendix I). Of the 655 species, 438 were listed in the vegetationmap4africa (these are mainly indigenous tree species), 353 in the SoW-FGR (expanded with the seed lists) and 230 in the Useful Trees for Ethiopia.

The next step was to identify species that had been categorized as priorities or as important species for Ethiopia based on a report that was recently prepared for the SoW-FGR (Institute of Biodiversity Conservation 2012). As this first step resulted in a list of 96 species (documented below), the list was further expanded to a long list of 240 species (*i.e.*, 36.6% or roughly one third of the 655 species).

The primary source of selecting candidate species for species suitability modelling (SDM) was the SoW-FGR report prepared by Ethiopia. This report provides **25 priority tree species** when excluding two invasive species (Table 4 in that report; see Section 3).

The SoW-FGR report for Ethiopia further lists the 52 main species currently used in Ethiopia for solid wood products, energy, non-wood forest products, agroforestry species and stimulants (Table 5 in that report), 34 forest species used for environmental services or social values (Table 6 in that report), 58 species distributed by

the FRC between July 2006 and November 2010 (Table 8 in that report), 10 species for which genetic variability was assessed (Table 9 in that report), 7 target species for *in situ* conservation (Table 10 in that report), 9 species with tree improvement programs (Tables 13 and 14 in that report), 7 species with seed production areas (Table 15 in that report) and 56 species with seed available from the FSC (Table 16 in the report). To this list were added 70 species listed in the seed price list obtain from the Addis Ababa tree seed centre (obtained from CE-EFRC on 20th November 2017) and 36 species from the Amhara tree seed centre (obtained on 21st November 2017). Also added were tree species imported by the High Value Tree Crops project into the country (Table 12 in the SoW-FGR report). The complete list of species consisted of **96 species** (Table 4.1). Criteria that were not used to compile the top-96 included the number of *ex situ* conservation stands (Table 11 in the SoW-FGR report; including 32 of the top-96 species) and the number of species with identified natural stands (also 32 from the top-96, but a different species assemblage).

The top-96 species were classified as exotic or indigenous species based on information available from the SoW-FGR report and the Useful Trees and Shrubs of Ethiopia (Bekele-Tesemma *et al.* 2007). For species that were not included or species with conflicts in species origins between the two sources, information was obtained from Kew's Plants of the World portal (accessed 22nd November 2017). (The same method of checking species origins was used for the long list of species described below).

An alternative list of 10 most demanded exotic species and 10 most demanded indigenous species was obtained from an EEFRI presentation on 20th September 2017 attended by the BPCT (Hendre Prasad, pers. comm.). All these 20 species are included in the list of 96 species, with nine species (6 exotics and 3 indigenous species, see Section 5) occurring both in the top-25 and top-20 lists.

Table 4.1. 96 candidate species for breeding. T-25: top 25 species identified in the SoW-FGR; T-20: top 20 species identified by the BPC; Origin: native (N) or exotic (E); SoW-FGR: table number or Appendix 5 (A5) (see main text for details on these tables); Seed: seed listed in the seed price list of the Addis Ababa (AA) or Amhara (AM) seed centre. Species included both in top-25 and top-20 are shown in **bold** typeface.

	Species	T-25	T-20	Origin	SOW-FGR	Seed
1	Acacia abyssinica		x	N	5, 6, 8, 11, 16, A5	AA, AM
2	Acacia decurrens		x	E	5, 6, 8, 16	AA, AM
3	Acacia melanoxylon			E	8, 16	AA
4	Acacia nilotica		x	N	5, 8, 16, A5	AA, AM
5	Acacia polyacantha			N	8, 11, A5	AA, AM
6	Acacia saligna		x	E	5, 6, 8, 16	AA, AM
7	**Acacia senegal**	x	x	N	5, 6, 8, 9, 11, 13, 16, A5	AA, AM
8	Acacia seyal			N	6, 8, 11, A5	AA
9	Acacia tortilis		x	N	5, 6, 8, 11, 16, A5	AA
10	Adansonia digitata	x		N	5	
11	**Afrocarpus falcatus**	x	x	N	5, 6, 8, 10, 11, 16, A5	AA, AM
12	Albizia grandibracteata			N	8, 11, 16, A5	AA
13	Albizia gummifera			N	5, 8, 11, 16, A5	AA, AM
14	Albizia lebbeck			E	8, 16	AA
15	Albizia schimperiana			N	5, 8, 16, A5	AA
16	Azadirachta indica			E	5, 8, 16	AA
17	Balanites aegyptiaca			N	16, A5	AA, AM
18	Bauhinia thonningii			N	6, 11	
19	Boswellia microphylla			N	5	
20	Boswellia neglecta			N	5	
21	Boswellia ogadensis			N	5	
22	Boswellia papyrifera	x		N	5	AA, AM
23	Boswellia pirottae			N		AM
24	Boswellia rivae			N	5	
25	Cajanus cajan			E	6, 16	AA, AM
26	Calliandra calothyrsus			E	8	
27	Callistemon citrinus			E	8, 16	
28	Carica papaya			E	5, 12	
29	Casuarina cunninghamiana			E	8, 16	AA
30	Casuarina equisetifolia		x	E	8, 16	AA, AM
31	Catha edulis	x		N	5	
32	Celtis africana			N	6, 11	
33	Citrus sinensis			E	5	
34	Coffea arabica	x		N	5, 6, 9, 10	
35	Combretum molle			N		AM
36	Commiphora africana			N	5	
37	Commiphora guidottii			N	5	
38	Commiphora myrrha	x		N	5	
39	Cordeauxia edulis	x		N	5, 6	
40	**Cordia africana**	x	x	N	5, 6, 8, 9, 11, 13, 14, 16, A5	AA, AM
41	Corymbia citriodora		x	E	8, 16	AA, AM
42	Croton macrostachyus			N	5, 6, 8, 11, 16, A5	AA
43	Cupressus lusitanica	x		E	5, 8, 14, 16	AA, AM
44	Cupressus sempervirens			E	8	AA
45	Cytisus proliferus			E	8, 16	AA, AM
46	Delonix regia			E	8, 16	AA, AM
47	Dodonaea viscosa			N	8, 11, 16, A5	AA
48	Dovyalis abyssinica			N	8, 16, A5	
49	Dovyalis caffra			E	8, 16	AA
50	Ekebergia capensis			N	6, 8, 16, A5	AA
51	Entada abyssinica			N	8, 11, 16, A5	AA
52	Erythrina abyssinica			N	6, 11, A5	AA
53	Erythrina brucei			N	5, 6, 8, 16, A5	AA

	Species	T-25	T-20	Origin	SOW-FGR	Seed
54	**Eucalyptus camaldulensis**	x	x	E	5, 8, 9, 13, 16	AA, AM
55	**Eucalyptus globulus**	x	x	E	5, 8, 9, 11, 13, 16	AA, AM
56	Eucalyptus grandis		x	E	8, 9, 13, 16	AA
57	Eucalyptus saligna		x	E	8, 9, 13, 16	AA
58	Eucalyptus viminalis			E	8, 14, 16	AA
59	**Faidherbia albida**	x	x	N	5, 6, 8, 11, 16, A5	AA, AM
60	Ficus carica			E	6, 12	
61	Ficus sur			N	6, 11	
62	Ficus sycomorus			N	6, 11	
63	**Grevillea robusta**	x	x	E	5, 6, 8, 14, 16	AA, AM
64	**Hagenia abyssinica**	x	x	N	5, 6, 8, 9, 10, 11, 13, 14, 16, A5	AA
65	Jacaranda mimosifolia		x	E	8, 16	AA
66	Jatropha curcas			E	8, 9, 13	
67	**Juniperus procera**	x	x	N	5, 6, 8, 9, 11, 13, 14, 16, A5	AA, AM
68	Leucaena leucocephala			E	5, 6, 8, 16	AA, AM
69	Maerua aethiopica			N	8, A5	AA
70	Malus domestica			E	5	
71	Mangifera indica			E	5, 12	
72	Melia azedarach			E	8, 16	AA
73	Millettia ferruginea			N	5, 8, 11, 16, A5	AA, AM
74	Moringa stenopetala	x		N	5, 6, 8, 11, 16, A5	AA, AM
75	Olea europaea		x	N	5, 8, 11, 16, A5	AA, AM
76	Oxytenanthera abyssinica	x		N	5, 10, 11	AM
77	Parkinsonia aculeata			E	8, 16, A5	AA
78	Persea americana			E	5	
79	Phoenix reclinata			N	8, 11, 16, A5	AA
80	Pinus patula			E	5, 8, 14, 16	AA, AM
81	Pouteria adolfi-friedericii	x		N	5, 6, 10, A5	
82	Prunus africana	x		N	5, 6, 8, 11, 16, A5	AA
83	Pterolobium stellatum			N	8, 11, A5	AA
84	Rhamnus prinoides	x		N	5, 11	AM
85	Schefflera abyssinica			N	5	
86	Schinus molle			E	8, 16	AA, AM
87	Sesbania bispinosa			E	5, 8, 16	AA
88	Sesbania sesban			N	6, 11	AA, AM
89	Spathodea campanulata			N	8, 16	AA
90	Tamarindus indica	x		N	5, 6, 8, 11, 12, 16, A5	AA, AM
91	Terminalia brownii			N	6	AM
92	Vitellaria paradoxa	x		N	5, 6	
93	Warburgia ugandensis			N	6	
94	Yushania alpina	x		N	5, 10	
95	Ziziphus jujuba	x		N	5, 6, 12, 16	AA
96	Ziziphus spina-christi			N	11	AM

The top-96 could all be considered as candidate species for plant breeding (see Section 5). With the objective of expanding the list of 96 selected species towards 150 species to be mapped, following species were added from the master list:

(i) Any species that are priorities for the African Orphan Crops Consortium (AOCC, 16 species were added)
(ii) Any species listed among the 215 most frequently used species for plantations in the tropics (Pancel 2015; 15 species were added, not including *Psidium guajava* already added by the AOCC)

This process resulted in a list of 126 species that could be considered as the priorities for high resolution HSM defined by PATSPO. However, as paucity of presence point location data may complicate SDM (see sections 6 and 7), the priority list for SDM was expanded further with 114 native species that were listed both in the vegetationmap4africa and the UTSE manual. This resulted in the list of 240 candidate species of Appendix II (the 'long list').

A list of priority tree species prepared for an earlier report on the state of forest genetic resources in Ethiopia (Million and Leykun 2001) focused more on species with construction and industrial purposes. Out of the 23 species identified in that report, 11 occurred in the top-96. Species that were outside the top-96 were in the long list (*Apodytes dimidiata, Blighia unijudata, Diospyros abyssinica, Manilkara butugi, Milicia excelsa, Ocotea kenyensis, Olea capensis* [listed as *Olea hochstetteri*, a synonym of *Olea capensis* subsp. *macrocarpa*], *Polyscias fulva, Trilepisium madagascariense* and *Syzygium guineense*), but two species were not: *Afrocarpus gracilior* and *Olea welwitschii*. In the UTSE, *Afrocarpus (Podocarpus) gracilior* is treated as synonym of *Afrocarpus falcatus*, one of the six indigenous species that occurred both on the top-25 and top-20. In the *Atlas of Potential Natural Vegetation of Ethiopia* by Friis *et al.* 2010, *Afrocarpus (Podocarpus) gracilior* is not listed. However, both ThePlantList and the AfricanFloweringPlant database treat *Afrocarpus gracilior* as a unique species. *Olea welwitschii* is a unique species according to ThePlantList and the AfricanFloweringPlant database. It is listed under this name in the UTSE and in the Ethiopian atlas by Friis *et al.* 2010, but was listed in the VECEA project by its synonym of *Olea capensis* subsp. *welwitschii* as this was the name by which it was listed in the *Useful Trees and Shrubs* manuals for Uganda and Tanzania. *Olea capensis* was listed in the long list. (Both *Olea welwitschii* and *Olea capensis* are listed as unique species native to Ethiopia by the *Plants Of the World* portal [accessed January 2018]).

Desalegn *et al.* (2012) list eight species that have been selected as suitable veneer species for Ethiopia, five of which are included in the top-96. The three species that were not listed (*Ocotea kenyensis*, *Olea capensis* and *Olea welwitschii*) are mentioned in the previous paragraph as they were included in those species listed by Million and Leykun (2001).

Desalegn *et al.* (2015) provide a longer list of 68 commercial timber and bamboo species that could be further expanded to 70 species. Leaving aside the 16 *Eucalyptus* and 4 *Pinus* species listed and also species listed by Million and Leykun 2001, species outside the top-96 included *Acacia caffra*, *Acacia drepanolobium* (prioritized as invasive species by the latest SoW-FGR report), *Acacia mellifera*, *Acrocarpus fraxinifolius*, *Allophylus abyssinicus*, *Alstonia boonei*, *Antiaris toxicaria*, *Bridelia micrantha*, *Cordia alliodora*, *Fagaropsis angolensis*, *Gmelina arborea* (among the two species for expansion of the list of 68), *Mimusops kummel*, *Prosopis juliflora* (another invasive species prioritized for removal in the latest SoW-FGR report) and *Trichilia dregeana*. Leaving out the two invasive species, species occurred in the long list except for *Acacia caffra* (not in the master list and a species native to southern Africa), *Acacia mellifera* (master list, V4A), *Acrocarpus fraxinifolius* (not in the master list and a species native to Asia-Tropical and Asia-Temperate), *Alstonia boonei* (master list, V4A) and *Cordia alliodora* (not in the master list and a neotropical species).

Of the 20 highest scoring species for planting on private land identified by the multi-criteria decision support system by Reubens *et al.* (2011), 17 were included in the top-96. Not included were *Euphorbia candelabrum* (rank 11), *Acacia etbaica* (rank 13) and *Euphorbia abyssinica* (rank 16); these species were included in the long list, however.

The top five indigenous fruit tree species for Ethiopian drylands identified by Teklehaimanot 2008 (sorted from highest to lowest ranking as: *Cordeauxia edulis, Vitellaria paradoxa, Balanites aegyptiaca, Borassus aethiopum, Sclerocarya birrea*) were either in the top-96 (the first three species) or the long list (the last two species).

Highly preferred fodder and fruit tree species to improve livelihoods in the Afar and Somali Regions as identified by Derero *et al.* (2012) were among the top-96, with exception of *Berchemia discolor*, *Cordia sinensis* and *Dobera glabra* (all among the long list, except *Cordia sinensis*; this species was only listed in the master list [it is listed in the vegetationmap4africa, but not the UTSA]).

Although conservation priority was not a criterion to select candidate tree species, the top-96 included two species from those listed in the red list of endemic tree species for Ethiopia and Eritrea (Vivero *et al.* 2005): the critically endangered *Boswellia ogadensis* and the vulnerable *Boswellia pirottae*. Various threatened frankincense-producing species such as *Boswellia neglecta* (also top-96) have recently been identified as crucial to dryland restoration in Ethiopia (Mokria *et al.* 2016; see also BBC Earth 2017 and ICRAF 2016).

