

THE STATE OF **CAMEROON'S**
BIODIVERSITY FOR FOOD AND
AGRICULTURE

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MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT
(MINADER)

THE STATE OF BIODIVERSITY FOR FOOD AND AGRICULTURE IN CAMEROON



November 2015



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COVER PICTURES

Top left: *Coffea montekupensis* (Cheek & al., 2004)

Top middle: *Tryonomys swinderianus* (Vivien J., 1991)

Top right: *Gnetum Africana* (Bechem & al., 2012)

Bottom left: *Parapenaeopsis atlantica* (Njeng G.A., 2015)

Bottom middle: *Garcinia kola* (Awono & al., 2000)

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ABBREVIATIONS AND ACRONYMS

ABS :	Access and Benefit-Sharing
ANAFOR:	Agence Nationale d'Appui au Développement Forestier
ANCOR:	Apiculture and Nature Conservation Organization
BDCPC:	Bioresources Development and Conservation Programme Cameroon
BUCREP :	Bureau Central de Recensement et d'Etude de la Population
CAS :	Cameroon Academy of Sciences
CBff :	Congo Basin Forest Funds
CBD:	Convention on Biological Diversity
CBSD-C:	Centre for Biodiversity and Sustainable Development Cameroon
CDC:	Cameroon Development Corporation
CEMAC :	Communauté Economique et Monétaire de l'Afrique Centrale
CGIAR :	Consultative Group for International Agricultural Research
CGRFA	Commision on Genetic Resources for Food and Agriculture
CHM :	Clearing House Mechanism
CIFOR:	Centre for International Forest Research
CIG:	Common Initiative Group
CITES:	Convention on International Trade on Endangered Species
COMIFAC :	Commission des Forêts d'Afrique Centrale
COP:	Conference of Parties
CPB:	Cartagena Protocol on Biosafety
DABAC :	Développement d'Alternatives au Braconnage en Afrique Centrale
DGCD :	Direction Générale de la Coopération au Développement
FAO:	Food and Agriculture Organization of the United Nations
GIZ:	German International Cooperation Agency
GDP:	Gross Domestic Product
HEVECAM :	Hévéa du Cameroun
ICRAF:	International Centre for Agro-forestry Research
IITA:	International Institute of Tropical Agriculture
IMPM:	Institute of Medical Research and Medicinal Plants Studies
INS:	Institut National de la Statistique
IRAD:	Institute of Agricultural Research for Development
IRET:	Institut de Recherche en Ecologie Tropicale
IRScNB:	Institut Royal des Sciences Naturelles de Belgique
ITPGRFA:	International Treaty on Plant Genetic Resources for Food and Agriculture
ITTO:	International Tropical Timber Organization
LMO:	Living Modified Organisms
MINADER:	Ministry of Agriculture and Rural Development
MINATD:	Ministry of Territorial Administration and Decentralisation
MINEPAT	Ministry of Economy, Planning and Regional Development
MINCOMMERCE:	Ministry of Commerce

MINEPDED:	Ministry of Environment, Nature Protection and Sustainable Development
MINFOF:	Ministry of Forestry and Wildlife
MINEE:	Ministry of Water and Energy
MINEPIA:	Ministry of Fisheries & Animal Industries
MINRESI:	Ministry of Scientific Research and Innovation
MINREX	Ministry of External Relations
MINTOURL:	Ministry of Tourism and Leisure
MYFF:	Myrianthus Fosi Foundation for Biodiversity Conservation and Environmental Protection
NTFP :	Non Timber Forest Products
ONUFEEMMES :	Entité des Nations Unies pour l’Egalité des Sexes et l’Autonomisation des Femmes
PAPENOC :	Projet d'Appui aux Elevages Non Conventionnels
PHP :	Plantation du Haut Penja
Pas :	Protected Areas
SEMRY :	Société d’Expansion et de Modernisation de la Riziculture de Yagoua
SOCAPALM :	Société Camerounaise de Palmeraies
SoWBFA:	The State of World Biodiversity for Food and Agriculture
REDD+:	Reducing Emissions from Deforestation and forest Degradation, foster conservation and sustainable management of forest
RPFS:	Regional Programme for Food Security
TDCS:	Tadu Dairy Cooperative Society
TK:	Traditional Knowledge
UFA:	Unité Forestière d’Aménagement
UA:	African Union
UNEP:	United Nations Environment Programme
UNVDA:	Upper Noun Valley Development Authority
UNIKIS:	University of Kisangani
WWF:	World Wildlife Fund for Nature
ZIC:	Zone d’Intérêt Cynégétique
ZICGC	Zone d’Intérêt Cynégétique à Gestion Communautaire

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FOREWORD

Cameroon's rich agricultural biodiversity has for many years provided food, shelter, medicinal, social and economic benefits to individuals, communities and the country as a whole. The wide range of products seen in the internal and external markets and the food sufficiency, make our trade partners rank Cameroon among the countries with huge agricultural potentials. The various agro-ecological zones in Cameroon have their variety of products from biodiversity-related activities. In addition to the 21 common and regular food items produced in Cameroon, we are proud to register more than 300 plant species yielding edible fruits while over 500 species are classified as Non Timber Forest Products used for food and agriculture in Cameroon. Some products from the wild like Bush Mango (*Irvingia gabonensis*), Okok (*Gnetum spp*) etc. are heavily marketed within and outside Cameroon, while many others are used within village communities. Wildlife products also complement the requirements of the rural communities in food and agriculture. The need to conserve them for sustainable use is the challenge that the Government has been addressing through the creation of terrestrial and marine protected areas, domestication of plant and animal species, the encouragement of agro-forestry techniques and the use of improved planting materials, as well as the authorization for communities to own forests. Village communities are being taught modern farming methods linked with soil and water conservation. Government's innovation of "Second Generation Agriculture" will no doubt include industrializing the wild species whose domestication has proved encouraging. At village level, the threats are fought by the cultivation of those in high demand

Cameroon's employment rate in biodiversity-related activities is relatively high. In the agricultural sector, there are over 10 agro-industrial establishments and one of them, the Cameroon Development Corporation employs over 15000 workers; the fishery sector employs 240000; forestry accounts for 300000 jobs, while 30% of the population is engaged in cattle breeding (UNEP/MINEF, 2010). Crafts, ecotourism, food processing and marketing also provide direct and indirect jobs. Within the five agro-ecological zones, the fertile soils and luxuriant ever-green vegetation account for the variety of crops, livestock, fishery activities and the domestication of plant and animal species. All these encourage many Cameroonians to invest on biodiversity related activities and produce sufficiently for the internal and external markets. Some countries of the CEMAC sub-region are regularly provided with food products from Cameroon: tubers, cereals, fruits and vegetables while the cash crops like cocoa, coffee, timber, bananas, rubber, cotton are exported to Europe, USA and Asia. Farm products usually accompany introduction of domesticated species of plants and animals including conventional and unconventional breeding and the sale of cane rats, rabbits, frogs, snails all meant to satisfy local demands. Activities aimed at producing goods from biodiversity have reduced the rate of un-employment considerably.

This report is designed to respond to the FAO's invitation for national reports on the world's biodiversity for food and agriculture. It gives us the opportunity to have an update of the country's agricultural biodiversity, its products, productivity, and challenges. It also shows us the direction we should take if we must improve and compete with other world producers. We will also be able to draw lessons and make recommendations for appropriate short term and long term measures to stakeholders in the different areas of biodiversity.

Government's strategy in bringing Cameroon into emergence in the near future reminds all biodiversity stakeholders of the need to uphold the objectives of the Convention on Biological Diversity: conservation, sustainable use and the sharing of benefits from genetic resources. Cameroon is a party to the CBD and other biodiversity related conventions. Government has been endeavouring to encourage biodiversity stakeholders to implement such agreements accordingly. After signing the Cartagena Protocol on Biosafety, the Law on Biosafety was enacted in 2003. The International Treaty on Plant Genetic Resources for food and agriculture, the Regional Program for Food Security are among several regional and international initiatives to which Cameroon is a member. The Farmers, grazers and fishermen are constantly sensitized on their roles with regards to these obligations and research findings are made available to them on regular basis. The Ebolowa Agro-Pastoral Show in January 2011, presided over by the Head of State showed that agriculture and livestock activities are reliable income generating ventures. Thus Cameroon is fast moving from hand tool peasant farming to mechanized agriculture. The attractive prizes of some of our export products partly help to restrict youths in the rural areas for more production.

In appreciating the effort by the FAO for its regular assistance, The Ministry of Agriculture and Rural Development appeals to all biodiversity stakeholders that conservation, production and the sustainable use of Cameroon's agricultural biodiversity and its products is everybody's challenge. The Multi-sectorial Committee which I formed and chaired by the Minister Delegate with members drawn from various sectors and institutions of our biodiversity has worked seriously to produce this report. I am certain that we have all drawn inspirations from the technical expertise that led to this report. It will help us focus on the appropriate decisions, and sound management principles for increased production as well as recognizing appropriate programs and techniques for our food security. The livelihood of the farmer, the city industrialist, the trader consumer and the civil servant in Cameroon is unavoidably linked to biodiversity products and services.

**MINISTER FOR AGRICULTURE AND
RURAL DEVELOPMENT**

ACKNOWLEDGEMENTS

The report on the state of biodiversity for food and agriculture in Cameroon is the output of the valuable contributions from key actors involved in the domain of biodiversity for food and agriculture. These included representatives of ministries, local community groups, and national and international organisations as recognized below and to whom the Ministry of Agriculture and Rural Development remains grateful.

The process was carried out under the watchful supervision of the Minister for Agriculture and Rural Development, assisted by the Minister Delegate in charge of rural development who also presided over the report committee.

In order to guarantee the technical orientation from the FAO Secretariat of the Commission on Genetic Resources for Food and Agriculture and safeguard the cross sectorial character of biodiversity for food and agriculture issues, a Committee was set up (appendix 2).

The following scientists also provided information for the report: Dr. Songwa Denis, (CIFOR), Dr. Tieguhong Julius (Biodiversity International), Dr. Onguene Awana Nérée, Dr. Foahom Benard and Dr. Kameni Anselme (IRAD), Prof. Pamo Etienne and Dr. Ndongo Kounou Casimir (MINEPIA), Prof. Julius Oben, (University of Yaounde I).

EXECUTIVE SUMMARY

Cameroon's biological resources can be grouped into agricultural, fisheries, livestock, and the forestry sectors. Every sector has activities related to the nature of its resources. The six ecosystems and five agro-ecological zones constitute areas for either small or large scale production depending on the level of the operator and the demand of the product. About 80% of the population is actively engaged in biodiversity-related activities, most of which impact positively on the family revenue or on a greater extent, to the national economy and on foreign trade. In 2007, the contribution of biodiversity to the national Gross Domestic Product was 40.7% with 70% of the population engaged in agriculture. It is worth noting that the tropical forest zone covers 82.5% of the national territory and land under cultivation is estimated at 3% of the national territory (MINEF/UNEP, 2010). While deforestation through agriculture, logging and bush fires was estimated at 200.000 ha/yr; the population that depends on wild products for food and agriculture has continued to rise during the past 10 years. The relevant issue in the management of biological resources is the mastery of the various forms of resources, the management strategies and the need to exploit them in a sustainable manner for the welfare of the population and the economic advantage of the nation. This is why government sees the necessity to adopt sectorial policies and regulations accompanied by appropriate institutions to administer each sector accordingly. The Ministry of Agriculture and Rural Development caters for agricultural resources management and planning; the Ministry of Livestock and Fisheries focuses on domestic animals and fishery resources, while the Ministry of Forestry and Wildlife handles wildlife and forestry resources. The Ministry of Scientific Research and Innovation through its research institutes conducts and expands research in different fields and ensures that research results are available to all stake holders. Government cooperates and receives assistance (technical and financial) from international bodies on the sound management and sustainable use of resources from biodiversity. National organizations engaged in biodiversity-related activities assist government in sensitizing particularly the rural population and provide the much needed manpower for managing the resource in all the sectors.