From the above comparisons with other priority setting exercises, the importance of several of the top-96 species can be confirmed. Species not captured in the top-96 typically occurred in the long list. As the availability of presence location data is expected to be one of the main constraints to species distribution modelling and mapping (Boakes *et al.* 2010; Feeley and Silman 2011; Duputié *et al.* 2014; Kindt 2018), it probably was good practice to have selected an extra 90 species above the target of 150 species (see also Sections 6-8). Therefore, the main exercise that would remain is to check with Ethiopian researchers whether some important species have been omitted from the list of 240 candidate species. As the only seed lists that were considered in the compilation of the master list were those of the Addis Ababa and Amhara seed centres, it may also prove useful to cross-check seed lists from other tree seed centres against the top-96 and long lists.

5. Definition of criteria to identify up to 25 species to be included in the breeding programmes

When excluding two priority species identified as priorities for removal, the Ethiopian country report for the *State of the World's Forest Genetic Resources* (SoW-FGR, Institute of Biodiversity Conservation 2012) lists 25 priority tree species for Ethiopia, *i.e.* the same number of species to be identified through the consultancy. In response to the updated top-25 (from the top-24 of the PATSPO project document), Lars Graudal (email of 21st November 2017) agreed with the list but also mentioned that demand and supply data should be considered. Probably for similar reasons of selecting highly-demanded species (and ideally also species with high future demands), the BPCT seems to have departed from the top-24 of the PATSPO project document to a top-20 consisting of the 10 most demanded indigenous and 10 most demanded exotic species (these are listed in Table 4.1).

The BPCT has created a set of scores to prioritize species (Box 1). These criteria include criteria listed in Chapter 7 of the PATSPO project document:

(i) Survey of planting areas and value production in planting programmes,
(ii) Market survey of forest products consumption, and
(iii) User preference measurements.

Box 1. Criteria identified by the BPCT for selection of species for the PATSPO breeding programme.

1. Overall demand for seed
2. Farmers preference and economic benefits
3. Existence of seed value chain
4. Multipurpose species with weight on its suitability for agroforestry systems
5. High biomass production to provide values for local farmers through fodder, fruit production, fast and valuable timber production
6. Flowering and seed production at young ages to achieve a fast seed production and short breeding generations
7. Species with high value in restoration of degraded land
   a. High tolerance/resistance to drought and competition from weed and grass
   b. Create the right microclimate and soil conditions for regeneration of other species
   c. Soil improvement capacity
8. Tolerance/resistance to pests and diseases
9. Existence of enough genetic diversity and especially genetic variation at provenance- or individual-tree level

My recommendation would be to apply the criteria to the top-96 rather than the top-25 or top-20. Another recommendation could be to use a weighted scoring approach where national restoration targets (expected area to be restored) and economic benefits (long-term returns on investment; this was the main objective in ICRAF's priority setting for accelerated domestication) are given higher weights – one reason for higher weights is that an ideal species mixture does not necessarily require highly multipurpose species. Ideally the final selection of species would be done in close collaboration with national partners.

The first BPCT criterion (and the additional criterion given by Lars Graudal) reflects the current farmer demand for exotic and indigenous tree species. Six indigenous species occurred both on the top-25 and top-20: *Acacia senegal*, *Afrocarpus falcatus*, *Cordia africana*, *Faidherbia albida*, *Hagenia abyssinica* and *Juniperus procera*. If the main criterion was to select a subset of top-25 species based on the expected current demand for indigenous tree species, then these would be six candidate species for the breeding programme.

Only three exotic species occurred both on the top-25 and top-20: *Eucalyptus camaldulensis*, *Eucalyptus globulus* and *Grevillea robusta*. The small overlap can principally be explained by the fact that only four exotic species were included in the top-25, including the three Australian species mentioned in the previous sentence and *Cupressus lusitanica*. With an estimated number of seedlings planted of close to 44 million (Appendix IV), *Cupressus lusitanica* was the fourth most demanded exotic species and could join the three other exotic species to result in 10 priority species for breeding (equalling the original objective for the BPCT). Another choice, however, could be *Casuarina equisetifolia* (not top-25, but top-20) that is the second most demanded exotic species with close to an estimated 121 million seedlings planted (*Eucalyptus camaldulensis* tops the list with over 450 million seedlings and *Eucalyptus globulus* is third with over 50 million seedlings; *Grevillea robusta* only comes 21st with close to 330,000 seedlings).

Although using the consensus of top-25 and top-20 lists would probably not correspond to the scores that would be obtained with a carefully selected set of criteria, the consensus list of nine species did include the two species that were finally selected by the BPCT, *Cordia africana* and *Grevillea robusta*.

For the establishment of breeding seed orchards, the BPCT implicitly identified an additional criterion for the prioritization of species for the breeding programme: the species needs to be suitable to the planting sites available to PATSPO. The BPCT decided to focus on highland species or species from the Rift Valley. The principle reason to select these species was that breeding seed orchards need to be established close to research stations (figures 5.1 and 5.2).

All seed centres except Hawasa are in the potential natural vegetation (PNV) mosaic of "Complex of Afromontane undifferentiated forest (Fb) with wooded grasslands (wd) and evergreen or semi-evergreen bushland and thicket (Be) at lower margins". Hawasa is in the PNV of Upland *Acacia* wooded grassland (We).

What is interesting is that the locations of several seed centres are within ecological transects from *Combretum-Terminalia* wooded grassland to Dry Evergreen Forest. When the basic scientific objective is to test differences between vegetation types (proxies for planting zones), it is good to include species that have natural populations in adjacent vegetation types such as the *Combretum-Terminalia* wooded grassland.

Figure 5.1. Location of PATSPO seed centres on the vegetationmap4africa. Image created from Google Earth (23rd November 2017). Codes for vegetation types are given in the main text.

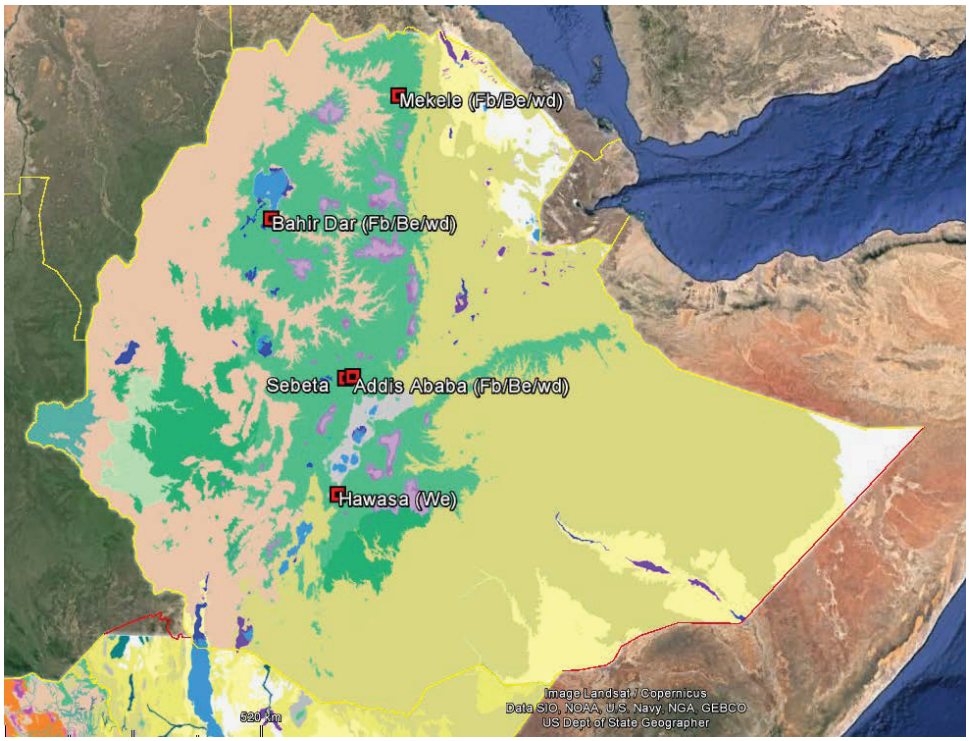


Figure 5.2. Locations of two PATSPO seed centres on the vegetationmap4africa. Image created from Google Earth (23rd November 2017). Codes for vegetation types are given in the main text. The salmon-coloured vegetation type directly east of Bahir Dar is Dry *Combretum* woodland.

Table 5.1. Characteristics of the five seed centres targeted by PATSPO. Latitude, longitude and altitude obtained from the BPCT. PNV: Potential Natural Vegetation inferred from the vegetationmap4africa (Figure 5.1; full names in main text). Other variables are bioclimatic variables obtained from AFRICLIM (Platts *et al.* 2014; 150 arc-seconds resolution; downloaded September 2015): abbreviations in table footnote, temperatures in degrees C, rainfall in mm.

Variable	Addis Ababa	Bahir Dar	Hawasa	Mekele	Sebeta
Latitude	8.9419	11.4938	7.0504	13.4815	8.9154
Longitude	38.7528	37.3472	38.4955	39.4640	38.6316
Altitude	2200	1890	1700	2100	2200
PNV	Fb-Be-wd	Fb-Be-wd	We	Fb-Be-wd	Fb-Be-wd
Bio1	17.5	18.9	19.1	18.0	16.7
Bio2	14.7	14.6	14.7	15.0	14.4
Bio3	74.9	69.9	75.3	72.0	74.2
Bio4	1.0	1.3	0.7	1.5	1.0
Bio5	27.2	28.9	28.7	28.0	26.2
Bio6	7.5	8.0	9.2	7.1	6.8
Bio7	19.7	20.9	19.5	20.9	19.4
Bio10	19.1	20.8	20.2	19.9	18.3
Bio11	16.5	17.5	18.5	16.0	15.6
Bio12	1067	1398	1024	595	1115
Bio13	255	419	141	205	261
Bio14	7	4	19	3	8
Bio15	83	143	43	68	84
Bio16	644	1015	410	438	661
Bio17	30	16	83	12	33
PET	1631	1686	1725	1656	1580
MI	65	83	59	35	71
MIaq	8	4	19	3	9
MImq	178	263	106	108	188
DM	6	7	5	10	6
LLDS	6	7	5	10	6

Bio1: mean annual temperature; **Bio2**: mean diurnal range; **Bio3**: isothermality; **Bio4**: temperature seasonality (standard deviation of monthly values); **Bio5**: maximum temperature of the warmest month; **Bio6**: minimum temperature of the coldest month; **Bio7**: annual temperature range; **Bio10**: mean temperature of the warmest quarter; **Bio11**: mean temperature of the coolest quarter; **Bio12**: mean annual rainfall; **Bio13**: rainfall of the wettest month; **Bio14**: rainfall of the driest month; **Bio15**: rainfall seasonality (standard deviation of monthly values); **Bio16**: rainfall of the wettest quarter; **Bio17**: rainfall of the driest quarter; **PET**: potential evapotranspiration; **MI**: moisture index; **MIaq**: moisture index of the most arid quarter; **MImq**: moisture index of the most moist quarter; **DM**: number of dry months; **LLDS**: length (months) of the longest dry season

Other descriptors (mainly for bioclimatic variables) of seed centres are given in Table 5.1. Mekele stands out as much drier (such as the number of dry months) than other locations in the Fb-Be-wd mosaic. As such, it provides an ideal location to check for accuracies of the vegetationmap4africa and AFRICLIM (Platts *et al.* 2014).

Table 5.2. Association of indigenous candidate species for breeding with vegetation types. T-25: top 25 species identified in the SoW-FGR; T-20: top 20 species identified by the BPC. Suitable vegetation types: Fb: Afromontane undifferentiated forest; Be: Evergreen and semi-evergreen bushland and thicket; We: Upland *Acacia* wooded grassland. Marginally suitable vegetation types: Wcd: Dry *Combretum* wooded grassland; Fa: Afromontane rain forest; Fe: Afromontane moist transitional forest. Not suitable vegetation types: Bd: Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket; S: Somalia-Masai semi-desert grassland and shrubland. Species are sorted first by suitable then marginally suitable vegetation types.

	Species	T-25	T-20	Fb	Be	We	Wcd	Fa	Fe	Bd	S
1	Acacia abyssinica		x	x				x	x		
2	Acacia nilotica		x		x		x			x	x
3	Acacia polyacantha				x	x	x				
4	Acacia senegal	x	x		x	x	x			x	x
5	Acacia seyal				x	x	x			x	x
6	Acacia tortilis		x			x	x			x	x
7	Afrocarpus falcatus	x	x	x				x			
8	Albizia gummifera			x				x	x		
9	Balanites aegyptiaca				x		x			x	x
10	Catha edulis	x		x	x		x	x	x		
11	Celtis africana			x				x	x		
12	Combretum molle				x	x	x				
13	Commiphora africana				x		x			x	x
14	Cordia africana	x	x	x		x	x	x	x		
15	Croton macrostachyus			x	x		x	x	x		
16	Dodonaea viscosa			x	x	x	x	x			
17	Dovyalis abyssinica			x	x			x	x		
18	Ekebergia capensis			x			x	x	x		
19	Entada abyssinica					x	x				
20	Erythrina abyssinica			x	x	x	x				
21	Erythrina brucei			x							
22	Faidherbia albida	x	x			x				x	
23	Ficus sur			x				x	x		
24	Hagenia abyssinica	x	x	x				x	x		
25	Juniperus procera	x	x	x	x						
26	Olea europaea		x	x	x			x			
27	Phoenix reclinata			x				x	x		
28	Prunus africana	x		x				x	x		
29	Pterolobium stellatum			x	x	x	x	x	x		
30	Rhamnus prinoides	x		x				x	x		
31	Schefflera abyssinica			x				x	x		
32	Terminalia brownii				x	x	x			x	
33	Yushania alpina	x		x				x			
34	Adansonia digitata	x					x			x	
35	Albizia grandibracteata							x	x		
36	Albizia schimperiana							x	x		
37	Bauhinia thonningii						x				
38	Boswellia papyrifera	x					x				
39	Ficus sycomorus						x				
40	Oxytenanthera abyssinica	x					x				
41	Pouteria adolfi-friedericii	x						x	x		
42	Tamarindus indica	x					x				x
43	Vitellaria paradoxa	x					x				
44	Warburgia ugandensis						x		x		
45	Ziziphus jujuba	x					x			x	

	Species	T-25	T-20	Fb	Be	We	Wcd	Fa	Fe	Bd	S
46	Boswellia microphylla									x	
47	Boswellia neglecta									x	
48	Boswellia rivae									x	x
49	Commiphora guidottii										x
50	Commiphora myrrha	x								x	x
51	Cordeauxia edulis	x									x
52	Sesbania sesban										x
53	Ziziphus spina-christi									x	x
54	Boswellia ogadensis										
55	Boswellia pirottae										
56	Coffea arabica	x									
57	Maerua aethiopica										
58	Millettia ferruginea										
59	Moringa stenopetala	x									
60	Spathodea campanulata										

In addition to the criteria for selecting breeding plant species for Ethiopia, tables 5.2 and 5.3 can be used to filter species suitable to PATSPO planting sites. For indigenous tree species, suitability is inferred by matching vegetation types of the vegetationmap4africa. For exotic tree species, suitability is inferred from Ecocrop with data on annual temperatures and precipitation as in Table 5.1. However, see section 8 on a note on the reliability of the Ecocrop approach.