Care has been taken towards capacity development in each sector such that the policies and regulations are strictly applied towards management for productivity in a sustainable manner. Resources which are regularly exploited for domestic and export market attract greater attention to enable the country compete qualitatively with products from other parts of the world. Cocoa, coffee, cotton and rubber are among the export commodities whose quality is handled by producer quality boards. There are laws and control staff as well as provision to sanction offenders. Provision of management capacities is seen through government's resolve to create state-run universities and professional schools. There are schools for fishery, wildlife, forestry and several institutions of agriculture. All these prepare young Cameroonians to acquire knowledge for resource management. The younger generation is being sensitized on modern advances in agriculture, product improvement using improved planting material, the domestication of wildlife species, and the need to diversify products following ecosystem adaptations, climatic and soil conditions. Since 2007, unconventional breeding has been practiced involving guinea pigs, rabbits, frogs, snails, cane rats and domestication of leaf vegetables like *Gnetum spp.*; the existence of fish farms for the growth of *Tilapia*, mud fish with consideration to increase the species variety, (MINEPIA, 2007).

Trends in resource management protection and exploitation have so far been encouraging. Emphasis have been on legal and institutional provisions, international cooperation, implementing treaties and conventions, some of which include the Convention on Biological Diversity, the International Treaty for Plant Genetic Resources for Food and of Agriculture, the Convention on International Trade on Endangered Species, the Nagoya Protocole and several others. There is progress towards the use of modern techniques in biodiversity resource management, through the application of the “Ecosystem Approach”, the use of improved planting material, the involvement of youths in agriculture, mechanization to improve production and the processing of farm and livestock products into finished products ready for the market. Cameroon’s policy of food sufficiency aims at reducing the importation of food types that can be produced in Cameroon and to create more jobs within major biodiversity-related sectors. Progresses in these areas also aimat improving productivity that can face competition in the market. Additional developments in key biodiversity sectors are the development of produce marketing cooperatives, involvement of more nationals in the fishing and the production of dairy products in the livestock sector. The export of food products particularly to neighbouring countries has continued to increase.

The Ministry of Agriculture and Rural Development continue to sensitize the rural population on the use of modern agricultural techniques and fishing methods that will not jeopardize future activities in the sector. Illegal forest exploitation, poaching and over-harvesting are among the practices that government is trying to reduce. Hunting using the burning of the vegetation or the felling of wild food producing species is being discouraged. Traditional Knowledge is valued through progressive surveys and ethno-botany studies in biodiversity hot-spots throughout the country. The Access to resources and the Benefit-sharing principle and resource property rights issues are closely followed up for implementation within rural communities. Continuous conservation and protection of habitats and ecosystem is followed up with the identification of major invasive species. Progress in this domain has been the establishment of a list of the major invasive species as well as a White and Black List in Cameroon. After enacting the law on Biosafety, efforts are now underway to prepare a draft law on biosecurity. The Cameroon Biosecurity Project which began in 2011 is working along those lines.

Plans for the future are contained in the various actions and strategies already developed in each biodiversity activity sector. From the national perspective, Government applies the “Participatory Approach” in the management of all biodiversity-based activities. There is the endeavour to encourage and finance Non Governmental Organisations, greater attention in the financing of agricultural activities through the creation of a Farmers’ Bank and the multiplication of producer cooperatives to enable the farmer/grazer/fisher folk to have fair prices for their labour. More plant and animal species from the wild are being domesticated and the farmer/grazer conflicts are reducing. Emphasis is being made towards the improvement of farm to market roads to enable farm products get to the market quickly and in good quality. For the protection of forestry and wildlife resources, more control staff are being trained and recruited. Through the creation of a fishery school, more Cameroonians are being encouraged to take up fishing as a worthwhile profession.

At the international level, there is every endeavour to implement the biodiversity-related agreements, cooperate with other international organizations (particularly those represented in the country) on

matters of biodiversity resource management. Cooperation ties with world bodies will brighten Cameroon's prospects through experiences and success stories in biological management and to improve the state of food and agriculture security.

This report is multi-sectorial and covers all aspects of agricultural biodiversity. That is why the composition of the data collection and report-drafting committee designed for this work involves the participation of all main biodiversity-related institutions in the country. Existing country reports and plans have been consulted principal amongst which are: *The Report of the Phylogenetic Resources of Cameroon, therevised*, *National Biodiversity Strategy and Action Plan*, *Cameroon's Fifth National Report on Biodiversity to the Convention on Biological Diversity* and the *PAPENOC reports on non-conventional breeding*. On-going activities in the principal biodiversity sectors in agriculture, livestock, forestry and fisheries are also included. The Institute of Agricultural Research for Development (IRAD) through its various structures within the five agro-ecological regions is well advanced in research towards improving growth performances of some species yielding wild foods. Its findings and annual public research fares have continued to teach stakeholders of various domains, the potential and values of some species which may not have existed or known useful in certain communities in the past.

Following the Table of Contents, chapters have been divided into headings in order to cover all the grounds as requested in the guidelines. However, the numbers in the guidelines have been maintained and they appear in brackets (x).

GLOSSARY¹

Agro-ecological zone: An open zone or ecosystem under agricultural management, dynamic and connected to other ecosystems through the transfer of energy or materials.

Agro-forestry: The collective name for land-use systems and technologies where woody perennials (tree, shrubs, palms, bamboos, etc.) is deliberately used on the same land management unit as agricultural crops and/or animals either in some of spatial arrangement or temporal sequence.

Biological Diversity: The variability among living organisms from all sources including *inter alia* terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Associated Biodiversity: For the scope of this report, associated biodiversity comprises those species of importance to ecosystem function, for example through pollination, control of plant animal and aquatic pests, soil formation and health, water provision and quality, etc., including *inter-alia*: micro-organisms, invertebrates, vertebrates, wild and cultivated terrestrial and aquatic plants other than crops and crops wild relatives in and around production areas.

Biodiversity for food and agriculture or agricultural biodiversity: It is the variety and variability of animals, plants and micro-organism that are used for food, fodder, fiber, fuel and pharmaceuticals. It also includes the diversity of non-harvested species that support production (soils, micro-organisms, predators and pollinators) and those in the wide environment that support agro-ecosystems (agricultural, pastoral, forest and aquatic) as well as the diversity of agro-ecosystems.

Bio-prospecting: It is the exploration of biodiversity for commercially valuable genetic and bio-chemical resources.

Bio-safety: It is the safe transfer, handling and use of any living modified organisms resulting from biotechnology.

Bio-security: This literally means 'safe life' and encompasses all policies and measures taken to secure humans, animals and plants against biological threats regardless of whether they are naturally occurring or man-made. It includes the prevention, detection and mitigation of damage by disease, pests and bio-terrorism to economies, the environment, (including water, agriculture and biodiversity) and animal health.

Biotechnology: A technique which uses living organisms to make or modify a product, to improve plants and animals or to develop micro-organisms for specific purposes

Genetic Resources: Are the genetic materials of actual or potential value.

¹ Definitions/Explanations of terms are those used by the United Nations Environment Program in relation to biodiversity (UNEP 1995) and FAO (1999).

Genetically Modified Organism: An organism whose genetic characteristics have been altered by the insertion of a modified gene or a gene from another organism using the techniques of genetic engineering.

Gene bank: Facility established for the ex-situ conservation of seeds, tissue or reproductive cells of animals or plants.

Habitat; The place or type of site where an organism or population occurs naturally.

Ecosystem: A dynamic complex of plant, animal, fungi and micro-organism communities and their associated non-living environment interacting as an ecological unit.

Ecosystem Services: Those services provided in an ecosystem which support or regulate conditions in an ecosystem. These include pollination, pests and disease regulation, water purification, and waste treatment, natural hazard, nutrient cycling, soil protection and formation, water cycling, habitat provisioning and provision of oxygen gas.

Ecotourism: Travel undertaken to witness sites or regions of unique natural or ecological quality or the provision of services to facilitate such travel.

Domestication: The process by which plants, animals, or microbes selected from the wild adapt to a special habitat created for them by humans.

Invasive species: An introduced species which invades natural habitats.

Ex situ Conservation: Keeping components of biodiversity alive away from their original habitat or natural environment.

In situ Conservation: Is the conservation of biodiversity within the evolutionary dynamic ecosystem of the original habitat or natural environment.

Seed Bank: A facility designed for the ex situ conservation of individual plant samples through seed preservation and storage.

Species: A population whose members are able to interbreed freely under natural conditions

Gene: The functional unit of heredity. It is part of the DNA molecule that encodes a particular protein.

Protected Area: A legally established land or water area under either public or private ownership that is regulated and managed to achieve specific conservation objectives.

Sustainable Use: The use of components of biological resources in a way and at a rate that does not lead to the long term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

Threatened Species: A species that runs the risk of disappearing in the future if appropriate measures for conservation are not taken.

Predator: An individual belonging to a species that feeds from another species.

Communal Forest: A forest which according which is reserved for the benefit of a community or a forest planted by the community on community land.

Community Forest: A forest in the non-permanent forest estate which is acquired and managed under a convention between a village community and the Forestry Administration. The management of such a forest is the responsibility of the village community with the technical assistance of the Forestry Administration.

A managed Forest: A permanent forest which is managed according to the management criteria set up by the Forestry law.

Forest Management Plan: A technical document made by the Forestry Administration or any authorized person(s) in the given circumstances and according to the studies undertaken in a Protected Area. In any case, management plans of protected areas privately owned can be done by the owners themselves.

Hunting Zone: A Protected Area reserved for hunting and managed by the Wildlife Administration, individuals, or authorized group of persons in which any form of hunting is subject to the payment of rights determined by the Finance Law. No hunting rights will be given to hunt animal species which are entirely protected.

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PROCEDURE USED IN PREPARING THE REPORT

The FAO Secretariat of the Commission on Genetic Resources for Food and Agriculture announced the need for National Reports on Agricultural Biodiversity and Food Security. This announcement contained directives on the model and content of the reports.

The Minister for Agriculture and Rural Development proceeded to designate a National Focal Point, a Technical Unit and a National Committee which were installed on the 4th February 2014. The Committee comprised 17 members drawn from government and private organizations involved in biodiversity activities nationwide (Appendix 1). A working Group was selected from the committee and the group was made up of experts in all domains of biodiversity. Their mandate and terms of reference were clearly defined.

The strategy adopted by the experts included the study of food products from crops, animals, forests and savannahs, marine and fresh water environments from the five agro-ecological zones and the six ecosystems in Cameroon. Information was got from existing national documents on the various forms of biodiversity all over the country. Visits made to the rural markets and interviews conducted with biodiversity stakeholders provided valuable information on the food security and agricultural practices in Cameroon.

Following the FAO guidelines, consultants laid special emphasis on associated cultivated and wild food products which were commonly used as food in the form of vegetables, fruits, spices, beverages, stimulants and other derivatives.