Table 5.3. Planting sites suitability (inferred from Ecocrop) of exotic candidate species for breeding. T-25: top 25 species identified in the SoW-FGR; T-20: top 20 species identified by the BPC team. Temperature suitability: t- < absolute minimum < ti < optimal minimum < T < optimal maximum < ta < absolute maximum < t+. Precipitation suitability: p- < absolute minimum < pi < optimal minimum < P < optimal maximum < pa < absolute maximum < p+. Species within the optimal ranges for all seed centres are in **bold** typeface. Note that SDM is expected to provide more robust estimates of site suitability (see section 8).

	Species	T-25	T-20	Addis Ababa	Bahir Dar	Hawasa	Mekele	Sebeta
1	**Acacia decurrens**		x	T P	T P	T P	T P	T P
2	Acacia melanoxylon			ti P	T P	T P	T P	T P
3	Acacia saligna		x	ti p+	ti p+	ti p+	ti p+	ti p+
4	Albizia lebbeck			ti P	ti P	ti P	ti P	ti P
5	Azadirachta indica			ti P	ti pa	ti pa	ti P	ti P
6	Cajanus cajan			ti P	T P	T P	T P	T P
7	Calliandra calothyrsus			t- pi	ti pi	ti pi	ti pi	ti pi
8	Callistemon citrinus			-	-	-	-	-
9	Carica papaya			ti pi	ti pi	ti pi	ti pi	ti pi
10	Casuarina cunninghamiana			ti P	ti P	ti P	ti P	ti P
11	Casuarina equisetifolia		x	ti P	ti P	ti P	ti P	ti P
12	Citrus sinensis			ti pi	ti P	ti P	ti pi	ti pi
13	Corymbia citriodora		x	ti P	ti P	ti P	ti P	ti P
14	Cupressus lusitanica	x		ti pi	ti pi	ti pi	ti pi	ti pi
15	Cupressus sempervirens			-	-	-	-	-
16	Cytisus proliferus			ti p+	T p+	T p+	T p+	T p+
17	Delonix regia			ti P	ti P	ti P	ti P	ti P
18	Dovyalis caffra			ti P	ti p+	ti p+	ti P	ti P
19	Eucalyptus camaldulensis	x	x	ti P	ti pa	ti pa	ti P	ti P
20	Eucalyptus globulus	x	x	ti P	T P	T P	T P	T P
21	Eucalyptus grandis		x	ti P	ti P	ti P	ti P	ti P
22	**Eucalyptus saligna**		x	T P	T P	T P	T P	T P
23	Eucalyptus viminalis			ti P	T P	T P	T P	T P
24	**Ficus carica**			T P	T P	T P	T P	T P
25	**Grevillea robusta**	x	x	T P	T P	T P	T P	T P
26	Jacaranda mimosifolia		x	ti P	ti P	ti P	ti P	ti P
27	**Jatropha curcas**			T P	T P	T P	T P	T P
28	Leucaena leucocephala			ti P	ti P	ti P	ti P	ti P
29	**Malus domestica**			T P	T P	T P	T P	T P
30	Mangifera indica			ti P	ti P	ti P	ti P	ti P
31	Melia azedarach			ti pa	T p+	T p+	T pa	T pa
32	Parkinsonia aculeata			ti p+	ti p+	ti p+	ti p+	ti p+
33	**Persea americana**			T P	T P	T P	T P	T P
34	Pinus patula			ti P	T P	T P	T P	T P
35	Schinus molle			ti p+	ti p+	ti p+	ti p+	ti p+
36	Sesbania bispinosa			ti P	T pa	T pa	T P	T P

6. Prepare guidelines for species distribution modelling for indigenous tree species (including candidate species for breeding)

Species distribution modelling (SDM) and subsequent habitat distribution mapping (HDM) in baseline and future climates can be achieved with the BiodiversityR software, using similar scripts for ensemble suitability modelling as described recently (Kindt 2018; see also De Sousa *et al.* 2017 or Gaisberger *et al.* 2017 for recent applications). Among the options available from *BiodiversityR*, it is recommended to use the Variance Inflation Factor method to select a subset of less-correlated environmental data layers, to calculate the ensemble suitability from *probit*-transformed algorithm-specific suitability values, to repeat the calibration procedure at least five times, to use a absence-presence threshold that maximizes the sum of sensitivity and specificity and also to provide *count suitability maps* (maps that show how many algorithms predict species presence; for this reason, it is further recommended to infer suitability from at least 10 algorithms).

Openly-available presence location data sets can be obtained from the Global Biodiversity Information Facility and from the RAINBIO mega-database (Dauby *et al.* 2016; the geographic focus of RAINBIO is the region south of the Sahel and north of Southern Africa, with the majority of data from tropical forest regions but also Ethiopia well represented [see Section 8]). It is recommended to calibrate SDM with presence location data that represent the range of each species, especially for HDM of future climates. However, to avoid that the environmental niche is not fully represented especially for Ethiopia, it is also recommended to supplement openly-available presence location data sets with data gathered in Ethiopia. One possibility are the location records available from passport data of accessions held by the Ethiopian Biodiversity Institute (ideally expanded with information from field genebanks) – a request for point locations has been forwarded by the Ethiopian PATSPO team. Other possibilities are location records from botanical expeditions (see Section 8) or from (previous) collections from Ethiopian tree seed centres (*e.g.* as records available from the Oromia regional tree seed centre).

Although the accuracy of location data has been checked in the RAINBIO mega-database, it is recommended to check for possible errors (such as locations that are not in the expected country, locations in the ocean or locations that correspond to the institute where herbarium specimens are kept rather than the collection site location) and exclude these records with software such as the *Biogeo* (Robertson *et al.* 2016) or *CoordinateCleaner* (Zizka and Silvestro 2017) packages.

Even after cleaning location data, it is likely that unknown biases will remain in the data (Fithian *et al.* 2015). Methods of environmental filtering (using the *dismo::gridSample* *R* function) that reduce bias and improve accuracy of SDM are described in Varela *et al.* 2014. Prior to SDM and possible environmental filtering with an added objective of reducing spatial autocorrelation of the data, it is further recommended to subject presence location data to spatial thinning as available from the *spThin* (Aiello-Lammens *et al.* 2015) or *red* (Cardoso 2017) packages (the randomized spatial thinning process needs to be repeated several times in attempts of maximizing the number of retained records).

With the objective to project HDM to future climates, the recommended source of bioclimatic layers is AFRICLIM (Platts *et al.* 2014) as future geospatial data are also inferred from regional climate models, whereas other data sets such as WorldClim or Climond do not use regional models. AFRICLIM further provide a wider set of bioclimatic variables than available from WorldClim, although the *envirem* package (Title and Bemmels 2017) can also generate a wider set of bioclimatic variables from WorldClim. A decision will need to be made whether the objective of SDM is to infer the bioclimatic niche of species, or whether a wider set of environmental variables should be considered. If soil gridded data would be used, the SoilGrids250m data set (Hengl *et al.* 2015) could be considered, but precision of presence location data in respect to soil properties will need to be evaluated

(bioclimatic data seem less problematic with respect to local variation). Probably interesting are the topographic wetness and terrain roughness indices available from ENVIREM (Title and Bemmels 2017) (it is a safe assumption that these elevation-derived topographic indices will not be significantly different in the mid-21st century that is the target of climate change modelling). When interpreting future HDM, it will be good practice to discuss transferability of SDM in space and time (*e.g.,* Werkowska *et al.* 2016).

Once HDM have been produced, clustering or related methods could be used to identify seed zones within areas mapped as suitable for a particular species, but such methods will need to be explored more fully once HDM exercises have been completed (one method is based on the Mahalanobis distance and available via the *R* functions of *BiodiversityR::ensemble.centroids* and *BiodiversityR::ensemble.zones*; among genecological references to be consulted in a literature review are Hamann *et al.* 2011; Breed *et al.* 2013; Butterfield et al. 2016; Espeland *et al.* 2016; Nevill *et al.* 2016; Bucharova *et al.* 2017; Derero *et al.* 2017; O'Neill *et al.* 2017 and Ramalho *et al.* 2017).

SDM would ideally be done as a multiple-stage process whereby distribution maps prepared in a previous stage are validated in a next stage. Validation can be done with different plausible HDM through a consensus algorithm based on expert opinions (*e.g.*, van Zonneveld *et al.* 2013 or Gaisberger *et al.* 2017). In the most ideal case, methods of expert validation or field checking could be incorporated in online HDM that are part of the decision-support tools to be developed within PATSPO. Where repeat HDM exercises would be conducted with updated presence data sets (or even updated bioclimatic layers), the same *R* scripts could be used at regular intervals to generate suitability layers that are used in a data portal.

If not used as calibration data, information from ecological surveys could also be used to verify the accuracy of HDM. One recent study that collated information on species assemblages from different montane forest surveys across Ethiopia is available from Young *et al.* 2017 (see also Figure 6.1 and section 16). Information from a comprehensive review of species composition of 'church forests' located in central and northern Ethiopia is available from Aerts *et al.* 2016. Of similar utility would be data from previous on-farm (*e.g.,* Endale *et al.* 2017) and nursery (*e.g.,* Dedefo *et al.* 2016) surveys conducted within Ethiopia. New data from surveys conducted within PATSPO could also prove valuable, especially if these were conducted in areas previously not explored or documented.

Figure 6.1. Distribution of montane forest reserves with studies on species assemblages. The list of references is available in Appendix VI. Source: Young *et al.* 2017

7. Prepare guidelines for species distribution modelling for exotic tree species (including candidate species for breeding)

For exotic species, similar SDM calibration approaches can be used as those for indigenous species that were documented in the previous section. However, it can be expected that presence locations from within Africa will not fully represent the environmental niche of an exotic species. Hence presence locations may need to be sourced globally or from an area that represents tropical and subtropical regions. The most likely source for these data is the Global Biodiversity Information Facility.

For 12 important (top-96) Australian species that had Australasia as the only native continent in GRIN-GLOBAL (*Acacia decurrens, Acacia melanoxylon, Acacia saligna, Callistemon citrinus, Casuarina cunninghamiana, Corymbia* (synonym: *Eucalyptus*) *citriodora, Eucalyptus camaldulensis, Eucalyptus globulus, Eucalyptus grandis, Eucalyptus saligna, Eucalyptus viminalis* and *Grevillea robusta*), an additional source for presence locations to combine with GBIF data would be the Atlas of Living Australia (possibly obtained via the Biodiversity and Climate Change Virtual Lab; http://www.bccvl.org.au/data-portal/).

With bioclimatic data required for location data outside of Africa, AFRICLIM (Platts *et al.* 2014) cannot be used. Hence bioclimatic data could be sourced from the second version of WorldClim (Fick *et al.* 2017) and possibly expanded with the *envirem* package (Title and Bemmels 2017). Generation of future suitability maps may require release of future data sets for WorldClim. It is possible that a comprehensive bioclimatic data set will not be needed for calibration of SDM (this is a hypothesis that could be tested). Using three *Eucalyptus* species as examples, Booth (2016) recommended using the three bioclimatic variables of the moisture index (the ratio of mean annual actual evapotranspiration to the mean annual potential evapotranspiration), the mean minimum temperature of the coldest period (week or month) and the growing degree days (the number of days more than 5 degrees C) to maps their future climatic ranges. To estimate suitability outside the native range of Australian species, Booth (2015) considered information from introductions and botanic gardens, albeit that management interventions such as irrigation may need to be considered to only include point locations where the species is suitable under ambient bioclimatic conditions.

Possibly mainly as an exercise to investigate data quality, the modelling framework of FAO's Ecocrop based on temperature and rainfall limits could also be applied for exotics. The Ecocrop approach is not expected to be as reliable as more sophisticated approaches of SDM such as machine-learning or ensemble approaches (*e.g.*, Elith *et al.* 2006; Wisz *et al.* 2008) and a wider set of bioclimatic variables (*e.g.*, Booth *et al.* 2014) may be essential to calibrate reliable SDM. As indication of Ecocrop's limitations, for example, is the observation that Addis Ababa is more suitable for *Eucalytpus globulus* than the other tree seed centre locations listed in Table 5.3. (Søren Moestrup, pers. comm.). In the case of this species, the mean annual temperature of Addis Ababa of 17.5 degrees C was below the lower optimal limit of 18.

8. Review species with respect to available information

With environmental data such as AFRICLIM (Platts *et al.* 2014) being available as open-source data sets, the major hurdle for reliable SDM is the availability of reliable presence point locations. Although record density is high in Ethiopia for the RAINBIO mega-database (Dauby *et al.* 2016; Figure 8.1), a considerable number of priority species do not have sufficient point locations for reliable SDM (30 records as defined by Wisz *et al.* 2008 or 100 geographically and climatically filtered data as defined by Varela *et al.* 2014; Table 8.1). Even for the lower limits of 14 for narrow-ranged and 25 for widespread species identified by van Proosdij *et al.* (2015), insufficient presence locations are available for many species. Several species do not have presence locations available in RAINBIO.

It is recommended, therefore, to supplement the openly available species data with data available from surveys in Ethiopia, such as the surveys conducted by Ib Friis and collaborators (Figure 8.2).

Figure 8.1. Record density (2 arc-degree grid) of records in the RAINBIO mega-database (Dauby *et al.* 2016).