A questionnaire format distributed to consultants was used for interviewing individuals, groups of persons considered to be users of biodiversity. The information had to cover the five agro-ecological zones in the country. Appendix 2 shows the members of the Report Committee; they came from national and international institutions associated with biodiversity in Cameroon. An editorial committee set up by the Coordinator who was working with the Technical Unit constituted the backstop office which collected all the data from the field, assembled, analysed and made the first draft of the report. A series of meetings were held between the field consultants and the backstop office to make sure that the draft corresponded to field observations.

At each stage care was taken that the directives of the FAO Secretariat were strictly followed. The working draft was circulated to all members of the Technical Committee for comments. A draft Review Committee workshop presided over by the Minister Delegate (President of the Technical committee), was then held to validate the final draft. It was after validation that the report was presented to the Minister of Agriculture for his appraisal and signature before being dispatched to the FAO Secretariat for Genetic Resources for Food and Agriculture.

INTRODUCTION

Cameroon is Africa in miniature as far as biodiversity is concerned and for many years provided varieties of useful products for the local populations. These uses range from foods, medicines, shelter, cultural to economic pursuits. All classes of plant and animal species fall within the choice range for the various user groups for example most forest community dwellers largely depend on wild plant and animal species for their livelihood. In a project “*Beyond Timber*” coordinated by CIFOR and executed in Cameroon, D.R. Congo and Gabon it was discovered that the preference rate for wild foods in the three countries was 74% while the family average consumption rate was 5 times/week on the local population, (Tieguhong et al.2014). Today, the choice of wild foods has become so fashionable that even city dwellers regard their menu as incomplete if it does not contain their traditional ingredients from the wild. The high traditional values and degree of appreciation for some of these products have gained tremendous market recognition.

Over the years, the demand for wild foods and ecosystem services has risen considerably. Their use began in rural communities and today, some of the rural dweller have moved to cities and still look for their food preferences. Africans living in Europe and the USA customarily use their traditional foods, (particularly spices from the wild) shipped from Africa. Popular Cameroon menu seasoned and flavoured with specific wild products are served in African cuisines in Europe and America. International trade in some of the food species from the wild has developed such that this vegetable *Gnetum spp* is being served in restaurants in many parts of the world and the demand is only increasing.

This report has about 436 species of plants and about 130 species of animals used as wild foods found in the various ecosystems of Cameroon. The mention of many species in some genera/families as seen in Table 14, demonstrates the richness of Cameroon’s biodiversity notably in genera like *Ficus* (15 species), *Landolphia* (10 species), *Cola* (10 species), *Diospyros* (8 species), Mushrooms (32 edible types with 8 species belonging to the *Termitomyces* genus), *Tilapia* (9 species), *Cephalophus* (9 species) and the *Secuiridae* family (9 species). More intensive and extensive surveys of wild food products will be required in all the ecosystems to provide a better understanding of particularly those heavily exploited species. In addition to resource inventories, sound management techniques must be adopted since some of the species already form the basis for lucrative business. Activities involving the exploitation and marketing of *Pygeum africanum*, *Irvingia gabunensis*, *Gnetum spp*, and the export trade on parrots (*Psittacus erithacus*) as well as safari hunting have been considerable sources of revenue for the public and private sectors. Unfortunately the methods used in harvesting these wild foods have remained unorganized and rudimentary. The quest for more agricultural land and climate uncertainties cause exploiters to worry about their next harvest. The long drawn conflicts between wild foods harvesters and timber exploiters continue to provoke friction and disunity among groups and individuals within the same community. In the agro-pastoral regions, the farmer-grazer land problems remind Government’s intervention towards the provision of satisfactory and lasting land-use plans.

Even if we had substitutes for these wild foods, majority of the rural population would find it difficult to afford, the reason why through this work, the FAO advises countries to be conscious of the need to identify all wild plants and animals that yield products for food and agriculture. Subsequently, governments should follow-up with appropriate policies, legislation and management techniques to encourage the sustainable use of those products and services. The ecosystem approach has been strongly recommended and any management principle should consider the needs and realities of the rural dwellers. Several biodiversity stakeholders (including the rural dwellers) know that the fast disappearance

of the Cameroon forests directly correspond to the reduction of valuable food yielding species of plants and animals. In 2005, the rate of deforestation in Cameroon was estimated at 200.000ha/yr., (MINEP 2010). The Government on its part is endeavouring to follow up with plans to review some policies and laws, training programs and the implementation of bilateral and international agreements related to biodiversity. It is worth mentioning the encouraging efforts made in the area of “*Unconventional Breeding*” whose trials began in 2007 with the rearing of cane rats (*Thryonomys spp*), snails (*Achatina spp*) guinea pigs (*Cavia porcellus*), frogs (*Conruana sp*) and by 2013 the program had extended to four regions creating jobs for many Cameroonians.

With the high pressure on the natural forest and the increasing demand for wild food products, we suggest that priority be given to their sustainable use by all biodiversity stakeholders. Regarding research in wild foods, IRAD has made valuable contributions towards more knowledge and appropriate programs in this line. Some international organizations that work on wild foods include CIFOR, CBFF, IRET, UNIKIS, CGIAR, research on Forest trees and Agro-forestry. It is important that their research findings be made available to policy-makers for proper review of the legislations on agricultural biodiversity. There is as well, a great need for collection and stocking of a comprehensive data base on the list of national and international organizations intervening in Cameroon biodiversity (App 2), the specialized roles of some of the organization, the traditional knowledge stored in the rural communities and the active role of women in agriculture, fisheries and local crafts. Women are the main gatherers and traders in wild food products which have improved in no small way, their house-hold income. Measures are being put in place to encourage them especially towards food production through the revision of agricultural and land regulations as well as organising them into common interest groups and food cooperatives. Care should be taken that legislative measures and institutional arrangements be focused on conservation and sustainability backed by sufficient financial allocations.

Whether in managing issues on ecosystem products and services, trends on Cameroon conservation, man-made or natural disasters, addressing the problem of invasive species, the focus should be to conserve, manage associated biodiversity and use it in a sustainable manner. The experiences and lessons gained in reporting on “*The State of Cameroon’s Biodiversity for Food and Agriculture*” has strengthened collaboration ties among biodiversity stakeholders in Cameroon and will enable rural dwellers play a participative role in ensuring that wild foods need to be sustainably used.

CHAPTER 1: INTRODUCTION TO THE COUNTRY AND TO THE ROLE OF BIODIVERSITY FOR FOOD AND AGRICULTURE

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1.1. BACKGROUND

1.1.1. Geography

Location

Cameroon is located to the west of the Central African Sub Region, stretching from the Gulf of Guinea to Lake Chad. It falls between latitude 2° to 13° North of the equator and longitude $8^{\circ} 30'$ to $16^{\circ} 10'$ East of the Greenwich Meridian. The country covers a surface area of $475,385 \text{ Km}^2$ and has a coast line of 402 Km (Sayer *et al*, 1992). It is bounded to the South by the Republic of Congo, Gabon, Equatorial Guinea and the Atlantic Ocean, to the west by the Republic of Nigeria, to the North by Lake Chad and to the East by the Republic of Chad and the Central African Republic.

Relief

Cameroon has a complex relief which can simply be divided into high and low relief. High relief comprises four different units: Adamawa plateau, the western highlands, the south Cameroon plateau and mount Mandara. The Cameroon volcanic Line oriented SW-NE consists of the highest mountains which culminate to Mt. Cameroon 4100m.

Mount Mandara: Rises 900m above sea level with its inselbergs and abrupt slopes. Constitutes a beautiful touristic site and is one of the few UNESCO geo-heritages in Cameroon.

The Adamawa plateau: It is gigantic uplift that rises to 1 100 m. The northern slopes constitute the Ngaoundere escarpment (falaise) which descends to the vast Benue plain. To the south it descends gradually to the south Cameroon plateau. Its surface is organized in steps between 900 and 1500 m. Though relatively flat at the top it is spanned by a series of volcanic cones.

The Western highlands: This is comprised of large volcanic massifs of the central part of the Cameroon Volcanic line: Oku (3010 m) Bamboutos (2740 m) interrupted by vast plains of Ndop and Mbo. It is limited to the west by the Cross River cuvette and to the east by the Mbam. The western plateau can again be divided into three principal parts: Plateau Bamileke (1400-1800 m), the Bamoun plateau (1100-1200 m) and the grasfields (1500-2000 m) separated by escarpments e.g the Bamenda escarpment.

The South Cameroon plateau: Rises from 650-900 m and covers almost a third of the entire national territory. Limited to the north by the Linte-Yoko escarpment to the west by that of Matomb. It is relatively flat but this monotony is interrupted by the Mbam Minkom (1295 m), the inselbergs of Yaounde, the hard pan hills and massif of Ntem not far from Ebolowa.

The northern plains: It all starts from the Chadian plain where altitudes decrease from west to east (from 550 to 280 m) accidented by the inselbergs of Maroua. From there are the flood plains of the northern rivers which extend as far as to Lake Chad. The second is the sedimentary basin drained by the Benue just at altitude of 200 m. To the south of this are the granitic and volcanic massifs of Gorna, Tcholire and Mt. Poli.

The coastal plain: Forms the 360 km Atlantic coastline of Cameroon divided into 3 parts: the rocky coast and escarpments around Mt. Cameroon (60 km), the mouth of Cameroon composed of the Sanaga and

the estuary of the Wouri (220 km) and the rocky coast of the beaches of Kribi to Campo. It prolongs into the hinterland in the Mamfe basin and the sedimentary basin of Ndian and Douala.

Climate

The climate as is influenced by the Inter-tropical Front broken into three distinct climatic zones namely:

- **The Sudano-sahelian climatic zone** which stretches above 10° N with a dry season lasting 7 to 9 months annually with less abundant rainfall ranging from 300 to 900mm/year with annual temperatures exceeding 28°C.
- **The Sudano-guinean climatic zone** which extends from 7° to 10° with a dry season lasting 5 to 6 months in the year with annual rainfall averages of about 1000mm with average temperatures of 22°C.
- **The Equatorial climatic zone** which extends from 2° to 6° N is characterized by average annual temperatures of about 25° with important vegetation cover of which some is mangrove in the coastal zone. The abundant rainfall is in the order of about 2000mm/year. Around Mount Cameroon, annual rainfall can be about 12m in Dedundsha which is actually one of the rainiest places in the world.

Vegetation:

Cameroon is sometimes considered as a condensed tropical Africa as illustrated by its vegetation. It has over 8000 species of flora repartitioned in vegetation units, grouped in regions domains and sectors.

➤ Congo-Guinean Region:

This is the humid tropical evergreen forest with gigantic trees that grow above 50-60 m in height.

In the **Atlantic sector**, mangroves cover the delta of the Niger River (Nigeria), Wouri, and estuaries of rivers Sanaga, Nyong and Ntem. The mangroves constitute a very fragile ecosystem. The main mangrove found here is *Rhizophora racemosa*. The Atlantic littoral forest develops on the lower plains, characterized by the abundance of two big tree species: *Lophira alata* (Azobe) and *Coula edulis* (Ewome). Endemic species here include, *Allexis*, *Cola* and *Rinora*. The primary forest of the Atlantic sector is fast disappearing due to over exploitation within the last two centuries.

The **Biafran Forest** borders from the Gulf of Guinea from Cross River to Nyong. To the south of Mamfe, it is in contact with the nord-western forest still intact and preserved. To the east of Mt. Cameroon, this forest stretches to the Nkam plain and Makombe and meets Ndikinimiki and Yaounde. It houses big trees with diameters of up to 4 m like *Microberlinia bisulcata* and *Piptadeniastrum africanum*. To the south of Yaounde most of the primitive vegetation is disappearing in favour of coffee and coco plantations.