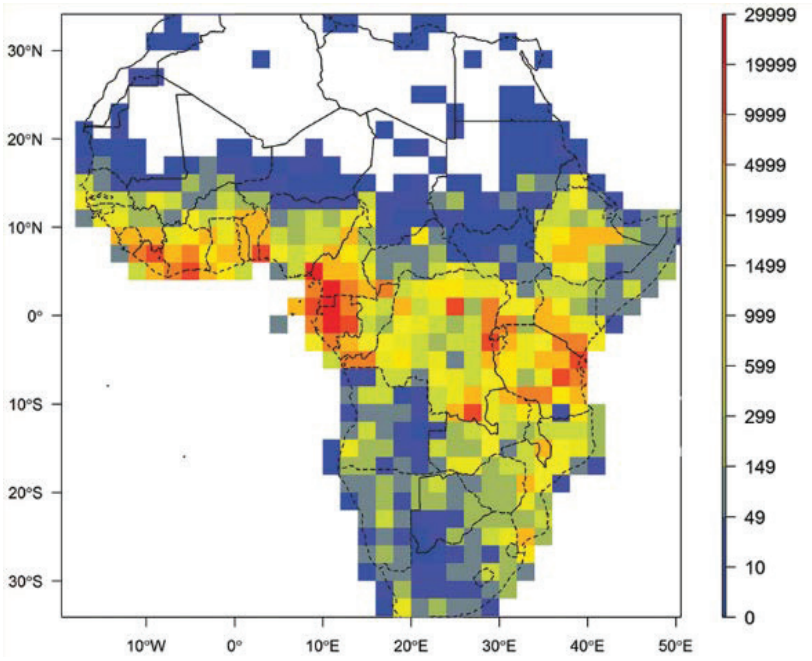
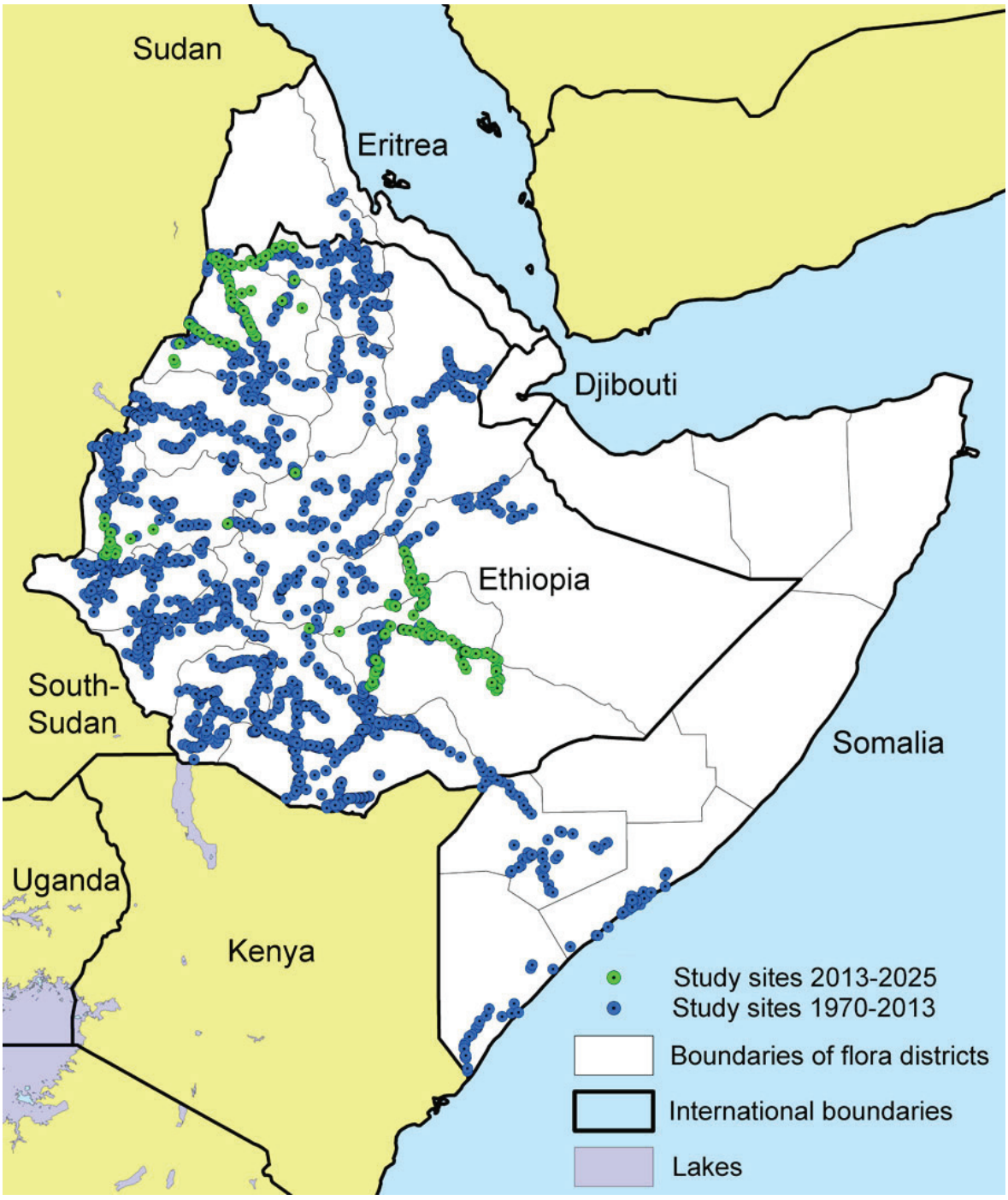


Table 8.2. Number of RAINBIO records for the long list of species.

Number of records	all	top 25	top 20	top 96
< 1	60	5	10	38
1-29	37	5	1	14
> 29	143	15	9	43
30-99	62	10	5	19
> 99	81	5	4	24

Figure 8.2. Location of botanical fieldwork involving Ib Friis (Carlsberg Foundation 2017). Image copied from web page.



9. Visits

Most of the visit to Ethiopia (18 – 26 November 2017) was spent on the ILRI campus. As an office was shared with the consultancy teams for the breeding plans and for the base line survey of seed demand and supply and the tree seed sector analysis, this offered ample time for discussions and information exchange.

In the morning of 20th November and together with the BPCT, the CE-EFRC (EEFRI) tree seed centre next to campus was visited and discussions held with Kedra Mohammed (CE-EFRC tree seed centre manager, kedramohammed@gmail.com).

Professor of Plant Systematics & Biodiversity Sebsebe Demissew (sebsebe.demissew@aau.edu.et; sebseb.demissew@gmail.com) was visited on the campus of the College of Natural Sciences on Friday 24th November to discuss collaboration and data exchange for SDM (he is a collaborator in the vegetationmap4africa).

10. Acknowledgments

This report benefited much from interactions with the Ethiopia-based PATSPO team (especially Søren Moestrup, Niguse Hagazi and Kiros Hadgu), the consultancy teams for the breeding plans (Jon Kehlet Hansen, Abayneh Derero and Hendre Prasad) and for the base line survey of seed demand and supply and the tree seed sector analysis (Jens-Peter B. Lillesø, Sammy Carsan, Abayneh Derero). Roeland is grateful for the interactions and information received from Kedra Mohammed of Ethiopian National Tree Seed Centre (EEFRI). The quick response from Nicholas Young, Bruno Verbist and Raf Aerts on species assemblage data sets from Ethiopia was great to receive. Administrative support from Mekdes Sime, Sallyannie Muhoro and Nellie Mutio was also greatly appreciated.

11. Appendix I. Master species list

Top 25: species identified as priority tree species by the Ethiopian report for the SoW-FGR; Top 96: species identified as candidate species for breeding; Long list: species identified as candidate species for species distribution modelling; Ethiopia useful trees: species listed in the Useful Trees and Shrubs for Ethiopia; SOWFGR and price list: species listed in the SOW-FGR report or seed lists; Ethiopia V4A: species listed in the vegetationmap4africa to be part of Ethiopian species assemblages. Species synonyms are provided in Appendix III.

	Species	Top 25	Top 96	Long list	Ethiopia useful trees	SOWFRR and price list	Ethiopia V4A
1	Acacia abyssinica		x	x	x	x	x
2	Acacia asak			x	x		x
3	Acacia brevispica			x	x		x
4	Acacia bricchettiana					x	
5	Acacia bussei			x	x		x
6	Acacia decurrens		x	x	x	x	
7	Acacia dolichocephala					x	
8	Acacia drepanolobium					x	x
9	Acacia edgeworthii						x
10	Acacia ehrenbergiana						x
11	Acacia etbaica					x	x
12	Acacia gerrardii						x
13	Acacia hockii					x	x
14	Acacia horrida						x
15	Acacia lahai			x	x	x	x
16	Acacia mearnsii			x	x	x	
17	Acacia melanoxylon		x	x	x	x	
18	Acacia mellifera						x
19	Acacia negrii					x	
20	Acacia nilotica		x	x	x	x	x
21	Acacia oerfota			x	x	x	x
22	Acacia paolii						x
23	Acacia persiciflora					x	
24	Acacia polyacantha		x	x	x	x	x
25	Acacia prasinata					x	
26	Acacia pseudonigrescens					x	
27	Acacia reficiens						x
28	Acacia robusta						x
29	Acacia saligna		x	x	x	x	
30	Acacia senegal	x	x	x	x	x	x
31	Acacia seyal		x	x	x	x	x
32	Acacia sieberiana			x	x	x	x
33	Acacia tortilis		x	x	x	x	x
34	Acacia venosa					x	
35	Acacia zanzibarica						x
36	Acalypha acrogyna					x	
37	Acalypha marissima					x	
38	Acanthopale pubescens					x	
39	Acanthus sennii					x	
40	Acokanthera schimperi			x	x		x
41	Adansonia digitata	x	x	x	x	x	x
42	Adenia globosa						x
43	Adenium obesum						x
44	Adenocarpus mannii						x
45	Aeschynomene abyssinica					x	x
46	Aeschynomene cristata						x
47	Aeschynomene elaphroxylon						x

	Species	Top 25	Top 96	Long list	Ethiopia useful trees	SOWFRR and price list	Ethiopia V4A
48	Aeschynomene pfundii						x
49	Aeschynomene schimperi					x	x
50	Aeschynomene sensitiva					x	
51	Afrocanthium lactescens						x
52	Afrocarpus falcatus	x	x	x	x	x	x
53	Agarista salicifolia						x
54	Albizia amara						x
55	Albizia anthelmintica						x
56	Albizia coriaria						x
57	Albizia grandibracteata		x	x	x	x	x
58	Albizia gummifera		x	x	x	x	x
59	Albizia lebbeck		x	x	x	x	
60	Albizia malacophylla			x	x	x	x
61	Albizia schimperiana		x	x	x	x	x
62	Alchornea laxiflora					x	
63	Allophylus abyssinicus			x	x	x	x
64	Allophylus africanus						x
65	Allophylus ferrugineus					x	
66	Allophylus rubifolius						x
67	Aloe rigens						x
68	Aloe vera				x		
69	Alstonia boonei						x
70	Annona muricata				x	x	
71	Annona reticulata			x		x	
72	Annona senegalensis			x	x		x
73	Anogeissus leiocarpa			x	x	x	x
74	Anthocleista schweinfurthii						x
75	Antiaris toxicaria			x	x	x	x
76	Antidesma venosum						x
77	Apodytes dimidiata			x	x	x	x
78	Argyrolobium schimperianum					x	
79	Aristida adscensionis						x
80	Arundo donax				x		
81	Aspilia mossambicensis						x
82	Azadirachta indica		x	x	x	x	
83	Baccharoides filigera					x	
84	Balanites aegyptiaca		x	x	x	x	x
85	Balanites glabra						x
86	Balanites pedicellaris						x
87	Balanites rotundifolia						x
88	Bambusa balcooa					x	
89	Bambusa distegia					x	
90	Bambusa tulda					x	
91	Bambusa vulgaris					x	
92	Baphia abyssinica			x	x	x	x
93	Barleria longissima					x	
94	Bauhinia thonningii		x	x	x	x	x
95	Berberis holstii			x	x		x
96	Berchemia discolor			x	x		x
97	Bersama abyssinica			x	x	x	x
98	Blepharis cuspidata					x	
99	Blepharis linariifolia						x
100	Blepharispermum obovatum					x	
101	Blighia unijugata			x	x	x	x
102	Borassus aethiopum			x	x		x
103	Boscia angustifolia						x
104	Boscia coriacea						x

	Species	Top 25	Top 96	Long list	Ethiopia useful trees	SOWFRR and price list	Ethiopia V4A
105	Boscia salicifolia						x
106	Boswellia microphylla		x	x		x	x
107	Boswellia neglecta		x	x		x	x
108	Boswellia ogadensis		x	x		x	
109	Boswellia papyrifera	x	x	x	x	x	x
110	Boswellia pirottae		x	x		x	
111	Boswellia rivae		x	x	x	x	x
112	Breonadia salicina			x	x		x
113	Bridelia micrantha			x	x	x	x
114	Bridelia scleroneura						x
115	Brucea antidysenterica					x	
116	Buddleja polystachya			x	x	x	x
117	Byttneria catalpifolia					x	
118	Cadaba divaricata					x	
119	Cadaba farinosa						x
120	Cadaba glandulosa						x
121	Cadaba linearifolia						x
122	Cadaba mirabilis						x
123	Cadaba rotundifolia						x
124	Caesalpinia decapetala				x		x
125	Caesalpinia trothae						x
126	Cajanus cajan		x	x	x	x	
127	Calliandra calothyrsus		x	x		x	
128	Callistemon citrinus		x	x		x	
129	Calotropis procera			x	x		x
130	Calpurnia aurea					x	
131	Calyptrotheca somalensis						x
132	Canarium schweinfurtii						x
133	Canthium oligocarpum					x	
134	Capparis cartilaginea						x
135	Capparis decidua						x
136	Capparis erythrocarpos					x	
137	Capparis fascicularis						x
138	Capparis tomentosa			x	x	x	x
139	Carica papaya		x	x		x	
140	Carissa spinarum			x	x	x	x
141	Casimiroa edulis			x	x		
142	Cassine buchananii					x	x
143	Cassipourea malosana					x	x
144	Cassipourea ruwensorensis						x
145	Casuarina cunninghamiana		x	x	x	x	
146	Casuarina equisetifolia		x	x	x	x	
147	Catha edulis	x	x	x	x	x	x
148	Caucanthus albidus						x
149	Ceiba pentandra			x	x		x
150	Celtis africana		x	x	x	x	x
151	Celtis gomphophylla					x	x
152	Celtis philippensis					x	
153	Celtis toka			x	x		x
154	Celtis zenkeri					x	
155	Chasmanthera dependens						x
156	Cissampelos mucronata						x
157	Cissus rotundifolia						x
158	Citrus aurantiifolia				x	x	
159	Citrus medica				x		
160	Citrus paradisi					x	
161	Citrus reticulata				x	x	

	Species	Top 25	Top 96	Long list	Ethiopia useful trees	SOWFRR and price list	Ethiopia V4A
162	Citrus sinensis		x	x	x	x	
163	Cladostigma nigistiae					x	
164	Clausena anisata						x
165	Clematis simensis						x
166	Cocculus hirsutus						x
167	Coffea arabica	x	x	x		x	
168	Combretum aculeatum			x	x		x
169	Combretum adenogonium						x
170	Combretum collinum			x	x		x
171	Combretum hartmannianum					x	x
172	Combretum molle		x	x	x	x	x
173	Commiphora africana		x	x	x	x	x
174	Commiphora campestris						x
175	Commiphora edulis						x
176	Commiphora erlangeriana						x
177	Commiphora erythraea			x	x		x
178	Commiphora gileadensis						x
179	Commiphora guidottii		x	x		x	x
180	Commiphora habessinica			x	x		x
181	Commiphora incisa						x
182	Commiphora kua						x
183	Commiphora monoica					x	
184	Commiphora myrrha	x	x	x		x	x
185	Commiphora rostrata						x
186	Commiphora samharensis						x
187	Commiphora schimperi						x
188	Commiphora sphaerocarpa						x
189	Coptosperma graveolens						x
190	Cordeauxia edulis	x	x	x	x	x	x
191	Cordia africana	x	x	x	x	x	x
192	Cordia monoica						x
193	Cordia sinensis						x
194	Cordia suckertii						x
195	Corymbia citriodora		x	x	x	x	
196	Corymbia maculata			x		x	
197	Craterispermum laurinum						x
198	Crateva adansonii						x
199	Crossopteryx febrifuga					x	x
200	Crotalaria agatiflora					x	x
201	Crotalaria exaltata					x	
202	Crotalaria intonsa					x	
203	Crotalaria rosenii					x	
204	Crotalaria sacculata					x	
205	Croton dichogamus						x
206	Croton macrostachyus		x	x	x	x	x
207	Croton sylvaticus						x
208	Cupressus lusitanica	x	x	x	x	x	
209	Cupressus sempervirens		x	x		x	
210	Cupressus torulosa			x		x	
211	Cussonia arborea						x
212	Cussonia holstii						x
213	Cussonia ostinii					x	
214	Cyathea dregei						x
215	Cyathea manniana			x	x	x	x
216	Cynanchum gerrardii						x
217	Cynanchum hastifolium						x
218	Cynanchum viminale						x

	Species	Top 25	Top 96	Long list	Ethiopia useful trees	SOWFRR and price list	Ethiopia V4A
219	Cytisus proliferus		x	x	x	x	
220	Dalbergia lactea					x	
221	Dalbergia melanoxylon			x	x		x
222	Dalbergia sissoo			x	x		
223	Delonix elata						x
224	Delonix regia		x	x	x	x	
225	Delosperma abyssinicum					x	
226	Delosperma schimperi					x	
227	Dendrocalamus asper					x	
228	Dendrocalamus brandisii					x	
229	Dichrostachys cinerea			x	x	x	x
230	Dicraeopetalum stipulare					x	
231	Diospyros abyssinica			x	x	x	x
232	Diospyros mespiliformis			x	x		x
233	Diospyros scabra						x
234	Dirichletia glaucescens						x
235	Discopodium penninervium			x	x	x	x
236	Dobera glabra			x	x		x
237	Dodonaea viscosa		x	x	x	x	x
238	Dombeya buettneri						x
239	Dombeya kefaensis					x	
240	Dombeya kirkii						x
241	Dombeya longibracteolata					x	
242	Dombeya rotundifolia						x
243	Dombeya torrida			x	x	3	x
244	Dovyalis abyssinica		x	x	x	x	x
245	Dovyalis caffra		x	x		x	
246	Dracaena ellenbeckiana						x
247	Dracaena fragrans					x	x
248	Dracaena ombet					x	
249	Dracaena steudneri			x	x		x
250	Echinops ellenbeckii					x	
251	Ehretia cymosa			x	x	x	x
252	Ekebergia capensis		x	x	x	x	x
253	Embelia schimperi			x	x	x	x
254	Ensete ventricosum			x	x		x
255	Entada abyssinica		x	x	x	x	x
256	Erica arborea			x	x		x
257	Erica trimera						x
258	Eriobotrya japonica				x		
259	Erythrina abyssinica		x	x	x	x	x
260	Erythrina brucei		x	x	x	x	x
261	Erythrina burana					x	
262	Erythrina melanacantha						x
263	Erythrococca bongensis						x
264	Erythrococca trichogyne					x	
265	Erythrococca uniflora					x	
266	Erythrophysa septentrionalis					x	
267	Erythroxylum fischeri			x	x		x
268	Eucalyptus camaldulensis	x	x	x	x	x	
269	Eucalyptus globulus	x	x	x	x	x	
270	Eucalyptus grandis		x	x	x	x	
271	Eucalyptus saligna		x	x	x	x	
272	Eucalyptus viminalis		x	x	x	x	
273	Euclea divinorum						x
274	Euclea racemosa			x	x		x
275	Eugenia capensis						x

	Species	Top 25	Top 96	Long list	Ethiopia useful trees	SOWFRR and price list	Ethiopia V4A
276	Euphorbia abyssinica			x	x	x	x
277	Euphorbia ampliphylla					x	
278	Euphorbia baleensis					x	
279	Euphorbia betulicortex					x	
280	Euphorbia burgeri					x	
281	Euphorbia candelabrum			x	x		x
282	Euphorbia cuneata						x
283	Euphorbia dalettiensis					x	
284	Euphorbia doloensis					x	
285	Euphorbia ellenbeckii					x	
286	Euphorbia fissispina					x	
287	Euphorbia makallensis					x	
288	Euphorbia nigrispinoides					x	
289	Euphorbia ogadenensis					x	
290	Euphorbia robecchii						x
291	Euphorbia scheffleri						x
292	Euphorbia shebeliensis					x	
293	Euphorbia somalensis					x	
294	Euphorbia tetracantha					x	
295	Euphorbia tirucalli			x	x		x
296	Euphorbia uniglans					x	
297	Euryops pinifolius					x	
298	Fagaropsis angolensis			x	x	x	x
299	Faidherbia albida	x	x	x	x	x	x
300	Faurea rochetiana						x
301	Ficus carica		x	x	x	x	
302	Ficus cordata					x	
303	Ficus elastica				x		
304	Ficus exasperata					x	x
305	Ficus glumosa						x
306	Ficus ingens						x
307	Ficus laurifolia					x	x
308	Ficus lutea					x	
309	Ficus mucuso					x	x
310	Ficus platyphylla						x
311	Ficus sur		x	x	x	x	x
312	Ficus sycomorus		x	x	x	x	x
313	Ficus thonningii					x	x
314	Ficus vallis-choudae					x	x
315	Ficus vasta					x	x
316	Filicium decipiens						x
317	Flacourtia indica			x	x	x	x
318	Fleroya rubrostipulata					x	x
319	Flueggea virosa			x	x		x
320	Galiniera saxifraga			x	x	x	x
321	Garcinia buchananii					x	x
322	Garcinia livingstonei			x			x
323	Gardenia ternifolia			x	x	x	x
324	Gardenia volkensii			x	x		x
325	Givotia gosai						x
326	Gmelina arborea			x	x		
327	Gnidia glauca						x
328	Grevillea robusta	x	x	x	x	x	
329	Grewia arborea						x
330	Grewia damine			x	x		x
331	Grewia ferruginea			x	x	x	x
332	Grewia mollis						x

	Species	Top 25	Top 96	Long list	Ethiopia useful trees	SOWFRR and price list	Ethiopia V4A
333	Grewia similis						x
334	Grewia tembensis						x
335	Grewia tenax						x
336	Grewia villosa			x	x	x	x
337	Gymnanthemum myrianthum						x
338	Gymnosporia heterophylla						x
339	Gymnosporia senegalensis			x	x		x
340	Gyrocarpus hababensis						x
341	Hagenia abyssinica	x	x	x	x	x	x
342	Halleria lucida						x
343	Harrisonia abyssinica						x
344	Helichrysum elephantinum					x	
345	Helichrysum horridum					x	
346	Hevea brasiliensis			x	x		
347	Hibiscus boranensis					x	
348	Hibiscus diversifolius						x
349	Hildebrandtia aloysii					x	
350	Hildebrandtia diredawaensis					x	
351	Hybanthus puberulus					x	
352	Hypericum gnidiifolium					x	
353	Hypericum quartinianum			x	x		x
354	Hypericum revolutum			x	x	x	x
355	Hypericum roeperianum			x	x		x
356	Hyphaene compressa						x
357	Hyphaene thebaica			x	x		x
358	Ilex mitis			x	x	x	x
359	Indigofera curvirostrata					x	
360	Indigofera ellenbeckii					x	
361	Indigofera kelleri					x	
362	Indigofera oblongifolia						x
363	Indigofera rothii					x	
364	Inula arbuscula					x	
365	Inula confertiflora					x	
366	Ipomoea donaldsonii						x
367	Jacaranda mimosifolia		x	x	x	x	
368	Jatropha curcas		x	x	x	x	x
369	Juniperus procera	x	x	x	x	x	x
370	Justicia schimperiana			x	x		x
371	Kanahia carlsbergiana					x	
372	Kelleronia splendens						x
373	Kigelia africana			x	x		x
374	Kirkia burgeri					x	
375	Kleinia gypsophila					x	
376	Kleinia negrii					x	
377	Kotschya africana						x
378	Kotschya recurvifolia					x	
379	Kyllinga alba						x
380	Landolphia buchananii						x
381	Lannea barteri						x
382	Lannea humilis						x
383	Lannea rivae						x
384	Lannea schimperi						x
385	Lannea schweinfurthii					x	x
386	Lannea triphylla						x
387	Lannea welwitschii			x	x		x
388	Lantana viburnoides					x	
389	Lawsonia inermis			x	x		x

	Species	Top 25	Top 96	Long list	Ethiopia useful trees	SOWFRR and price list	Ethiopia V4A
390	Lecaniodiscus fraxinifolia					x	x
391	Lepidotrichilia volkensii			x	x	x	x
392	Lepisanthes senegalensis						x
393	Leptadenia arborea						x
394	Leptadenia lancifolia						x
395	Leptadenia pyrotechnica						x
396	Leucaena diversifolia					x	
397	Leucaena leucocephala		x	x	x	x	
398	Leucas abyssinica						x
399	Leucas tomentosa						x
400	Lindenbergia awashensis					x	
401	Lobelia giberroa					x	
402	Lobelia rhynchopetalum						x
403	Lonchocarpus laxiflorus			x	x		x
404	Ludwigia adscendens						x
405	Luffa cylindrica					x	
406	Lycium shawii						x
407	Macaranga capensis					x	x
408	Maerua aethiopica		x	x		x	
409	Maerua boranensis					x	
410	Maerua crassifolia						x
411	Maerua decumbens						x
412	Maerua denhardtiorum						x
413	Maerua oblongifolia						x
414	Maerua triphylla						x
415	Maesa lanceolata			x	x	x	x
416	Malus domestica		x	x	x	x	
417	Mangifera indica		x	x	x	x	
418	Manilkara butugi			x	x	x	x
419	Margaritaria discoidea						x
420	Markhamia lutea			x	x		x
421	Maytenus addat					x	
422	Maytenus arbutifolia			x	x	x	x
423	Maytenus cortii					x	
424	Maytenus harenensis					x	
425	Maytenus undata						x
426	Melia azedarach		x	x	x	x	
427	Melia volkensii						x
428	Melocarpum hildebrandtii						x
429	Meyna tetraphylla						x
430	Micromeria unguentaria					x	
431	Milicia excelsa			x	x		x
432	Millettia ferruginea		x	x	x	x	
433	Mimusops kummel			x	x	x	x
434	Momordica sessilifolia						x
435	Momordica spinosa						x
436	Morella salicifolia			x	x		x
437	Moringa oleifera			x	x	x	
438	Moringa peregrina						x
439	Moringa rivae					x	
440	Moringa stenopetala	x	x	x		x	x
441	Morus alba			x	x	x	
442	Morus mesozygia			x	x	x	x
443	Mucuna pruriens					x	
444	Mussaenda arcuata						x
445	Myrsine africana					x	x
446	Myrtus communis				x		

	Species	Top 25	Top 96	Long list	Ethiopia useful trees	SOWFRR and price list	Ethiopia V4A
447	Nuxia congesta			x	x	x	x
448	Ochna holstii						x
449	Ochradenus baccatus						x
450	Ocimum formosum					x	
451	Ocimum gratissimum					x	
452	Ocimum spectabile						x
453	Ocotea kenyensis			x	x	x	x
454	Olea capensis			x	x	x	x
455	Olea europaea		x	x	x	x	x
456	Olinia rochetiana			x	x		x
457	Olyra latifolia			x	x		x
458	Oncoba spinosa			x	x	x	x
459	Opilia campestris						x
460	Orbivestus cinerascens						x
461	Ormocarpum trachycarpum						x
462	Ormocarpum trichocarpum						x
463	Oryza longistaminata						x
464	Osyris lanceolata						x
465	Otostegia tomentosa					x	
466	Oxyanthus speciosus					x	
467	Oxytenanthera abyssinica	x	x	x	x	x	x
468	Ozoroa insignis						x
469	Panicum subalbidum						x
470	Panicum turgidum						x
471	Pappea capensis						x
472	Paraserianthes lophantha				x		
473	Parkinsonia aculeata		x	x	x	x	x
474	Pavetta abyssinica					x	
475	Pavetta crassipes						x
476	Pavetta oliveriana			x	x		x
477	Pennisetum macrourum						x
478	Pergularia daemia						x
479	Persea americana		x	x	x	x	
480	Phoenix dactylifera				x	x	x
481	Phoenix reclinata		x	x	x	x	x
482	Phyllanthus borenensis					x	
483	Phyllanthus dewildeorum					x	
484	Phyllanthus emblica					x	
485	Phyllanthus limmuensis					x	
486	Phyllanthus reticulatus					x	
487	Phytolacca dodecandra			x	x	x	x
488	Pinus patula		x	x	x	x	
489	Pinus radiata			x	x	x	
490	Pistacia aethiopica						x
491	Pithecellobium dulce			x	x	x	
492	Pittosporum viridiflorum			x	x	x	x
493	Platycelyphium voense						x
494	Plectranthus barbatus						x
495	Polyscias farinosa					x	
496	Polyscias fulva			x	x	x	x
497	Polysphaeria aethiopica					x	
498	Pouteria adolfi-friedericii	x	x	x	x	x	x
499	Pouteria alnifolia					x	
500	Pouteria altissima			x	x	x	x
501	Premna resinosa						x
502	Premna schimperi			x	x	x	x
503	Prosopis juliflora				x	x	

	Species	Top 25	Top 96	Long list	Ethiopia useful trees	SOWFRR and price list	Ethiopia V4A
504	Prunus africana	x	x	x	x	x	x
505	Prunus persica				x		
506	Pseudoblepharispermum bremeri					x	
507	Pseudocedrela kotschyi						x
508	Psiadia punctulata						x
509	Psidium guajava			x	x		
510	Psydrax parviflora						x
511	Psydrax schimperiana			x	x		x
512	Pterocarpus lucens					x	
513	Pterolobium stellatum		x	x		x	x
514	Punica granatum					x	
515	Pyrenacantha malvifolia						x
516	Rapanea melanophloeos						x
517	Rhamnus prinoides	x	x	x	x	x	x
518	Rhamnus staddo			x	x		x
519	Rhoicissus revoilii			x	x		x
520	Rhoicissus tridentata			x	x		x
521	Rhynchosia erlangeri					x	
522	Rhynchosia splendens					x	
523	Ricinus communis				x	x	
524	Rinorea friisii					x	
525	Ritchiea albersii					x	x
526	Rosa abyssinica			x	x		x
527	Rotheca myricoides					x	x
528	Rothmannia urcelliformis						x
529	Rubia cordifolia					x	
530	Rubus aethiopicus					x	
531	Rubus apetalus						x
532	Rubus erlangeri					x	
533	Rubus volkensii						x
534	Ruellia boranica					x	
535	Rydingia integrifolia			x	x		x
536	Saba comorensis			x			x
537	Salix mucronata				x		
538	Salvadora persica			x	x		x
539	Sarcocephalus latifolius			x	x	x	x
540	Schefflera abyssinica		x	x	x	x	x
541	Schefflera myriantha					x	
542	Schefflera volkensii						x
543	Schinus molle		x	x	x	x	
544	Schrebera alata					x	x
545	Sclerocarya birrea			x	x	x	x
546	Scutia myrtina						x
547	Searsia glutinosa			x	x		x
548	Searsia longipes						x
549	Searsia natalensis			x	x	x	x
550	Searsia pyroides			x	x		x
551	Searsia retinorrhoea				x		
552	Searsia ruspolii					x	
553	Searsia tenuinervis						x
554	Securidaca longipedunculata			x	x	x	x
555	Senecio myriocephalus						x
556	Senna alexandrina			x	x		x
557	Senna didymobotrya			x	x		x
558	Senna longiracemosa						x
559	Senna petersiana					x	
560	Senna siamea			x	x		