In the **Cameroono-congolais** sector the Dja district is characterized by very large trees with the absence of semi-deciduous forest. There is abundance of inundated forest.

Within the **Congo-guinean** domain, semi-deciduous forest differentiates into numerous trees with tabular cymes. Here there is high abundance of Sterculiaceae with *Cola* characteristics, *Cola altissima*, *Cola*

gigantea. The herbaceous strata mainly made of Andropogonaceae is well developed making light to reach the soil.

Guinea-sudanian sector composed of perifereste savannah with *Pennisetum purpureum* (elephant grass), savannah with *Imperata* and elements of forest. Forest is juxtaposed in mosaic composed of Guinean flora: *terminalia glaucescens*, *Albizia adianthiifolia*, *Albizia zygia*. Some of the savannah components are highly used for construction.

The **Afro-alpine prairies** found mainly on Mt. Cameroon and Mt. Oku. On Mt. Cameroon it is affected by volcanic outpours while on Mt. Oku it is affected by overgrazing.

Great agricultural activities take place in the three sectors described above. Oil palms, banana, rubber and tea plantations exist at industrial levels. Peasant farmers cultivate maize, cocoyams, yams, cassava, groundnuts, etc. for local consumption and the market. There is also the domestication of wild plants and animal species.

➤ **The Sudano-Sahelian Region**

This extends from 6° N to Lake Chad and composed of mixed vegetation of grass and shrubs.

The **sudano-guinean** sector occurs at altitudes of 800-1200 m principally on the Adamawa plateau with abundant *Daniellia oliveri*, and *Lophira lanceolata*. This sector is noted for its high cattle breeding potentials.

Medio-sudanian sector is found to the north of the Ngaoundere escarpment and corresponds to woody savannah. Intense agricultural activities take place here. We can distinguish a northern part with abundant *Anogeissus leiocarpus* and *Uapaca togoensis* and a southern part with *Isobertia doka*.

Sudano-sahelian sector extends from 8°30' to 10°N and marks the northern limit of certain sudanian species: *Amblygonocarpus andongensis*, *Lophira lanceolata*, *Vitellaria* etc. Mt. Mandara constitutes an imbrication of sahelo-sudanian type but population pressure has put in place anthropogenic vegetation on terraced farms: *Ziziphus mauritiana*, *Olarrihena floribunda*, *Celtis integrifolia* etc.

Sahelian domain comprises two types of vegetation: spiny formation with different types of Acacia (*Acacia seyal*, *Acacia Senegal*, *Acacia nilotica*) and periodically flooded prairies. However, in heavily populated areas, selected population by man tends to dominate.

Soils:

The majority of soils of Cameroon are linked to the parent rock, topography age and also the bioclimatic medium where it is formed. Generally in Cameroon we can identify the following types of soils:

- **Less evolved sols:** Considered as rich and fertile, they can be hydromorphic, carbonated, halomorphous and are founded in Lake Chad and on recent volcanic ash of the western massifs.
- **Vertisols:** are clayey and sometimes called swollen clays because of some physical properties and chemical properties. They are found around the Lake Chad and Maroua.

- **Andosols:** are young with homogeneous profiles and always poorly evolved. Often saturated with nutritional elements and have less abundant organic matter. Considered as good soils for agriculture, they are found on the basic rocks of the Cameroon volcanic line.
- **Fessiallitic and ferruginous sols:** are reddish brown homogeneous fessiallitic soils considered very fertile. They are abundant to the south of 9° N.
- **Ferralsols:** cover almost 2/3 of the national territory to the south of 8°N. Minerals are all hydrolysed due to abundant rainfall and high temperatures. They are generally poor in nutritive elements, acidic and fragile.
- **Hydromorphic sols:** are dominated by excess water with grey and discolored horizons. Containing lots of swollen clays, they are found in Lake Chad basin. They are humic and acid in the south and basic in the north.

1.2. Hydrology

Cameroon has a rich fresh water system comprising river basins, (Figure 2), hydroelectric dammed lakes and about 50 crater lakes dotted along the Cameroon Volcanic Line. Total inland water surface is estimated at 39,600km² made up of rivers (1000km²), flood plains and marshes (34000km²), natural lakes (1800km²) occupying about 4% of the water mass, the rivers and streams about 3% while the rest of the water surface area is estimated at 86%. The artificial reservoirs cover an area of about 2800km² (Afian, 1991, MINEF 1996b).

The Adamawa plateau constitutes the main watershed for Cameroon from where rivers flowing to the north and south take their rise. To the south you have the Atlantic and the Congo hydrographic basins; to the north we have Niger and Chad basins. Water regimes are controlled by latitude and climate. The Atlantic basin is the most extensive with its watershed of 140000km³ and river Sanaga with length of 920 km is the longest river in Cameroon. It pours out 66 billion m³ of water per year into the Atlantic Ocean. During the rainy season, its flow rate goes up to 7600m³/s. The other rivers take their rise from the western highlands and include Rivers Manyu, Ndian, Meme, Mungo, Wouri, Dibamba etc. or the south Cameroon plateau like the Nyong (800 km long is navigable for 250 km), the Lakoundje, Kienke, Lobe and Ntem Rivers of the Congo basin include: Ngoko (120 km) and the Sangha. Benue river to the north (1400 km with 350 km in Cameroonian territory), transfers at least 5.5 billion m³ of water per year into the Niger. The Lagdo hydroelectric dam is built on it and it has a watershed of 31 000Km². Less extensive is the Chad basin which is drained by the Chari, LogoneEl Beid, Serbewel, Mayo Tsanga and the Yaere flood plains. From Mayo Kebi to Lake Chad you have vast flood plains that are inundated almost seasonally.

These water resources are habitats to very rich plant and animal biodiversity on which the rural population depends.

1.1.3. Human activities

The increase in human population and resource consumption led to the destruction of natural habitats and the overexploitation of many wild life species added to the consequences of pollution, global warming and the introduction by humans of alien invasive species. The impact of agricultural activities (crops, livestock and timber plantations), the extractive industries (mining, fishing, logging and pickups), the human development activities such as transport and urbanization is very important in the destruction of biodiversity in Cameroon. Also, Cameroon's geographical position influences migrants from other countries in Africa. This explains the high degree of ethnic groups (over 230) which influences biodiversity in food and utilities.

1.1.4. Population and Administration

Cameroon is divided into 10 administrative regions: South, Centre, Littoral, South West, West, North West, Adamawa, North, Far North and East. Following the recent census, there were about 17,463,836 million inhabitants in 2005. This population is spread both in rural and in urban areas with an average density of 37.5 inhabitants /km² with a marked difference in the density within the regions. There are 7.1 inhabitants/km² for the East Region whereas 124 inhabitants/km² can be recorded in the Littoral region. Based on the trends in the evolution of the population of Cameroon from 1976 to 2005 (results of the 3rd census) the population of Cameroon in 2012 is about 20,386,799 million inhabitants. (BUCREP, 2005).

1.1.5. Economy

The Gross Domestic Product (GDP) of Cameroon was valued at 13,514.7 billion FCFA in 2012 against 9,792.3 billion FCFA in 2009. In 2012, the GDP of Cameroon was about 30.19 % of the CEMAC GDP. The GDP growth rate in real terms in Cameroon between 2007 and 2012 shows an evolution (in%) of 3.3 to 4.6 and the inflation rate moves from 5.3% to 2.4% during the same period (INS, 2013).

According to the National Institute of Statistics, in 2013, the Cameroonian economy earns a point growth compared to 2012: the growth rate was 5.6% against 4.6% in 2012. This growth was mainly driven by internal demand and results from a sharp increase in spending on final consumption.

From the supply side, the services sector continues to drive growth. It reached 6.3% in 2013 against 5.4% a year earlier, and its contribution to GDP growth is 2.8 points. This dynamism is mostly made of branches "trade, restoration, hotels, transport", and "Warehouse and Communication", which respectively contributed 2.8 and 2.1 points to the growth of the sector.

The secondary sector continues to consolidate with a rate 5.7% in 2013 from 4.9% in 2012, contributing 1.3 points to growth in 2013. This development is mainly driven by the branches of "Buildings and Public works" (12.9%), the "Mining" (+ 8.7%), as well as "Electricity, gas and water".

The primary sector continues to recover by displaying an increase of 3.7%, one percentage point more than in 2012. Its contribution to growth in 2013 was 0.8 points. The good performance of the primary sector is to be credited to "Export Agriculture" (+ 6.9%), "Farming and hunting" (+ 4.8%) and "Agricultural food products" (+ 3.9%). The upward trend in activity in these branches is to be linked with actions such as supervision of farmers and intensification projects and improved seed programs for the high consumption of crops such as cassava, maize and plantain; and also the implementation of development programs of sectors in livestock industry for the benefit of producer organizations.

Cameroon is the greatest exporter of food crops to the Central African Sub-region. Cameroon is food sufficient but imports food products like fish. Fish imports in 2013 were estimated at 205,295 tons for a value of 144,199,240,000 FCFA (INS, 2013).

1.2. Background Information Sheet

The Background Information Sheet for Cameroon shows the demographic, economic, land-use, land classification, biodiversity characteristics and the ground water situation. This information shows Cameroon’s rich potential in biodiversity products and ecosystem services.

DEMOGRAPHIC	
Population.....	21 000 000 inhabitants
Population Density.....	44.9 inh/km ²
Population Growth.....	2.6%
Urban Population.....	50%
Females.....	5.59%
Engaged in Agriculture.....	70%
Engaged in Industries.....	21%
Engaged in Tertiary Sectors.....	9%
Ethnic Groups	230

Source: INS, 2013

ECONOMY (GDP Growth in the primary Sector)		
SECTOR	% GROWTH	
	2010	2013
Primary Sector	6.0	3.7
Agriculture Food Crops	3.7	3.9
Agriculture Industrial and Export	7.8	6.9
Livestock and Hunting	2.7	4.8
Sylviculture and Forest Exploitation	32.8	-1.8
Fisheries	3.4	2.8

Source: INS, 2013

LAND USE TYPE (2007)	
Agricultural land.....	91,600km ²
Permanent Crops.....	12,000km ²
Forest Area.....	208,050km ²
Protected Area.....	2682,407 ha
Arable land.....	59,600 km ²
Permanent Meadow.....	20,000km ²
Rate of Deforestation.....	270,000ha/yr

LAND CLASSIFICATION	
Area of Territory.....	475,446 Km ²
Land Area.....	472,710 Km ²
Tropical Forest Zone.....	397,700 Km ²
Wooded Savannah.....	101,992Km ²
Coastal &Maritime.....	9,670 Km ²
Stretch of Coast line.....	402 km

Source : Adapted from NBSAP, 2012

GROUND WATER RESOURCES OF CAMEROON

AQUIFERS	VOLUME (M ³)	% TOTAL
LAKE CHAD (Sedimentary)	3.2	5.72
BENOUE (Sedimentary)	15.75	28.14
COASTAL BASIN (Sedimentary)	21.63	38.64
Bassement rock zone	15.40	27.1
NATIONAL TOTAL	55.98	100

1.2.1. Principal Products from Cameroon's Biodiversity

Cameroon's rich biodiversity results in the production and the marketing of a large variety of plant and animal products as shown in table below.

Cameroon's Products from Biodiversity

CASH CROPS	FOOD CROPS	DOMESTIC ANIMALS	FOREST PRODUCTS	WILDLIFE	FISH AND HALIEUTIC PRODUCTS
Cocoa	Plantains	<u>Conventional</u>	Timber	Mammals	Sea Fish
Coffee	Cocoyams	<u>Breeding</u>	NTFP ¹	Reptiles	Fresh water
Rubber	Cassava	Cattle	FFP ²	Amphibians	fish
Palm Oil	Yams	Goats	Medicinal	Birds	Shrimps
Cotton	Rice	Sheep	Products	Insects	Crabs
Groundnuts	Corn	Poultry	Furniture	Molluscs	Lobsters
Bananas	Sweet	Pigs	Material	Caterpillars	
Tea	Potatoes	<u>Non conventional</u>	Bulding Material	Larvae	
Bush Pepper	Irish	<u>Breeding</u>	Charcoal		
	Potatoes	Snails	Arts and Culture		
	Fruits	Cane rats			
	Vegetables	Guinea pigs			
	Spices	Rabbits			
		Giant rats			
		Frogs			
		Quails			

¹: Non timber Forest Product; ²: Food Forest products

Source: UNEP/MINEP, DEPCS-MINEPIA

Cameroon Main Cash Products: 2007-2012

Cash crops (Tons)	2007	2008	2009	2010	2011	2012*
Cotton (fibre)	73,082	45,651	53,514	52,985	61,392	82,124
Bananas	233,054	268,768	259,100	277,774	296,110	285,789
Coffee	47,792	50,687	54,483	57,795	46,819	43,000
Cacao	212,619	229,203	230,032	244,077	246,120	250,000
Rubber	43,807	53,744	52,497	50,215	50,983	46,318

*estimation on production

Source: INS 2013

Here are the varieties of food crops from the various agro-ecological zones:

Cameroun Main Food Crops 2012-2013(in tons)

year	Paddy rice	Maize	Millet	Sorghum	Irish potatoes	Sweet potatoes	Cassava	Colocasia	Yams	Beans
2012	181,818	1,749,976	1,296,814	1,425,895	210,015	327,126	4,287,177	1,614,103	537,802	489,851
2013	194,094	1,647,036	1,355,170	1,490,060	219,192	327,126	4,596,383	1,551,596	556,647	510,925

Source: www.countrystat.org/cmr, INS 2013

year	Voandzou	Vegetables	Soya beans	Ground nuts	Palm oil	Shea nuts	Sesame	Tomatoes	Cucumber and gherkin	Pepper
2012	34,778	272,649	11,742	633,799	265,570	383,464	50,803	889,794	219,285	37,307
2013	36,639	479,862	12,241	666,947	287,612	415,292	51,496	954,384	224,903	41,548

Source: www.countrystat.org/cmr, INS 2013

year	Onions	Okra	Bananas/ plantains	Grape fruit	Peach and nectarines	Water melon	Mangoes	Pineapples	Pawpaw	Ginger
2012	181,818	1,749,976	1,296,814	47,819	327,126	50,108	4,368,705	167,853	327,972	44,990
2013	194,094	1,647,036	1,355,170	50,927	327,126	51,893	4,674,514	171,509	349,290	46,350

Source : www.countrystat.org.cmr, INS 2013

Levels of principal food/cash crop production (2011)

CASH CROPS (tons)		FOOD PRODUCTION (tons)		FRUITS/ VEGETABLES (tons)	
Arabica Coffee	8,563	Cassava	4,776,787	Cow peas	154,914
Robusta Coffee	38,256	Plantains	3,425,757	Onions	184,032
Cocoa	246,120	Cocoyams	1,568,804	Sesame	44,563
Cotton	61,392	Corn	1,572,067	Pineapple	165,471
Banana	296,110	Millet/sorghum	1,240,970	Cucumber	198,988
Palm Oil	135,215	Yams	517,069	Ginger	40,531
Groundnuts	564,230	Beans	366,463	Okro	63,533
Rubber	50,983	Sweet Potato	307,687	Water Melon	46,113
Timber	2,086,244m ³	Irish Potato	196,817	Hot Pepper	33,310

Source: www.countrystat.org/cmr, INS 2013

Levels of principal domestic animals and fish production

TYPE OF BREEDING	LIVESTOCK SPECIES	POPULATION (number)	TYPE OF FISHING ACTIVITY	FISH SPECIES	QUANTITY (tons)
Conventional	Cattle	5 805 297	Industrial	Fish	36 385
	Goats	2 952 624		Shrimps	9 335
	Caprine	6 298 059	Maritime artisanal		32 735
	Pigs	3 112 973	Continental		16 263
	Poultry	72 758 691			
Non-conventional	Snails	40 000	Rabbits		267 120
	Cane rats	15 120	Frogs		-
	Giant rats	NA	Quails		2 893 680
	Bees++	106 560	Guinea pigs		1 320 840
	Others+	183 960			

+Domestic animals (dogs, cats, horses), ++Bees farms

Source: DEPCS-MINEPIA

Two products do clearly illustrate the exceptional character of part of Cameroon's biodiversity for food and agriculture. Reference is being made here to the Penja white pepper and the Oku honey. These two products have been recognized and presently do benefit from some international status with the "Protected Geographical Indication"; in view of their valorization and protection in 16 African countries members of the African Organization for Intellectual Property (OAPI).

The Penja white pepper is cultivated in the tropical lowlands of the eponym region. The geographical habitat for the Penja white pepper is generally situated in the hilly relief area on the south of Mount Kupe between the Littoral and South West Regions of Cameroon. This is situated between 100 and 500 meters of altitude and, on basaltic sub-soils of the fourth era.

The Penja white pepper has a unique taste thanks to the qualities of the Penja volcanic soil. In as much as all colours do exist for this plant (black, green and red); the one with the white colour is more appreciated by consumers because of its good taste which is somehow pepperish and its very specific aroma which is comparable to none other.

The Oku honey is produced in the Kilum-Ijim protected mountainous tropical forest. With up to 3011 meters of altitude, the forest covers a total surface area of about 20 000 ha offering an exceptional biodiversity: rich flora, endemic birds, elephants and loved by some very unique monkeys.

The bees do not live spontaneously in this forest: bee farmers have their hives colonized in the plains before transporting them to the forest to have them installed on trees. The quality of the honey is directly linked to the forest and specifically to two plant species: *Schefflera abyssinica* and *Nuxia congesta*; whose flowers are highly appreciated by the bees. The oku honey has a sweet and slightly acidic taste, soft, creamy and fairly granular texture.

(3)

1.2.2. Role of Biodiversity for Food and Agriculture

As an agricultural economy in West and Central Africa, Cameroonians owe much to the country's biological resources: plants, animals, micro-organisms for their food and economy. This is seen in the conservation and sustainable measures being undertaken for the resources, the evolution in the use of biodiversity for food and agriculture and their contribution to national economy.

1.2.3. Generalities on the Biodiversity of Cameroon

The country's geographical position, climatic variations and the rich volcanic soils of the west account for the ecosystem variations and species diversity. This renders the biodiversity of Cameroon very rich in fauna, flora and micro-organisms. In Africa, Cameroon ranks fourth in floral richness and fifth in faunal diversity (UNEP, 1995). Most of Africa's ecosystems are founded in Cameroon. The UNEP/MINEP, (1999) biodiversity studies have classified Cameroon into six ecosystems, while IRAD classifications divide the country into five agro-ecological zones. The main characteristics of Cameroon's biodiversity are abundance, endemism, diversity, threat, invasion, over-exploitation, discovery and domestication.

Conservation and sustainable use

Considerable effort has since been underway to conserve particularly much of the threatened biological resources and the endeavour to sustain the availability of their products and services. This is demonstrated in the following actions:

- **The laying down of policies** in Agriculture, forestry, Livestock, fishery and environment and enforcing these regulations;
- **Restoration and creation of new Protected Areas** including marine protected areas. From 1996 to 2013, protected area coverage rose from 1164842 to 9124666 hectares, UNEP /MINEP, MINFOF (2013).
- **Agricultural Techniques and Technologies** are being adopted in farms and plantations.
- Gene banks have been created to conserve existing variations of desired plants and animal species.
- **Better Land-use Principles and Extension Services.**
- Research results now reach the farmers, fishermen and grazers.
- **Regeneration Methods** are applied through the creation of new forest plantations for poles, fuel wood and timber.
- **Promotion of Aquaculture** through better fish production techniques and **introduction of improved** species, breeds and varieties of fish to increase the population's protein intake.

- **Improved animal reproduction techniques** like artificial insemination (Tadu Dairy and Heifer Project International) and embryos transfer in cattle (IRAD) to improve breeds for beef and dairy products

Evolution in the use of Biodiversity for Food and Agriculture

In recent years, the population's demand for food and ecosystem services has increased and government is conscious of this demand. Among the strategic measures are:-

- Extension programs to attract encourage farmers and herdsman towards new production;
- Provision of inputs and improved planting materials;
- Multiplication of research stations and availability of research results in all the agro-ecological zones;
- The domestication of plant species whose products are in high demand; like leaves of *Gnetum spp*, (Eru,Okok) seeds of *Irvingia spp*, (Bush Mango) *Ricinodendron heudelotii* (Njansang) already feature in the international markets but so far only *Gnetum* is being domesticated and not yet at commercial quantities (CIFOR, ICRAF and IRAD);
- The domestication of wild animal species like cane rats, giant rats, frogs, quails, are practiced to maintain cultural habits and as well as the need to improve income of the local population(IRAD, ICRAF, DABAC, PAPENOC, Heifer Project International, PEAC.);
- The increase in production centres for propagation intended for conventional and non-conventional breeding (MINEPIA)as well as for the improvement of vegetative material(IRAD, MINADER).
- Enacting the law N°94/01 of the 20 January 1994 related to the sale of bush meat and NTFPs including products from domestication.
- Increase of the institutional provisions and improvement of the legal provisions to assist in management and control processes.

Through the introduction of food processing facilities considerable value has been added on Cameroon's food products. Cassava grinding machines have been introduced in communities where the tuber is grown while palm oil presses are available in communities where oil palm is the main economic crop. Due to the high degree of post-harvest losses from harvest to the pot, it is important that special attention be given to post-harvest loss and also that appropriate structures be provided for the domestication of NTFPs (driers, grinding machine). Production levels in the agricultural sector have been very encouraging especially with the high demand for these products out of the country. Cassava production in 2005 was 2.2 million tons and in 2011 it rose to 4 million tons due to the high demand and government efforts to industrialise the sector.

Importance of Biodiversity in Food and Agriculture

Majority of Cameroonians depend on biodiversity for their food, shelter, and health especially in rural areas. Due to the importance of biodiversity, Government is placing a lot of emphasis on economic planning. The variety of ecosystem services enjoyed by many communities depends strongly on the variation of agro-ecological zones and biodiversity richness. Among the benefits associated to biodiversity in Cameroon are:

Food

More than 90% of the rural population and about 80% of the urban population depend on biodiversity for their food. Surveys have shown that the main forest foods can be grouped into seeds, green vegetables, spices, mushrooms, wines and honey. Bush meat and fish both fresh water and marine are main sources of proteins and serve as the principal diet for rural population especially the Bakas of the South and East Regions. The role of organic fertilizers is mainly known by the rural and urban population.