	Species	Top 25	Top 96	Long list	Ethiopia useful trees	SOWFRR and price list	Ethiopia V4A
561	Senna singueana						x
562	Senna sophera						x
563	Sericocomopsis hildebrandtii						x
564	Sericocomopsis pallida						x
565	Sesamothamnus busseanus						x
566	Sesamothamnus rivae						x
567	Sesbania bispinosa		x	x		x	
568	Sesbania melanocaulis					x	
569	Sesbania sesban		x	x	x	x	x
570	Shirakiopsis elliptica			x	x	x	x
571	Smilax anceps						x
572	Solanecio mannii					x	x
573	Solanum giganteum					x	
574	Sorghum arundinaceum						x
575	Sparmannia ricinocarpa					x	
576	Spathodea campanulata		x	x	x	x	x
577	Steganotaenia araliacea			x	x		x
578	Sterculia africana			x	x	x	x
579	Sterculia rhynchocarpa						x
580	Sterculia stenocarpa						x
581	Stereospermum kunthianum			x	x	x	x
582	Stomatanthes meyeri					x	
583	Strychnos henningsii			x	x		x
584	Strychnos innocua			x	x		x
585	Strychnos mitis					x	x
586	Strychnos spinosa			x	x		x
587	Suaeda monoica						x
588	Suregada procera						x
589	Syzygium guineense			x	x	x	x
590	Tacazzea venosa					x	
591	Tamarindus indica	x	x	x	x	x	x
592	Tamarix aphylla			x	x	x	x
593	Tamarix senegalensis						x
594	Tarchonanthus camphoratus						x
595	Taverniera abyssinica					x	
596	Tecoma stans			x		x	
597	Tephrosia dichroocarpa					x	
598	Terminalia brevipes						x
599	Terminalia brownii		x	x	x	x	x
600	Terminalia hararensis					x	
601	Terminalia hecistocarpa					x	
602	Terminalia laxiflora			x	x		x
603	Terminalia orbicularis						x
604	Terminalia prunioides						x
605	Terminalia schimperiana						x
606	Terminalia spinosa						x
607	Tetradenia riparia						x
608	Thalia geniculata						x
609	Thespesia danis						x
610	Tinnea aethiopica						x
611	Tragia abortiva					x	
612	Tragia negeliensis					x	
613	Trema orientalis					x	x
614	Trichilia dregeana			x	x	x	x
615	Trichilia emetica			x	x		x
616	Trichilia prieuriana					x	
617	Trichocladus ellipticus						x

	Species	Top 25	Top 96	Long list	Ethiopia useful trees	SOWFRR and price list	Ethiopia V4A
618	Trilepisium madagascariense			x	x	x	x
619	Turraea holstii					x	
620	Turraea mombassana						x
621	Turraea nilotica						x
622	Vallisneria spiralis						x
623	Vangueria apiculata					x	x
624	Vangueria madagascariensis			x			x
625	Vepris borenensis					x	
626	Vepris dainellii			x	x		x
627	Vepris nobilis			x	x	x	x
628	Vepris simplicifolia						x
629	Verbascum arbusculum					x	
630	Vernonia amygdalina			x	x	x	x
631	Vernonia auriculifera						x
632	Vernonia brachycalyx						x
633	Vernonia cylindrica					x	
634	Vernonia dalettiensis					x	
635	Vernonia tewoldei					x	
636	Vernonia thulinii					x	
637	Vitellaria paradoxa	x	x	x	x	x	x
638	Vitex doniana			x	x	x	x
639	Warburgia ugandensis		x	x	x	x	x
640	Wellstedia filtuensis					x	
641	Wendlandia arabica					x	
642	Woodfordia uniflora			x	x		x
643	Wrightia demartiniana						x
644	Ximenia americana			x	x		x
645	Xylopia parviflora						x
646	Yushania alpina	x	x	x	x	x	x
647	Zanha golungensis						x
648	Zanthoxylum chalybeum						x
649	Zanthoxylum gilletii						x
650	Zanthoxylum usambarense						x
651	Ziziphus abyssinica						x
652	Ziziphus jujuba	x	x	x	x	x	x
653	Ziziphus mucronata			x	x	x	x
654	Ziziphus pubescens			x	x		x
655	Ziziphus spina-christi		x	x	x	x	x

12. Appendix II. Long list of candidate species for species distribution modelling

T-25: species identified as priority tree species by the Ethiopian report for the SoW-FGR; T-96: species identified as candidate species for breeding; Long list: species identified as candidate species for species distribution modelling; Origin: native (N) or exotic (E); E: Ecocrop; F: Selection of Forages for the Tropics; G: Global Species Matrix; H: Tropical Forestry Handbook; L: Seed Leaflets; T: AgroforesTree database; U: Food Composition Database; W: The Wood Database; A: AOCC; C: Invasive Species Compendium; I: Global Invasive Species Database; S: SoW-FGR with minimum two countries; w: wood density database. Species synonyms are provided in Appendix III.

	Species	T-25	T-96	Origin	E	F	G	H	L	T	U	W	Y	A	C	I	S	w
1	Acacia abyssinica		x	N	x	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Acacia asak			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Acacia brevispica			N	x	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Acacia bussei			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Acacia decurrens		x	E	x	-	-	x	-	x	-	-	-	-	x	-	x	x
6	Acacia lahai			N	-	-	-	-	-	x	-	-	-	-	-	-	-	x
7	Acacia mearnsii			E	x	-	-	x	x	x	-	x	-	-	x	x	x	x
8	Acacia melanoxylon		x	E	x	-	-	x	-	x	-	x	-	-	x	x	x	x
9	Acacia nilotica		x	N	x	x	x	x	x	x	-	-	-	-	x	x	x	x
10	Acacia oerfota			N	x	-	-	-	-	-	-	-	-	-	-	-	-	-
11	Acacia polyacantha		x	N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
12	Acacia saligna		x	E	x	-	x	x	-	x	-	-	-	-	x	x	x	-
13	Acacia senegal	x	x	N	x	-	x	x	x	x	-	-	-	-	-	-	x	-
14	Acacia seyal		x	N	x	-	x	-	x	x	-	x	-	-	-	-	x	x
15	Acacia sieberiana			N	x	-	-	-	-	x	-	-	-	-	-	-	x	-
16	Acacia tortilis		x	N	x	-	x	x	x	x	-	-	-	-	-	-	x	-
17	Acokanthera schimperi			N	x	-	-	-	-	-	-	-	-	-	-	-	-	-
18	Adansonia digitata	x	x	N	x	-	x	-	x	x	-	-	-	x	-	-	x	x
19	Afrocarpus falcatus	x	x	N	x	-	-	-	x	x	-	-	-	-	-	-	x	x
20	Albizia grandibracteata		x	N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
21	Albizia gummifera		x	N	-	-	-	-	-	x	-	-	-	-	-	-	-	x
22	Albizia lebbeck		x	E	x	x	x	x	x	x	-	x	-	-	x	x	x	x
23	Albizia malacophylla			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	Albizia schimperiana		x	N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
25	Allophylus abyssinicus			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
26	Annona reticulata			E	x	-	-	-	-	x	x	-	-	x	-	-	x	x
27	Annona senegalensis			N	x	-	-	-	-	x	-	-	-	x	-	-	x	-
28	Anogeissus leiocarpa			N	-	-	-	-	x	-	-	-	-	-	-	-	x	x
29	Antiaris toxicaria			N	-	-	-	-	-	x	-	-	-	-	-	-	x	x
30	Apodytes dimidiata			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
31	Azadirachta indica		x	E	x	-	x	x	x	x	-	-	-	-	x	-	x	x
32	Balanites aegyptiaca		x	N	x	-	x	-	x	x	-	-	-	x	-	-	x	x
33	Baphia abyssinica			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34	Bauhinia thonningii		x	N	x	-	x	-	-	x	-	-	-	-	-	-	-	-
35	Berberis holstii			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36	Berchemia discolor			N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
37	Bersama abyssinica			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
38	Blighia unijugata			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
39	Borassus aethiopum			N	x	-	x	-	x	x	-	-	-	-	-	-	x	x
40	Boswellia microphylla		x	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	Boswellia neglecta		x	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42	Boswellia ogadensis		x	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43	Boswellia papyrifera	x	x	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44	Boswellia pirottae		x	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	Boswellia rivae		x	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	Species	T-25	T-96	Origin	E	F	G	H	L	T	U	W	Y	A	C	I	S	w
46	Breonadia salicina			N	-	-	-	-	-	-	-	-	-	-	-	-	x	x
47	Bridelia micrantha			N	x	-	-	-	x	x	-	-	-	-	-	-	-	x
48	Buddleja polystachya			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
49	Cajanus cajan		x	E	x	x	x	-	-	x	x	-	x	-	-	-	-	-
50	Calliandra calothyrsus		x	E	x	x	x	x	x	x	-	-	-	-	-	-	x	x
51	Callistemon citrinus		x	E	-	-	-	-	-	-	-	-	-	-	-	-	-	-
52	Calotropis procera			N	x	-	x	-	-	x	-	-	-	-	x	-	-	-
53	Capparis tomentosa			N	x	-	-	-	-	x	-	-	-	-	-	-	-	-
54	Carica papaya		x	E	x	-	-	-	-	x	x	-	x	x	-	-	x	-
55	Carissa spinarum			N	-	-	-	-	-	-	-	-	-	x	-	-	-	-
56	Casimiroa edulis			E	x	-	-	-	-	x	-	-	-	x	-	-	-	-
57	Casuarina cunninghamiana		x	E	x	-	-	-	-	x	-	-	-	-	x	-	x	x
58	Casuarina equisetifolia		x	E	x	-	x	x	x	x	-	-	-	-	x	x	x	x
59	Catha edulis	x	x	N	x	-	-	-	-	-	-	-	-	-	-	-	-	x
60	Ceiba pentandra			NE	x	-	x	x	x	x	-	-	x	-	-	-	x	x
61	Celtis africana		x	N	-	-	-	-	-	x	-	-	-	-	-	-	-	x
62	Celtis toka			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
63	Citrus sinensis		x	E	x	-	-	-	-	x	x	-	x	-	-	-	x	x
64	Coffea arabica	x	x	N	x	-	-	-	-	x	-	-	x	-	-	-	x	x
65	Combretum aculeatum			N	x	-	-	-	x	x	-	-	-	-	-	-	-	-
66	Combretum collinum			N	-	-	-	-	-	x	-	-	-	-	-	-	-	-
67	Combretum molle		x	N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
68	Commiphora africana		x	N	x	-	-	-	x	x	-	-	-	-	-	-	x	x
69	Commiphora erythraea			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	Commiphora guidottii		x	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
71	Commiphora habessinica			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72	Commiphora myrrha	x	x	N	-	-	-	-	-	x	-	-	-	-	-	-	-	-
73	Cordeauxia edulis	x	x	N	x	-	x	-	-	x	-	-	-	-	-	-	-	-
74	Cordia africana	x	x	N	x	-	-	-	x	x	-	-	-	-	-	-	x	x
75	Corymbia citriodora		x	E	-	-	-	x	-	-	-	x	-	-	-	-	x	x
76	Corymbia maculata			E	-	-	-	x	-	x	-	x	-	-	-	-	-	x
77	Croton macrostachyus		x	N	-	-	-	-	-	x	-	-	-	-	-	-	-	x
78	Cupressus lusitanica	x	x	E	x	-	-	x	-	x	-	x	-	-	-	-	x	x
79	Cupressus sempervirens		x	E	x	-	-	-	-	-	-	x	-	-	x	-	x	x
80	Cupressus torulosa			E	x	-	-	x	-	x	-	-	-	-	-	-	x	x
81	Cyathea manniana			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
82	Cytisus proliferus		x	E	x	-	x	-	-	x	-	-	-	-	-	-	-	-
83	Dalbergia melanoxylon			N	x	-	-	-	x	x	-	x	-	-	x	-	x	x
84	Dalbergia sissoo			E	x	-	-	x	x	x	-	x	-	-	x	x	x	x
85	Delonix regia		x	E	x	-	-	x	-	x	-	-	-	-	x	-	x	x
86	Dichrostachys cinerea			N	x	-	-	-	-	x	-	-	-	-	x	x	-	x
87	Diospyros abyssinica			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
88	Diospyros mespiliformis			N	x	-	-	-	-	x	-	-	-	x	-	-	x	x
89	Discopodium penninervium			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
90	Dobera glabra			N	x	-	-	-	-	x	-	-	-	-	-	-	-	-
91	Dodonaea viscosa		x	N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
92	Dombeya torrida			N	-	-	-	-	-	x	-	-	-	-	-	-	-	x
93	Dovyalis abyssinica		x	N	-	-	-	-	x	-	-	-	-	-	-	-	-	-
94	Dovyalis caffra		x	E	x	-	-	-	x	x	-	-	-	x	-	-	-	x
95	Dracaena steudneri			N	-	-	-	-	-	-	-	-	-	-	x	-	-	-
96	Ehretia cymosa			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
97	Ekebergia capensis		x	N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
98	Embelia schimperi			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
99	Ensete ventricosum			N	x	-	-	-	-	-	-	-	-	x	-	-	-	-
100	Entada abyssinica		x	N	x	-	-	-	-	x	-	-	-	-	-	-	-	-
101	Erica arborea			N	-	-	-	-	-	-	-	x	-	-	x	-	-	-
102	Erythrina abyssinica		x	N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
103	Erythrina brucei		x	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
104	Erythroxylum fischeri			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	Species	T-25	T-96	Origin	E	F	G	H	L	T	U	W	Y	A	C	I	S	w
105	Eucalyptus camaldulensis	x	x	E	x	-	x	x	-	x	-	x	-	-	x	-	x	x
106	Eucalyptus globulus	x	x	E	x	-	x	x	-	x	-	-	-	-	-	-	x	x
107	Eucalyptus grandis		x	E	x	-	x	x	-	x	-	x	-	-	-	-	x	x
108	Eucalyptus saligna		x	E	x	-	-	x	-	x	-	-	-	-	-	-	x	x
109	Eucalyptus viminalis		x	E	x	-	-	x	-	-	-	-	-	-	-	-	-	x
110	Euclea racemosa			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
111	Euphorbia abyssinica			N	-	-	x	-	-	-	-	-	-	-	-	-	-	-
112	Euphorbia candelabrum			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
113	Euphorbia tirucalli			N	x	-	x	x	-	x	-	-	-	-	x	-	-	x
114	Fagaropsis angolensis			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
115	Faidherbia albida	x	x	N	x	-	x	x	x	x	-	-	-	x	-	-	x	x
116	Ficus carica		x	E	x	-	-	-	-	x	x	-	x	-	-	-	x	-
117	Ficus sur		x	N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
118	Ficus sycomorus		x	N	x	-	-	-	-	x	-	-	-	-	x	-	-	x
119	Flacourtia indica			N	x	-	-	-	-	x	-	-	-	-	x	x	x	x
120	Flueggea virosa			N	-	-	-	-	-	x	-	-	-	-	-	-	-	-
121	Galiniera saxifraga			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
122	Garcinia livingstonei			N	-	-	-	-	-	x	-	-	-	x	-	-	-	x
123	Gardenia ternifolia			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
124	Gardenia volkensii			N	-	-	-	-	x	-	-	-	-	-	-	-	-	-
125	Gmelina arborea			E	x	-	-	x	x	x	-	-	-	-	-	-	x	x
126	Grevillea robusta	x	x	E	x	-	-	x	-	x	-	x	-	-	x	x	x	x
127	Grewia damine			N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
128	Grewia ferruginea			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
129	Grewia villosa			N	-	-	-	-	-	x	-	-	-	-	-	-	-	-
130	Gymnosporia senegalensis			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
131	Hagenia abyssinica	x	x	N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
132	Hevea brasiliensis			E	x	-	x	x	-	x	-	x	x	-	-	-	x	x
133	Hypericum quartinianum			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
134	Hypericum revolutum			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
135	Hypericum roeperianum			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
136	Hyphaene thebaica			N	x	-	x	-	-	x	-	-	-	-	-	-	x	-
137	Ilex mitis			N	-	-	-	-	-	x	-	x	-	-	-	-	-	x
138	Jacaranda mimosifolia		x	E	x	-	-	x	-	x	-	-	-	-	-	-	-	x
139	Jatropha curcas		x	E	x	-	x	-	x	x	-	-	-	-	x	-	x	x
140	Juniperus procera	x	x	N	x	-	-	-	-	x	-	x	-	-	-	-	x	x
141	Justicia schimperiana			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
142	Kigelia africana			N	x	-	-	-	x	x	-	-	-	-	-	-	-	x
143	Lannea welwitschii			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
144	Lawsonia inermis			N	x	-	x	-	-	x	-	-	-	-	-	-	-	-
145	Lepidotrichilia volkensii			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
146	Leucaena leucocephala		x	E	x	x	x	x	-	x	-	-	-	-	x	x	x	x
147	Lonchocarpus laxiflorus			N	x	-	-	-	-	-	-	-	-	-	-	-	-	-
148	Maerua aethiopica		x	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
149	Maesa lanceolata			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
150	Malus domestica		x	E	x	-	-	-	-	x	x	x	x	-	-	-	-	-
151	Mangifera indica		x	E	x	-	-	-	-	x	x	x	x	x	-	-	x	x
152	Manilkara butugi			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
153	Markhamia lutea			N	x	-	-	-	x	x	-	-	-	-	-	-	-	x
154	Maytenus arbutifolia			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
155	Melia azedarach		x	E	x	-	x	x	x	x	-	x	-	-	x	x	x	x
156	Milicia excelsa			N	x	-	-	x	x	x	-	x	-	-	-	-	x	x
157	Millettia ferruginea		x	N	-	-	-	-	-	x	-	-	-	-	-	-	-	-
158	Mimusops kummel			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
159	Morella salicifolia			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
160	Moringa oleifera			N	x	-	x	-	x	x	x	-	-	x	x	-	x	x
161	Moringa stenopetala	x	x	N	x	-	x	-	-	x	-	-	-	-	-	-	-	-
162	Morus alba			E	x	-	x	-	-	x	-	x	-	x	x	x	x	x
163	Morus mesozygia			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x