Medicine

Most rural communities in Cameroon depend on plant and animal parts for medicine. This practice does not end in the rural areas but has also extended into big cities. Sometimes this might be due to lack of proper health care facilities but we still have many Cameroonians who believe that some illnesses can only be cured by medical traditionalists using these specific biological species. Ethno botanic studies in the Korup Area in the South West Region named over 500 plants or plant parts used by the indigenous population for the treatment of various kinds of diseases.

Shelter

In Cameroon, the construction of houses uses at one point or the other, materials from the wild which consist of sticks, timber, leaves, bark, ropes, grass, etc. Grass is predominantly used as the roofing material in villages in the savannah and sahelian regions while thatched palm leaves are used in the forest regions and areas where different palm species grow. Research carried out by Duncan et al, (1989) identified 63 plant species capable of yielding planks, building poles, and carving in the forest zone alone while 8 were seen as the source of gums, rubber and resins. The leather and skins are valued for furniture while other animal parts are used for decoration, game trophies, charms, musical instruments, kitchen utensils, arms and other cultural values.

Employment

Biodiversity employs about 84.2% of the country's population (MINEF, 1996). A large proportion of the Cameroonian population is engaged in biodiversity-related activities. Those in rural areas are farmers, hunters, grazers, fishermen, traditional practitioners and in small crafts like weaving, carving, wine and oil production. Agro-industrial establishments employ many workers of various categories.

Commerce

Since the beginning of last century, there have been increased economic activities in internal and external trade on commodities from various forms of biodiversity. The principal export commodities have been cocoa, coffee, rubber, timber, bananas, etc. Cameroon's trade partners are countries of the CEMAC Sub-region mostly for food commodities while Europe, the USA and Asia trade in cash crop items. The commercial importance accorded to animal products from non-conventional breeding and NTFPs has continued to rise. The internal trade flourishes between various regions as evidenced in the commodity markets within the country.

Tourism

Eco-tourism has continued to be a major foreign trade activity in Cameroon. The national parks, the endemic plants and animal's species as well as new discoveries of plants, have continued to attract tourists in Cameroon. The number of tourists visiting Cameroon is constantly increasing. For example, in 2013, 912 000 international tourists has been registered against 451 441 in 2006; an increase in the relative value of more than 100% (INS, 2013).

Research

Many national research programs are based on the country's biodiversity components. IRAD and IMPM have for over the years focused on agricultural research involving agronomy, animal and fishery, food composition and nutritional value research. Research centres are found in the five agro-ecological zones to cater for the problems of crops and animal species in each zone. The Ministry of Scientific Research and Innovation regularly makes research results available to biodiversity stake-holders. Universities also carry out research in the various fields of agriculture. In addition to agricultural research, investigations and various forms of studies are being undertaken based on the socio-economic interests of the population.

Institutional and Legal Provisions

The Government lays importance on biodiversity through the signing of bilateral agreements and international conventions related to biodiversity.

- In Decrees creating new ministries, more than seven ministries related to biodiversity were formed; they include MINADER, MINEPIA, MINFOF, MINRESI, MINEPDED, MINCOM, MINTOUL, MINEPAT, MINATD and MINEE.
- There are national laws and decrees of application (biosafety law, environmental law, Forestry and wildlife law, orientation law on territory aménagement and sustainable development, etc.) and international conventions (CBD, CPB, ITPGRFA, including Nagoya Protocole) on the management of biodiversity and products.

Traditional Knowledge and Cultural Values

As party to the Rio Convention on Biological Diversity, Cameroon is aware of the need to recognize the existence of Traditional Knowledge (TK) and the Government thus encourages the use and documentation, especially within the rural communities. There is the improvement of studies in medicinal plants and animals through the creation of the Institute of Medical and Medicinal Plants Research (IMPM) and the survey of medicinal plants which led to the publication of The National Pharmacopeia, (Adjanohou et al, 1996). Tradi-practitioners collaborate with the Ministry of Health.

Cultural Values

Cameroon with a population of about 21.1 million inhabitants in 2013 has 250 ethnic groups and 230 languages (INS, 2013). The increased use of biodiversity for cultural and spiritual requirements is practiced all over Cameroon. Every tribe attaches a cultural and spiritual value to specific plants and animals around them. Indigenous people are said to be communicating with the non-human world through invisible spirits, (Gray, 1999).

National Economy

Cameroon's economic activities are based on biodiversity products and services and so greatly contribute to national economy. In 1994, biodiversity contribution to the GDP was 34% and accounted for 82% of the country's working population. MINEF (1997) show that the population engaged in Crop production was estimated at 65%, while that involved in Animal Husbandry stood at 30%.

Economic importance of the Forestry and Wildlife sector is seen through the survey of Non timber forest products (NTFP) undertaken in the Takamanda Forest Reserve by Ayeni et al 2001. The survey showed that income from NTFPs was estimated at 500 million FCFA (1million US dollars) in the Takamanda Forest Reserve and in another survey conducted in six villages around Mount Cameroon, Nkwantoh et al (1998) identified 27 products as income sources for the women in those villages.

Changes on Agriculture and Food Security

During the past decade, policies related to agriculture, livestock, fishery and forestry and food security in general changed considerably as can be seen in the following sections:

In Livestock

- Increased production: Evolution in animal numbers between 2010 and 2012

Principal	2010	2011	2012
Cattle	4 843 104	5 084 754	5 527 128
Sheep	3 739 325	2 879 280	2 974 297
Goats	5 405 046	6 053 651	5 950 739
Pigs	2 440 404	2 806 464	2 896 271
Poultry	70 176 806	65 286 625	66 592 358

Source: INS, 2013

Today, there is remarkable increase in the production of meat and dairy products and all the chicken consumed in Cameroon is produced locally.

In crops production

- Provision of more agricultural inputs
- Mechanizing agriculture and assisting in the manufacture of farm tractors and farming tools.
- Establishment of agricultural research specialized structures in all the agro-ecological zones in Cameroon and communicating research findings to all stake-holders.
- Under the revision of the land-use policy land is becoming available to those who want to use it.
- The farmer/grazer conflicts are promptly settled and land uses clearly defined.

In Fishery Sector

In the past, 90% of fisher people in the high seas of Cameroon and multipurpose hydro-electric dams were foreigners. In an effort to let Cameroonians develop interest in this sector, the government has laid emphasis on the:

- Enforcement of the regulations on fisheries
- Promoting fish farming by providing technical assistance and distribution of fingerlings to fish farmers.
- Fishery research has intensified with the existence of a fishery research station in Batoke, South West Region.
- The creation of specialized IRAD Centers with the existence of fishery research stations in Batoke (S.W. Region), Kribi, (South Region) and in Foumban, (West Region).
- The creation of the institute of Fishery Sciences in Yabassi (University of Douala) and
- The Fishery Marine Academy is another landmark – it will encourage young Cameroonians and others to invest and improve on the fishing profession, (Njock, 2014)

In forestry and Wildlife

This sector is controlled by the Ministry of Forestry and Wildlife which ensures the sustainable use of forestry and wildlife resources. The rural population in particular is being sensitized on the strict application of forestry and wildlife regulations. In recent years, there has been an increase of protected area coverage. From 2008 to date, the increase has moved from 1,164,842 ha to 3,100,000 ha which is approximately 11% of the national territory (MINFOF, 2015). It is worth noting that habitat change through human activities has adversely affected biodiversity.

In domestication/Unconventional Breeding

The domestication of plants and animal species has been encouraged all over the country. The common wild plant and animal species under domestication are:

- a) **For plant species:** *Gnetum spp*, *Coula edulis*, *Ricinodendron heudelotii*, *Baillonella toxisperma*, *Irvingia gabonensis* etc - serves the internal and external markets of Nigeria, Europe and the USA.
- b) **For livestock:** Due to its very high internal demand, cane rats appear to be the central species on which the domestication of other wildlife species revolves. It is followed by guinea pig, frog, snails, giant rat, quails, rabbits and bee-farming.

In genetic Resources

Gene banks have been created for some major crop cash (cocoa, coffee, rubber, oil palm and banana) as well as some strategic food crop like corn, rice, cassava, sweet potato, irish potato, sorghummillet, etc.

Animal Genetic Resources are grouped into wildlife and domesticated animals (IRAD, 2012). Mbah (2007) recommends more investment for the creation and maintenance of additional gene banks, proper infrastructure and capacity building of human resources.

In microbial Biodiversity

Microbial Diversity in Cameroon, classified under bacteria, fungi and viruses influence the Country's economy in the areas of agriculture, forestry, health, commerce and industry. They have a potential which can be used in producing many products such as beverages, foods, special protein, solvents, bio-fertilizers, bio-pesticides and minerals, Nwaga (1997).

In training and Sensitization

Government has embarked on training programmes in all sectors of biodiversity with a view to improving the level of manpower in the management of genetic resources. Several TV and radio programmes have been introduced for farmers in Cameroon. The farmers even have a weekly News Paper called “La VOIX du PAYSAN”. To further encouragement to farmers annual agricultural shows are being organized at the council, sub Divisional, Divisional and Regional Levels. After four years a National Agricultural Show (jamboree) is organized where the farmers exhibit and showcase their products. At all these level competitive prizes are given to farmers. In the University of Dschang, the Faculty of Agronomy is training mostly agricultural engineers, rural development Engineers and Forestry Engineers. The Universities of Buea and Bamenda also train Agricultural Engineers.

In youth Programs in Agriculture

During the past 10 years, the youths are constantly being encouraged on making agriculture, livestock and fishing their main occupations. There is provision for certifying common initiative groups (CIGs) or cooperatives and providing financial support for justifiable projects.

In the Ministry of Agriculture and Rural Development, there is a special programme to encourage youth in agriculture. The objective of this Programme (Young Farmers Settling Programme) is to facilitate the integration of youth in production channels through the practice of professional, sustainable and commercial agriculture. The programme provides support to young male and female Cameroonians aged between 18 and 35 for the implementation of their agricultural projects.

Also, the National Programme for Youths in Participation for Development meant to train the youths to appreciate the importance and possibility of self-employment on natural resource management and exploitation.

Challenges and Problems in all Biodiversity Sectors

The problems and challenges affecting production in various biodiversity sectors are listed below:

1. Crops

- a) There is limited land for cultivation;
- b) Women, the main cultivators of land have no rights to land;
- c) The prevalence of pest and diseases affects yield;
- d) There are climatic uncertainties and farmers cannot be certain of weather conditions;
- e) Production fluctuates due to changes in prices of basic commodities;
- f) The unavailability of agricultural inputs especially fertilizers and chemicals;
- g) Traditional farming methods greatly limit production;
- h) Rampant farmer/grazer conflict in the livestock zone.

2. Wild Flora

- a) There is threat of species due to agricultural expansion and forest exploitation
- b) Bush fires destroy the vegetation resulting to the loss of many species
- c) Uncontrolled exploitation of forest products;
- d) Insufficient control in the exploitation of forest products;
- e) Non mastery in the application in the use of resources towards sustainable use as well as non implementation of the laws and regulations.

3. Domestic Animals

- a) Diseases affecting many species of animals;
- b) Veterinary facilities are usually inadequate;
- c) Land for grazing is not usually adequate;
- d) There are still traditional livestock practices.

4. Wild Fauna

- a) Habitat destruction through forest exploitation poor farming methods;
- b) Poaching and illegal hunting methods;
- c) Miner exploration;
- d) Floods, erosion and bush fires;
- e) Poor knowledge of specie population.

5. Aquatic

- a) Over-cropping and disrespect of fishery regulations;
- b) Pollution of coastal and continental waters from mining, petroleum and agricultural chemicals;
- c) Floods in fresh water systems;
- d) Fishing with poisonous chemicals;
- e) Population pressure on mangrove vegetation.

6. Insects

- a) Habitat loss by agriculture and bush fires;
- b) Destruction of favoured species for nectar, pollination and niches;
- c) Climatic hazards like tropical thunderstorms, the Harmattan and harsh weather.

7. Micro-organisms

- a) Changes in environmental conditions;
- b) Bush fires for farming, grazing, hunting;
- c) Pollutant chemicals from fertilizers;
- d) Upset of the soil by mining activities which destroy soil biota;

8. Avian

Many bird species have been classified as endangered. There are 48 endemic species and 15 are threatened with extinction, (Fotsa et al, 2011).

(4)

1.2.4. Production Systems Present in the Country

Table1: The production Systems in the country

Sector	Code	Name of Production System	In Place (Yes/No)
Livestock	L1	Livestock grassland based systems: Tropics	Yes
	L5	Livestock landless systems: Tropics	Yes
Forests	F1	Naturally regenerated forests: Tropics	Yes
	F5	Planted forests: tropics	Yes
Aquaculture And Fisheries	A1	Self-recruiting capture fisheries: Tropics	Yes
	A5	Culture-based fisheries: Tropics	Yes
	A9	Fed Aquaculture: Tropics	Yes
	A13	Non-fed aquaculture: Tropics	Yes
Crops	C1	Irrigated crops: (rice) Tropics	Yes
	C5	Irrigated crops: (other) Tropics	Yes
	C9	Rain fed crops: Tropics	Yes
Mixed	M1	Mixed systems (livestock, crop, forest, and/or aquatic and fisheries): Tropics	Yes

(5)

1.2.5. Description of various production systems

A description of the main production systems is shown in Table 2 below.

Table 2: Description of various Production Systems in Cameroon

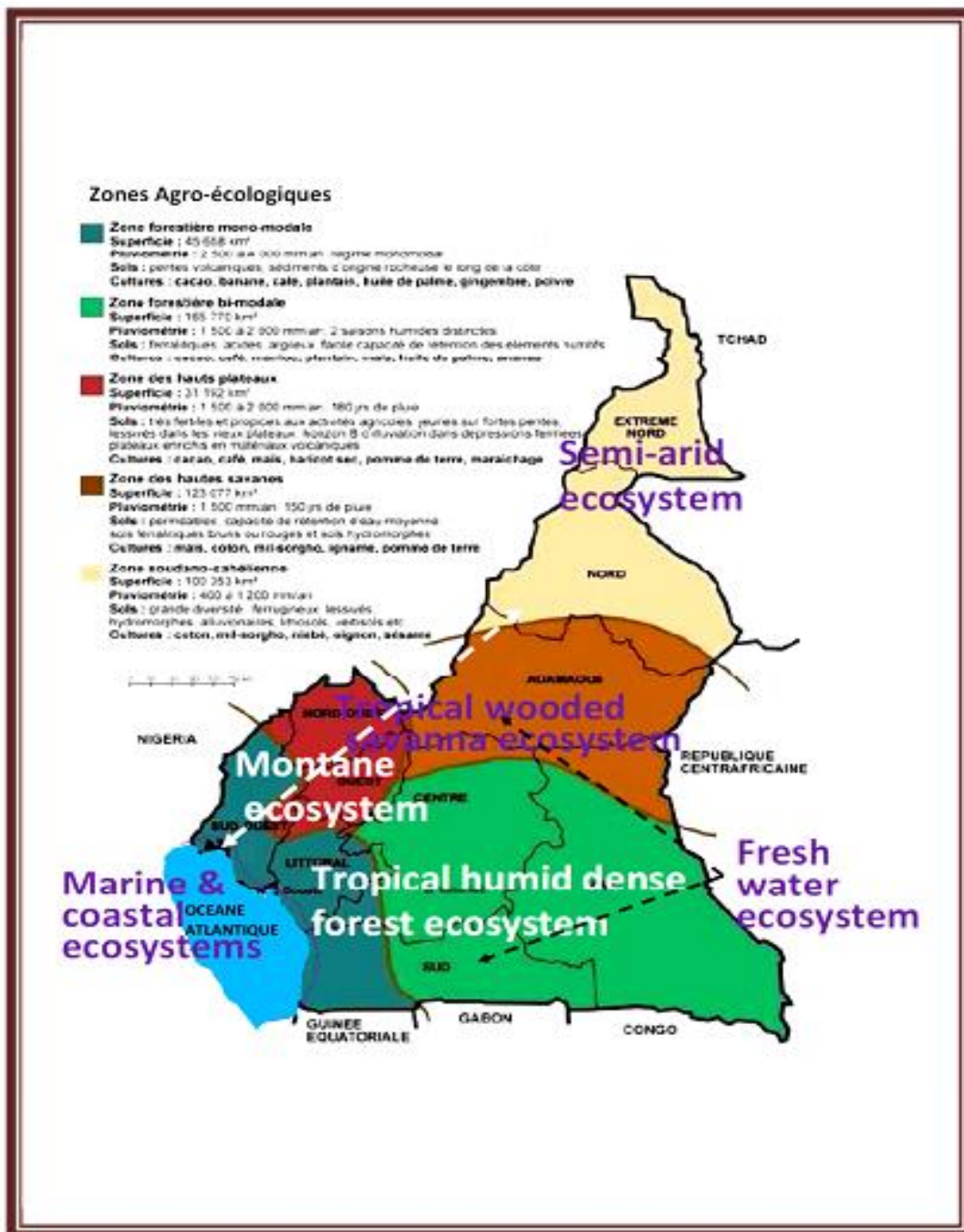
Code	Production System	System Classification (See Annex 2)	Description Details
F1	Naturally regenerated Forests	Primary Forests	<ul style="list-style-type: none"> - Found in the humid Climate – South West, East, South, Centre; - Mosaic ever-green all year round; - 50% of rural population live and depend on forest resources; - Little or no portions of primary forest found in urban areas; - Women make the bulk of the actively productive population of the rural communities; - Contributes largely to livelihoods of rural dwellers - food, fuel wood, building materials, medicine; - Contains large plantations of crops and farms - rubber, cocoa, oil palm, bananas.
		Modified Natural Forests	<ul style="list-style-type: none"> - Found in sub-humid climate - - Green in rainy season except patches of farmland; - About 50% of population live in forest zone; - Few village communities in rural areas; - Mostly women engaged in production, men hunt and cultivate cash crops; - Contributes reasonable percentage of livelihood and improves rural economy; - System contains peasant farms of food/cash crops. Agro-forestry practices due to lack of land.
		Semi Natural	<ul style="list-style-type: none"> - Mostly in the semi- arid climate – A, N, FN Regions; - Green during the short rainy period while dry periods show light brown expanse of grass with black traces left by forest fires; - Less than 30% of population live in rural areas, many are nomads moving with their cattle in search for rich pasture; - Forests do not contain enough resources to support rural population; - Do not depend on the natural forests to support production activities so products needs are complimented by practicing agro-forestry; - Forest gives very little contribution to the livelihood of the rural people. - Contains Protected Areas, peasant farms of groundnuts and plantations of cereals, like rice sorghum.

F5	Planted forests	Semi-natural (planted)	<ul style="list-style-type: none"> - In humid zone - Green where plantations are already old and canopy closed (Ototomo, Mbalmayo, Bakundu) - All such plantations are state-owned; Globally by 2012 had 21451 nursery seedlings for the dry savannah region - Not Known - Workers in ANAFOR both men and women - Income earners as corporation employees; - Contains plantations of <i>Eucalyptus</i>, <i>Tectona grandis</i>, <i>Pinus spp.</i> <i>Gmelina arborea</i>
		Plantations (Productive)	<ul style="list-style-type: none"> - Woodland Savannah: NW, W, Adamawa - Green mosaic on plantation sites; - Participation of small holders but proportion not known; - Some plantations found in peri-urban areas but proportion not known; - Women hardly own forest plantations since they are not entitled to land; - Income-generating especially from private owned plantations. - Contains plantations of <i>Eucalyptus spp</i> some of which are privately owned
		Plantations (Protective)	<p>There are no plantations designed for the protection of soil, wind or water-erosion vulnerable sites.</p> <p>There are private initiatives in the Sahelian zone used as a measure to arrest the encroachment of the Sahara Desert</p>
A1	Self-recruiting capture fisheries	Fresh waters	Covers 4million hectares and comprise rivers (Benue, Nyong, Sananga, etc.) natural lakes, Lake Chad and reservoirs (Lagdo, Magba, Mbakou, etc.
A5	Culture-based fisheries		In terms of inland fisheries, 45000 fishermen in full or part time and 70200 direct jobs in the sector. National production is estimated at 80000 tons annually
A9	Fed aquaculture tropics		Some indicators for aquaculture: 42000 fishes, exploited in 75 fish ponds covering 245 ha. Producing 870tons in 2006.
A13	Non-fed - aquaculture tropics	Marine waters	<p>Continental shelf: 1400 km²</p> <p>Exclusive economic zone (EEZ): 20000km²</p> <p>There are about 25000 fishermen</p> <p>Artisanal fisheries catch: 93000 t/yr</p> <p>Industrial fisheries catch: 4000 t/yr</p>

C1	Crops	Irrigated rice	Irrigated rice of SEMRY Irrigated rice of UNVDA Irrigated rice of Mbo plane by farmers groups
C5		Irrigated others	Irrigated banana plantation of PHP, SPM, CDC and Boh limited Plantation
C9		Rain-fed crops	Cocoa, coffee, rubber, oil palm, cassava, yams, cocoyams,, colocasia, millet, sorghoum, cotton, niebe, beans , groundnuts, onions, tomatoes, pawpaw, mangoes, citrus, pineapples
L1	Livestock on grassland system	<p>ADAMAWA :Tropical humid climate of the Sudan type with mono seasonal rainfall averaging 1500mm and temperatures varying between 20 to 26°C</p> <p>SOUTH-WEST AND NORTH-WEST: Tropical humid Climate of the Cameroonain altitudinal type with mono seasonal rainfall ranging from 1500mm to 2000mm and average temperatures are 19°C</p> <p>NORTH AND FAR NORTH: Rainfall varies between 400 à 1200mm and temperature varies from 25 to 45°C.</p>	<p>- Small scale livestock farming on ranches and restricted cows and kept in private grass lands with no special reservation for pastures and no provision for veterinary care.</p>
		<p>CENTER, SOUTH, EAST: Guinea type of climate with rainfall occurring twice a year, ranging from 1500 to 2000 mm and temperature variations between 22 and 29°C.</p>	<p>- Livestock Farming involving large and small ruminants (generally left in community pastoral lands which are not generally improved).This form of livestock farming is usually associated with some kind of agricultural activity.</p> <p>- .The nomadic traditional form of livestock which depends on the seasonality of the pastures; the community determine on the mode and frequency of movement of the herd. This form of breeding is associated with small amounts...of inputs and veterinary drugs.</p> <p>Light livestock farming of small ruminants left on their own (poultry, pigs, small ruminants), the herds move on their own without enclosures, food or veterinary care.</p>

L5	Landless system	WEST, NORTH-WEST, LITTORAL, CENTER, EAST, SOUTH, ADAMAWA, NORTH, FAR-NORTH, SOUTH-WEST	Special conventional light monogastric livestock breeding (poultry, pigs) and in the non-conventional breeding sector,(Snails, quills, cane rats, rabbits, bees, frogs) Such activities are characterized by the intensity in the various production systems which could vary from simple shelter for domestic animals to large industrial systems.
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(6) Figure 1: Map of Cameroon Ecosystems and the Agro-Ecological Zones