	Species	T-25	T-96	Origin	E	F	G	H	L	T	U	W	Y	A	C	I	S	w
164	Nuxia congesta			N	-	-	-	-	-	x	-	-	-	-	-	-	-	x
165	Ocotea kenyensis			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
166	Olea capensis			N	x	-	-	-	-	x	-	x	-	-	-	-	-	x
167	Olea europaea		x	N	x	-	x	-	-	x	x	x	x	-	-	x	x	x
168	Olinia rochetiana			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
169	Olyra latifolia			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
170	Oncoba spinosa			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
171	Oxytenanthera abyssinica	x	x	N	-	-	x	-	-	-	-	-	-	-	-	-	x	x
172	Parkinsonia aculeata		x	E	x	-	x	x	-	x	-	-	-	-	x	-	-	x
173	Pavetta oliveriana			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
174	Persea americana		x	E	x	-	x	-	-	x	x	-	x	x	-	-	x	x
175	Phoenix reclinata		x	N	x	-	-	-	-	x	-	-	-	-	-	-	-	-
176	Phytolacca dodecandra			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
177	Pinus patula		x	E	x	-	-	x	x	x	-	x	-	-	x	-	x	x
178	Pinus radiata			E	x	-	x	x	-	-	-	x	-	-	x	-	x	x
179	Pithecellobium dulce			E	x	-	x	x	-	x	-	-	-	-	x	-	x	x
180	Pittosporum viridiflorum			N	-	-	-	-	-	-	-	-	-	-	-	x	-	x
181	Polyscias fulva			N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
182	Pouteria adolfi-friedericii	x	x	N	-	-	-	-	-	-	-	x	-	-	-	-	-	-
183	Pouteria altissima			N	-	-	-	-	-	-	-	x	-	-	-	-	-	x
184	Premna schimperi			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
185	Prunus africana	x	x	N	x	-	-	-	x	x	-	-	-	-	-	-	x	x
186	Psidium guajava			E	x	-	-	x	-	x	x	-	x	x	x	x	x	x
187	Psydrax schimperiana			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
188	Pterolobium stellatum		x	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
189	Rhamnus prinoides	x	x	N	x	-	-	-	-	x	-	-	-	-	-	-	x	-
190	Rhamnus staddo			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
191	Rhoicissus revoilii			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
192	Rhoicissus tridentata			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
193	Rosa abyssinica			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
194	Rydingia integrifolia			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
195	Saba comorensis			N	-	-	-	-	-	x	-	-	-	x	-	-	-	-
196	Salvadora persica			N	x	-	x	-	-	x	-	-	-	-	-	-	x	x
197	Sarcocephalus latifolius			N	-	-	-	-	-	x	-	-	-	-	x	-	-	-
198	Schefflera abyssinica		x	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
199	Schinus molle		x	E	x	-	-	x	x	x	-	-	-	-	-	-	x	x
200	Sclerocarya birrea			N	x	-	x	-	x	x	-	-	-	x	-	-	x	x
201	Searsia glutinosa			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
202	Searsia natalensis			N	-	-	-	-	-	x	-	-	-	-	-	-	-	-
203	Searsia pyroides			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
204	Securidaca longipedunculata			N	x	-	-	-	-	x	-	-	-	-	-	-	-	-
205	Senna alexandrina			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
206	Senna didymobotrya			N	-	-	-	-	-	x	-	-	-	-	-	-	-	-
207	Senna siamea			E	x	-	x	x	x	x	-	x	-	-	x	-	x	x
208	Sesbania bispinosa		x	E	x	-	-	x	-	x	-	-	-	-	-	-	-	-
209	Sesbania sesban		x	N	x	x	x	-	-	x	-	-	-	-	x	-	-	x
210	Shirakiopsis elliptica			N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
211	Spathodea campanulata		x	N	x	-	-	x	-	x	-	-	-	-	x	x	x	x
212	Steganotaenia araliacea			N	-	-	-	-	-	x	-	-	-	-	-	-	-	-
213	Sterculia africana			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
214	Stereospermum kunthianum			N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
215	Strychnos henningsii			N	-	-	-	-	-	x	-	-	-	-	-	-	-	-
216	Strychnos innocua			N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
217	Strychnos spinosa			N	x	-	-	-	-	x	-	-	-	x	-	-	-	x
218	Syzygium guineense			N	x	-	-	-	-	x	-	-	-	x	-	-	-	x
219	Tamarindus indica	x	x	N	x	-	x	x	x	x	x	x	-	x	-	-	x	x
220	Tamarix aphylla			N	x	-	-	x	-	x	-	-	-	-	x	x	-	x
221	Tecoma stans			E	x	-	-	x	-	x	-	-	-	-	x	x	-	x
222	Terminalia brownii		x	N	x	-	-	-	x	x	-	-	-	-	-	-	-	-

	Species	T-25	T-96	Origin	E	F	G	H	L	T	U	W	Y	A	C	I	S	w
223	Terminalia laxiflora			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
224	Trichilia dregeana			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
225	Trichilia emetica			N	-	-	x	-	x	x	-	-	-	-	-	-	-	x
226	Trilepisium madagascariense			N	-	-	-	-	-	-	-	-	-	-	-	-	-	x
227	Vangueria madagascariensis			N	x	-	-	-	-	x	-	-	-	x	-	-	-	-
228	Vepris dainellii			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
229	Vepris nobilis			N	-	-	-	-	-	x	-	-	-	-	-	-	-	x
230	Vernonia amygdalina			N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
231	Vitellaria paradoxa	x	x	N	x	-	x	-	x	x	-	-	x	x	-	-	x	-
232	Vitex doniana			N	x	-	-	-	-	x	-	-	-	x	-	-	-	x
233	Warburgia ugandensis		x	N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
234	Woodfordia uniflora			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
235	Ximenia americana			N	x	-	-	-	x	x	-	-	x	-	-	-	x	x
236	Yushania alpina	x	x	N	-	-	-	-	-	-	-	-	-	-	-	-	x	-
237	Ziziphus jujuba	x	x	N	-	-	-	-	-	-	x	-	-	-	-	-	x	x
238	Ziziphus mucronata			N	x	-	-	-	-	x	-	-	-	-	-	-	-	x
239	Ziziphus pubescens			N	-	-	-	-	-	-	-	-	-	-	-	-	-	-
240	Ziziphus spina-christi		x	N	-	-	-	x	-	x	-	-	-	-	-	-	-	-

13. Appendix III. Synonyms of species names used in the report

Synonyms based on *The Plant List* (November 2017). The list also contains spelling variants and mistakes from documents referred to during the consultancy.

Species	Synonym or alternative spelling
Afrocanthium lactescens	Canthium lactescens
Afrocarpus falcatus	Podocarpus falcatus
Afrocarpus gracilior	Afrocarpus falcatus subsp. gracilior
Agarista salicifolia	Agauria salicifolia
Allophylus ferrugineus	Allophylus macrobotrys
Anogeissus leiocarpa	Anogeisus leocarphus
Baccharoides filigera	Vernonia filigera
Baccharoides filigera	Vernonia hymenolopis
Bauhinia thonningii	Piliostigma thonningii
Brucea antidysenterica	Brucea antidysentrica
Byttneria catalpifolia	Bytteneria catalpifolia
Cadaba divaricata	Cadaba divericata
Cadaba linearifolia	Cadaba heterotricha
Canarium schweinfurtii	Canarium schweinfurthii
Carissa spinarum	Carissa edulis
Cassine buchananii	Elaeodendron buchananii
Cassipourea ruwensorensis	Cassipourea ruwensoriensis
Citrus aurantiifolia	Citrus aurantifolia
Combretum hartmannianum	Combretum hartnannianum
Combretum molle	Combretum rochetanum
Coptosperma graveolens	Tarenna graveolens
Corymbia citriodora	Eucalyptus citriodora
Corymbia maculata	Eucalyptus maculata
Crossopteryx febrifuga	Croaaophy pebripuga
Cupressus sempervirens	Cupressus pyramidalis
Cynanchum hastifolium	Cynanchum clavidens
Cynanchum viminale	Sarcostemma viminale
Cytisus proliferus	Chamaecytisus palmensis
Cytisus proliferus	Chamaecytisus proliferus
Dirichletia glaucescens	Carphalea glaucescens
Discopodium penninervium	Discopodium eremanthum
Dodonaea viscosa	Dodonaea angustifolia
Dombeya longibracteolata	Dombeya longebracteolata
Dombeya torrida	Dombeya schimperiana
Dombeya torrida	Dombya torrida
Ehretia cymosa	Ehretia abyssinica
Euphorbia burgeri	Euphorbia burger
Euphorbia nigrispinoides	Euphorbia nigrispinioides
Euphorbia shebeliensis	Monadenium shebeliensis
Faidherbia albida	Acacia albida
Ficus cordata	Ficus salicifolia
Ficus laurifolia	Ficus ovata
Ficus thonningii	Ficus ruspolii
Fleroya rubrostipulata	Hallea rubrospiculata
Fleroya rubrostipulata	Hallea rubrostipulata
Galiniera saxifraga	Galiniera saxifrage
Gardenia ternifolia	Gardenia turnifolia
Grewia damine	Grewia bicolor
Gymnanthemum myrianthum	Vernonia myriantha
Gymnosporia heterophylla	Maytenus heterophylla
Gymnosporia senegalensis	Maytenus senegalensis

Species	Synonym or alternative spelling
Helichrysum elephantinum	Helichrysum elephantium
Hypericum roeperianum	Hypericum roeperanum
Kirkia burgeri	Kirkia burger
Lannea schweinfurthii	Lanna schaleintunthii
Lantana viburnoides	Lantana kisi
Lecaniodiscus fraxinifolia	Lecaniodiscus fraxinifolius
Lepisanthes senegalensis	Aphania senegalensis
Leptadenia lancifolia	Leptadenia hastata
Leucaena diversifolia	Leucaena diversifolica
Lonchocarpus laxiflorus	Philenoptera laxiflora
Ludwigia adscendens	Ludwigia stolonifera
Luffa cylindrica	Luffa cylindica
Maerua denhardtiorum	Maerua deinhardtiorum
Manilkara butugi	Manilkara butugii
Maytenus arbutifolia	Gymnosporia arbutifolia
Melia azedarach	Melia azadarach
Micromeria unguentaria	Satureja unguentaria
Millettia ferruginea	Millettia feruginea
Moringa rivae	Moringa rivae subsp. longisiliqua
Mucuna pruriens	Mucuna pruniens
Ocimum formosum	Becium formosum
Ocimum spectabile	Erythrochlamys spectabilis
Olea capensis subsp. welwitschii	Olea welwitschii
Olea europaea	Olea europaea subsp. cuspidata
Olea europaea	Olea europaea var. africana
Orbivestus cinerascens	Vernonia cinerascens
Otostegia tomentosa	Otostegia tomentosa subsp. steudneri
Paraserianthes lophantha	Paraserianthes lophanta
Phoenix dactylifera	Phoenix dactlifera
Phyllanthus dewildeorum	Phyllanthus dewildiorum
Phyllanthus emblica	Emblica officinalis
Phytolacca dodecandra	Phytolaca dodecandra
Polyscias farinosa	Polyscias farinose
Pouteria alnifolia	Malacantha alnifolia
Premna schimperi	Premna shimperi
Pterocarpus lucens	Terocarphus lucease
Pterolobium stellatum	Petrolobium stellatum
Rotheca myricoides	Clerodendron myricoides
Rotheca myricoides	Clerodendrum myricoides
Rydingia integrifolia	Otostegia integrifolia
Sarcocephalus latifolius	Sarcocephatur latitolive
Sclerocarya birrea	Sclerocarya birrea subsp. caffra
Searsia glutinosa	Rhus glutinosa
Searsia longipes	Rhus longipes
Searsia natalensis	Rhus natalensis
Searsia pyroides	Rhus pyroides
Searsia retinorrhoea	Rhus retinorrhoea
Searsia ruspolii	Rhus ruspolii
Searsia ruspolii	Rhus susplii
Searsia tenuinervis	Rhus tenuinervis
Sesbania bispinosa	Sesbania aculeata
Shirakiopsis elliptica	Sapium ellipticum
Spathodea campanulata	Spathodea nilotica
Tamarix senegalensis	Tamarix nilotica
Tragia abortiva	Tragia abortive
Vepris borenensis	Teclea borenensis
Vepris nobilis	Teclea nobilis
Vernonia cylindrica	Vernonia cylindrical
Wendlandia arabica	Wendlandia arabica subsp. aethipica

Species	Synonym or alternative spelling
Yushania alpina	Arundinaria alpina
Yushania alpina	Sinarundinaria alpina
Ziziphus jujuba	Ziziphus mauritiana

14. Appendix IV. Species descriptions from the SoW-FGR for 96 candidate species for plant breeding

	Species	Priority	Uses	Services	Seedlings	Ex situ
1	Acacia abyssinica		energy, non wood forest products, agroforestry	soil and water conservation, aesthetic values	3,186,834	13
2	Acacia decurrens		energy, agroforestry	soil and water conservation	15,736,872	
3	Acacia melanoxylon				6,724,278	
4	Acacia nilotica		energy, non wood forest products		99,707	
5	Acacia polyacantha				146,710	8
6	Acacia saligna		energy, non wood forest products, agroforestry	soil and water conservation, shade	21,986,737	
7	Acacia senegal	economic, gum and resin	energy, non wood forest products	soil and water conservation , biodiversity conservation	1,266,270	4
8	Acacia seyal			soil and water conservation, shade	1,442,806	10
9	Acacia tortilis		energy, non wood forest products, agroforestry	soil and water conservation, shade	437,011	6
10	Adansonia digitata	economic, high value fruit in lowlands	non wood forest products			
11	Afrocarpus falcatus	economic, timber, threatened	solid wood products	biodiversity conservation, cultural values, aesthetic values, shade	174,257	3
12	Albizia grandibracteata				73,043	1
13	Albizia gummifera		solid wood products, energy, non wood forest products, agroforestry		159,330	6
14	Albizia lebbeck				303,659	
15	Albizia schimperiana		solid wood products, energy, non wood forest products, agroforestry		384,714	
16	Azadirachta indica		solid wood products, energy, non wood forest products, agroforestry		28,512	
17	Balanites aegyptiaca					
18	Bauhinia thonningii			soil and water conservation		6

	Species	Priority	Uses	Services	Seedlings	Ex situ
19	Boswellia microphylla		non wood forest products			
20	Boswellia neglecta		non wood forest products			
21	Boswellia ogadensis		non wood forest products			
22	Boswellia papyrifera	economic, gum and resin	non wood forest products			
23	Boswellia pirottae					
24	Boswellia rivae		non wood forest products			
25	Cajanus cajan			soil and water conservation		
26	Calliandra calothyrsus				112	
27	Callistemon citrinus				3,516,191	
28	Carica papaya		non wood forest products, agroforestry			
29	Casuarina cunninghamiana				372,947	
30	Casuarina equisetifolia				120,976,035	
31	Catha edulis	economic and social, , stimulant, medicinal, agroforestry, export commodity	stimulant			
32	Celtis africana			shade		1
33	Citrus sinensis		non wood forest products, agroforestry			
34	Coffea arabica	economic and social, , stimulant, medicinal	stimulant	soil and water conservation, cultural values		
35	Combretum molle					
36	Commiphora africana		non wood forest products			
37	Commiphora guidottii		solid wood products, non wood forest products			
38	Commiphora myrrha	economic, gum and resin	non wood forest products			
39	Cordeauxia edulis	economic, high value fruit in lowlands	non wood forest products	soil and water conservation		
40	Cordia africana	economic, timber, agroforestry, threatened	solid wood products, non wood forest products, agroforestry	soil and water conservation, soil fertility, biodiversity conservation, cultural values, aesthetic values, shade	2,760,830	27
41	Corymbia citriodora				20,790,393	

	Species	Priority	Uses	Services	Seedlings	Ex situ
42	Croton macrostachyus		solid wood products, non wood forest products, agroforestry	soil and water conservation	3,320	2
43	Cupressus lusitanica	economic, timber	solid wood products		43,988,449	
44	Cupressus sempervirens				68,548	
45	Cytisus proliferus				2,178,995	
46	Delonix regia				91,066	
47	Dodonaea viscosa				27,980	3
48	Dovyalis abyssinica				306,828	
49	Dovyalis caffra				3,143,528	
50	Ekebergia capensis			soil and water conservation, shade	22,014	
51	Entada abyssinica				90,984	6
52	Erythrina abyssinica			soil and water conservation		1
53	Erythrina brucei		non wood forest products, agroforestry	soil and water conservation	940	
54	Eucalyptus camaldulensis	economic, construction, fuelwood	solid wood products, energy		450,270,952	
55	Eucalyptus globulus	economic, construction, fuelwood	solid wood products, energy,		50,607,540	1
56	Eucalyptus grandis				15,148,622	
57	Eucalyptus saligna				43,572,735	
58	Eucalyptus viminalis				8,161,041	
59	Faidherbia albida	agroforestry	energy, non wood forest products, agroforestry	soil and water conservation, soil fertility, biodiversity conservation	2,148,579	3
60	Ficus carica			biodiversity conservation		
61	Ficus sur			biodiversity conservation		2
62	Ficus sycomorus			soil and water conservation		1
63	Grevillea robusta	economic, multipurpose	solid wood products, energy, agroforestry	soil and water conservation	329,598	
64	Hagenia abyssinica	economic, timber, medicinal, agroforestry, threatened	solid wood products, non wood forest products, agroforestry	soil and water conservation, aesthetic values	9,004,788	4
65	Jacaranda mimosifolia				3,472,549	
66	Jatropha curcas				169	
67	Juniperus procera	economic, timber, threatened	solid wood products	biodiversity conservation, aesthetic values	1,789,985	4
68	Leucaena leucocephala		non wood forest products, agroforestry	soil and water conservation	8,909,564	
69	Maerua aethiopica				9,767	

	Species	Priority	Uses	Services	Seedlings	Ex situ
70	Malus domestica		non wood forest products, agroforestry			
71	Mangifera indica		NA			
72	Melia azedarach				713,305	
73	Millettia ferruginea		NA		427,072	6
74	Moringa stenopetala	economic, multipurpose	non wood forest products, agroforestry	soil and water conservation	227,361	9
75	Olea europaea		solid wood products, energy, non wood forest products		355,434	3
76	Oxytenanthera abyssinica	economic, multipurpose	solid wood products, energy, non wood forest products			5
77	Parkinsonia aculeata				258,773	
78	Persea americana		non wood forest products, agroforestry			
79	Phoenix reclinata				22,459	2
80	Pinus patula		solid wood products		286,184	
81	Pouteria adolfi-friedericii	economic, timber	solid wood products	soil and water conservation		
82	Prunus africana	economic, timber, medicinal, threatened	solid wood products, energy, non wood forest products	soil and water conservation, shade	69,533	2
83	Pterolobium stellatum				1,695	2
84	Rhamnus prinoides	economic, beverage	non wood forest products			1
85	Schefflera abyssinica		non wood forest products, agroforestry			
86	Schinus molle				5,054,218	
87	Sesbania bispinosa		non wood forest products, agroforestry		22,731,571	
88	Sesbania sesban			soil and water conservation, shade		1
89	Spathodea campanulata				4,621,920	
90	Tamarindus indica	economic, high value fruit in lowlands	non wood forest products, agroforestry	soil and water conservation, soil fertility, biodiversity conservation, shade	53,523	6
91	Terminalia brownii			shade		
92	Vitellaria paradoxa	economic, high value fruit in lowlands	non wood forest products	soil and water conservation, shade		
93	Warburgia ugandensis			shade		
94	Yushania alpina	economic, multipurpose	solid wood products, energy, non wood forest products			

	Species	Priority	Uses	Services	Seedlings	Ex situ
95	Ziziphus jujuba	economic, high value fruit in lowlands	non wood forest products	soil and water conservation		
96	Ziziphus spina-christi					3

15. Appendix V. Number of locations records from the RAINBIO database

Top 25: species identified as priority tree species by the Ethiopian report for the SoW-FGR. Top 20: top 20 species identified by the BPC. Top 96: species identified as candidate species for breeding; Records: number of location data points in the RAINBIO mega-database (Dauby *et al.* 2016).

	Species	Top 25	Top 20	Top 96	Records
1	Acacia abyssinica		x	x	72
2	Acacia asak				**6**
3	Acacia brevispica				153
4	Acacia bussei				62
5	Acacia lahai				63
6	Acacia nilotica		x	x	374
7	Acacia oerfota				53
8	Acacia polyacantha			x	275
9	Acacia senegal	x	x	x	197
10	Acacia seyal			x	139
11	Acacia sieberiana				235
12	Acacia tortilis		x	x	115
13	Acokanthera schimperi				35
14	Adansonia digitata	x		x	91
15	Afrocarpus falcatus	x	x	x	**12**
16	Albizia grandibracteata			x	**24**
17	Albizia gummifera			x	145
18	Albizia malacophylla				**14**
19	Albizia schimperiana			x	30
20	Allophylus abyssinicus				32
21	Annona senegalensis				308
22	Anogeissus leiocarpa				117
23	Antiaris toxicaria				99
24	Apodytes dimidiata				120
25	Balanites aegyptiaca			x	121
26	Baphia abyssinica				**6**
27	Bauhinia thonningii			x	245
28	Berberis holstii				74
29	Berchemia discolor				34
30	Bersama abyssinica				346
31	Blighia unijugata				126
32	Borassus aethiopum				158
33	Boswellia neglecta			x	33
34	Boswellia ogadensis			x	**3**
35	Boswellia papyrifera	x		x	47
36	Boswellia pirottae			x	**1**
37	Boswellia rivae			x	**11**
38	Breonadia salicina				66
39	Bridelia micrantha				337
40	Buddleja polystachya				36
41	Calotropis procera				61
42	Capparis tomentosa				147
43	Carissa spinarum				206
44	Catha edulis	x		x	39
45	Celtis africana			x	175
46	Celtis toka				97
47	Coffea arabica	x		x	43
48	Combretum aculeatum				152
49	Combretum collinum				500
50	Combretum molle			x	600

	Species	Top 25	Top 20	Top 96	Records
51	Commiphora africana			x	194
52	Commiphora guidottii			x	**1**
53	Commiphora myrrha	x		x	**4**
54	Cordeauxia edulis	x		x	**2**
55	Cordia africana	x	x	x	117
56	Croton macrostachyus			x	117
57	Cyathea manniana				104
58	Dalbergia melanoxylon				138
59	Dichrostachys cinerea				328
60	Diospyros abyssinica				101
61	Diospyros mespiliformis				182
62	Discopodium penninervium				77
63	Dobera glabra				**16**
64	Dodonaea viscosa			x	179
65	Dombeya torrida				51
66	Dovyalis abyssinica			x	43
67	Dracaena steudneri				167
68	Ehretia cymosa				180
69	Ekebergia capensis			x	295
70	Embelia schimperi				121
71	Ensete ventricosum				**12**
72	Entada abyssinica			x	152
73	Erica arborea				66
74	Erythrina abyssinica			x	105
75	Erythrina brucei			x	**12**
76	Erythroxylum fischeri				**7**
77	Euclea racemosa				103
78	Euphorbia abyssinica				**8**
79	Euphorbia candelabrum				**12**
80	Euphorbia tirucalli				36
81	Fagaropsis angolensis				**15**
82	Faidherbia albida	x	x	x	57
83	Ficus sur			x	321
84	Ficus sycomorus			x	156
85	Flacourtia indica				231
86	Flueggea virosa				147
87	Galiniera saxifraga				247
88	Garcinia livingstonei				74
89	Gardenia ternifolia				290
90	Gardenia volkensii				**29**
91	Grewia villosa				59
92	Gymnosporia senegalensis				225
93	Hagenia abyssinica	x	x	x	49
94	Hypericum quartinianum				**29**
95	Hypericum revolutum				111
96	Hypericum roeperianum				36
97	Hyphaene thebaica				62
98	Ilex mitis				147
99	Juniperus procera	x	x	x	90
100	Kigelia africana				208
101	Lannea welwitschii				143
102	Lawsonia inermis				**25**
103	Lepidotrichilia volkensii				97
104	Lonchocarpus laxiflorus				73
105	Maerua aethiopica			x	**8**
106	Maesa lanceolata				357
107	Manilkara butugi				**4**
108	Markhamia lutea				73
109	Maytenus arbutifolia				76

	Species	Top 25	Top 20	Top 96	Records
110	Milicia excelsa				546
111	Millettia ferruginea			x	**20**
112	Mimusops kummel				62
113	Morella salicifolia				78
114	Moringa stenopetala	x		x	**2**
115	Morus mesozygia				45
116	Nuxia congesta				158
117	Ocotea kenyensis				40
118	Olea capensis				79
119	Olea europaea		x	x	56
120	Olinia rochetiana				59
121	Olyra latifolia				228
122	Oncoba spinosa				100
123	Oxytenanthera abyssinica	x		x	38
124	Pavetta oliveriana				60
125	Phoenix reclinata			x	423
126	Phytolacca dodecandra				131
127	Pittosporum viridiflorum				191
128	Polyscias fulva				63
129	Pouteria adolfi-friedericii	x		x	43
130	Pouteria altissima				41
131	Premna schimperi				**23**
132	Prunus africana	x		x	148
133	Psydrax schimperiana				73
134	Pterolobium stellatum			x	34
135	Rhamnus prinoides	x		x	116
136	Rhamnus staddo				**21**
137	Rhoicissus revoilii				74
138	Rhoicissus tridentata				131
139	Rosa abyssinica				**18**
140	Rydingia integrifolia				**10**
141	Saba comorensis				166
142	Salvadora persica				198
143	Sarcocephalus latifolius				210
144	Schefflera abyssinica			x	30
145	Sclerocarya birrea				282
146	Searsia glutinosa				**20**
147	Searsia natalensis				94
148	Searsia pyroides				141
149	Securidaca longipedunculata				236
150	Senna alexandrina				**26**
151	Senna didymobotrya				82
152	Shirakiopsis elliptica				167
153	Spathodea campanulata			x	116
154	Steganotaenia araliacea				91
155	Sterculia africana				34
156	Stereospermum kunthianum				133
157	Strychnos henningsii				35
158	Strychnos innocua				107
159	Strychnos spinosa				144
160	Syzygium guineense				547
161	Tamarindus indica	x		x	160
162	Tamarix aphylla				**8**
163	Terminalia brownii			x	53
164	Terminalia laxiflora				100
165	Trichilia dregeana				48
166	Trichilia emetica				107
167	Trilepisium madagascariense				212
168	Vangueria madagascariensis				60

	Species	Top 25	Top 20	Top 96	Records
169	Vepris dainellii				**15**
170	Vepris nobilis				78
171	Vernonia amygdalina				176
172	Vitellaria paradoxa	x		x	66
173	Vitex doniana				337
174	Warburgia ugandensis			x	**19**
175	Woodfordia uniflora				**12**
176	Ximenia americana				285
177	Yushania alpina	x		x	**29**
178	Ziziphus mucronata				146
179	Ziziphus pubescens				**17**
180	Ziziphus spina-christi			x	36

16. Appendix VI. References of a recent review of species distribution and population structures in Ethiopia

References included in a recent review (Young *et al.* 2017) of the population structure of montane forest species.

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Provision of adequate tree seed portfolios

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