Source :NBSAP, 2012

Problems and challenges on Production

The following are the problems and challenges associated with various forms of production:

1. For Crops

- Limited land for cultivation
- Women, main cultivators have no right to land;
- Pests and diseases
- Climatic uncertainties
- Production fluctuates due to price changes
- Unavailability of agricultural inputs – fertilizers, chemicals
- Traditional farming methods limit production
- Farmer/grazer conflicts for pastoral and farming

2. For Wild Flora

- Species threat by agricultural expansion and urbanization;
- Illegal exploitation of forest products
- Bush fires common in savannah areas

3. For Domestic Animals

- Diseases
- Inadequate veterinary activities
- Limited land for grazing
- Traditional livestock practices
- Low adoption of improved livestock practices and genes

4. For Wild Fauna

- Habitat destruction through forest exploitation, agriculture and pressure from urbanisation ;
- Poaching and illegal hunting methods ;
- Floods, erosion and forest fires
- Illegal exploitation of forest products
- Poor knowledge of species and;
- Poor impact of the domestication process

5. For Aquatic Species

- Over-cropping and disrespect of fishery regulations;
- Pollution of coastal and continental waters from mining, petroleum and agricultural chemicals.
- Poaching and poor fishing methods
- Floods in fresh water systems
- Population pressure on the mangrove vegetation

6. For Insects

- Habitat loss by agriculture and bush fires
- Destruction of favoured species for nectar, pollination and niches
- Climatic hazards

7. For Micro-organisms

- Changes in environmental conditions
- Bush fires for farming, grazing hunting
- Pollutant chemicals from fertilizers
- Mining activities upset the soil and destroy soil biotope

1.2.6. Area under Production

Production systems in Cameroon vary according to the variety of ecosystems and the agro-ecological zones. Agricultural activities are intensified within the Tropical Dense Forest Ecosystem in the South West, Littoral and South Regions as evidenced by industrial plantations of rubber, oil palm, bananas and many peasant farms of food crops. The volcanic soils and heavy rainfall encourages the growth of a large variety of crops –cocoa, coffee, cassava, plantains, cocoyams, yams as well as vegetables and fruits. Logging and the collection of NTFPs for food and medicine is also practiced

The Marine Coastal Ecosystem is associated with activities based on maritime industrial and artisanal fishing. The Woodland Savannah and the Semi-arid are known for the cultivation of cereals, and livestock activities. There are also varieties of food products collected from the wild according to the needs and habits of the dwellers in the zone. Production quantities vary according to the market demands and food preferences of the local communities.

There is however the problem of getting reliable information on the production, the quantities and production area. This is due to the following:

- Most producers in the rural areas are peasant farmers who hardly keep records of their activities;
- Some crop producers and wild food gatherers do not specialize in producing and improving in the production of special food items.
- Food species problems including pests and diseases are not mastered by most rural producers;
- Peasant farmers and rural community dwellers depend on traditional production method for their farming, hunting and fishing activities.
- Production of food crops and livestock is associated with conflicts of land use and land ownership. Government has been intervening in the land use problems especially the farmer /grazier land conflicts
- In almost all the ecosystems and around the production zones, women do not own land.
- Government has continued to regulate resource exploitation through forestry, wildlife and fishery regulations and provision of control staff to arrest and punish defaulters.
- Fish farming, un-conventional breeding, granting of community forests are some of the various ways that government encourages the local population to apply the principle of sound resource management and sustainable use. Table 3 provides information on the main production systems in the country.

(7)

Table 3: Area under production, quantity and contribution

Code of production System	Name of Production System	Area (indicate unit)	Production Quantity (indicate unit)	Contribution agricultural sector economy %	Reference year
F 1	Naturally regenerated forest (tropics)	17.500.000 ha	2,300,000 m ³ /yr of Timber 3,107,812 tons/yr of Fire wood 330.626 tons/yr of Charcoal	PIB 4.9%	MINFOF (2011)
	Planted Forests (tropics)	80.000 ha	NK	NK	
	community Forests	1.200.000 ha	NK	NK	
	communal Forests	1.223.717 ha	NK	NK	MINFOF (2013)
	Private Forests	(NK)	35.000 electric poles	NK	
	Protected Areas	9.124.666 ha 19,20% of national territory	Eco-tourism	NK	
C9	Rain fed crops : Tropics	(Hectares)	(Tons)	Contribution agricultural sector economy %	Reference year
	Pine apple :	4,711	165,471	NK	INS (2013)
	Groundnuts	403,475	564,230	NK	
	Banana	84,591	1,394,675	NK	
	Plantain	274,342	3,425,757	NK	
	Cucumber	194,998	198,988	NK	
	Ginger	4,898	40,531	NK	
	Okra	60,384	26,127	NK	
	Beans	296,371	366,463	NK	
	Palm oil	88,002	254,129	NK	
	Yams	44,836	517,069	NK	
	Cocoyams	184,168	1,568,804	NK	
	Corn	849,885	1,572,067	NK	
	Cassava	280,189	4,082,903	NK	
	Water melon	2,091	46,113	NK	
	Millet/sorghum	1,374,977	1,240,970	NK	
	Cow peas	284,763	154,9141	NK	
	Onions	13,260	184,032	NK	
	Other melons	2,135	34,582	NK	
Sweet Potatoes	53,537	307,955	NK		
Hot pepper	16,143	33,310	NK		

	Irish potatoes	14,395	196,687	NK
	Sesame	31,179	44,563	NK
	Soya beans	10,104	13,077	NK
	Tomatoes	67,550	853,060	NK
	Voandzou	29,308	36,220	NK
C1	Rice	155,052	174,089	NK

Source: MINFOF 2011, 2013MINADER/INS 2013 (revoir avec DESA)

(8)

1.2.7. Export Local Consumption and Effects on Biodiversity and Services

The effect of export and local consumption production and their effects on biodiversity are expressed mostly in agricultural and pastoral activities of the farming and livestock populations. In Cameroon, there is large scale farming of cash and food crops in all the ecosystems and the products are either consumed locally or exported. The bulk of products from industrial agriculture are exported.

1.2.8. Impact of Production Activities on Biodiversity

Production activities have been seen to impact biodiversity as evidenced in food and cash crop production, forest exploitation (logging, harvesting of NTFPs), hunting. Uncontrolled activities like poaching, illegal timber exploitation and irrational use of land through burning all destroy biodiversity. CIFOR² reports on the difficulty of not knowing the amount of timber illegally exploited from Cameroon forest. The overall impact of production activities on the country's biodiversity is reflected on the reduction of ecosystem service, reduced yields in some products, destruction of habitats and the threats posed on some species due to their uncontrolled exploitation. The impact of production is seen in the following production systems:

- **Agriculture**

Crop Farming, The industrial cultivation of rubber, oil palm, bananas and the massive involvement in peasant farming greatly results in the loss of extensive forest cover. The main agricultural industrial establishments are: the CDC, PHP, PAMOL, SOCAPALM and HEVECAM. These plantations are established on clear felled forest usually without leaving any food species as is the practice with agro-forestry. Food crop farming has the same destructive consequences on biodiversity although to a lesser degree.

- **Fishing**

Poor fishing methods and over-harvesting in both marine and continental waters destroy aquatic biodiversity and reduce the prevalence of popular fish species. Some rural communities have been known to fish by using toxic chemicals to kill fish. This process greatly affects the evolution of the younger generation of many fish species from attaining maturity.

- **Hunting**

Poor and non selective hunting methods as well as non sustainable harvesting of non timber forest product, currently lead to the loss of biodiversity in all ecosystems. Most rural dwellers habitually use wildlife as a source of protein. Some rural communities still use gorilla for food whereas it is considered totally protected by wildlife regulations.

²About 75% of the timber harvested for domestic use in Cameroon is produced illegally, (Pye-Smith, 2010)

- **Livestock**

In many cattle rearing areas, cattle are made to graze aroundcrop farms, eventually leading to crop destruction. Such destructions usually result into farmer/grazer conflicts which are quite frequent in livestock practicing areas.

- **Forestry**

Forestry activities are logging inforest concessions and collection of NTFPs. The practice of illegal forest exploitation and over-harvesting in the concessions destroy the forest biodiversity. The collection of wild foods is sometimes insufficiently controlled and there is a consequent danger of the threat of valuable species. Besides, the destruction of unmanaged forests the habitat of many species of wildlife is destroyed.

The forest area cleared for agriculture and logging increase each year as the population and the demand for land rises. Unfortunately, the exact amount of land cannot easily be estimated since much of the cleared areas (especially that of the peasant farmers) are never mapped or recorded.

CHAPTER 2: DRIVERS OF CHANGE

2.1. Drivers Affecting Extent and Distribution of Forest/Wildlife Production in Cameroon

Over the years a number of natural and man-made factors have affected production and distribution of forestry and wildlife resources and services. These factors (drivers) and their indicators have been summarized below:

(9)

2.1.1. Effect of drivers on production and distribution of associated biodiversity

Change in land use management

In Dense Humid Forest Ecosystem there is a loss of biodiversity as indicated in the agro industrial establishments: CDC, PAMOL, HEVECAM, SOCAPALM, and Tea Plantations in the South, North and South West Cameroon (oral information from MINADER, 2014).

Over-harvesting and uncontrolled bush fires

Threats of plant and animal species; unsustainable supply of NTFPs; as indicated by *Chlorophora* spp. *Baillonella toxisperma* and *Bracharia brisenta* now absent in some forests, (MINFOF reports, 2013).

Market, private Sector

Marketing wood & NTFPs internally and externally; Sawn wood marketed; Timber exported with prices following world market. NTFPs consumed and sold locally as Log export in Douala Port; sawn timber sold in all towns;

Natural Disaster

Within the last century Mt. Cameroon erupted 7 times (1909, 1922, 1954, 1959, 1982, 1999 and 2000 (Belinga & Njilah 2001) destroying vegetation, wildlife and soil micro-flora and fauna indicated Boulders of rock and new vegetation, (MINEPDED 2012). Lake Monoun and Nyos erupted respectively in 1984 and 1986. While Lake Monoun killed 37 people, Lake Nyos killed over 1746 people, 3000 domestic and wildlife not forgetting the millions of insects that could not be accounted for. In recent times floods have intensified in Cameroon both at the coastal towns of Limbe and the flood plains of the Benue, Logone and Shari rivers resulting in loss of life and untold sufferings.

Policies

Policies have been reviewed to suit principle of Sustainable Use.

Forest concessions granted on inventories and management units (UFA) Wildlife species exploited on quota basis; taxes on inventories, exploitation and exportation of products, The promotion of breeding and non-conventional breeding PAPENOC and DABA Projects, according to the reports of MINFOF, MINADER, MINEPIA, IRAD, and MINRESI.

Population growth and urbanisation

More demand for forest products including specifically bush meat; settlements demand land even from Protected Areas. Roads through Parks destroy wild life habitats and upset wild life species. This is

evidenced on the growth of Ejagham Sub Division in the Ejagham Forest Reserve, Forestry Administration Reports.

Pests/Diseases/Invasive Alien Species

Pests/diseases affect natural species population through the removal species which affect the propagation of some plant species. This is seen as the reduction in the elephant in the Korup National Park has resulted in the reduction of those plants which can germinate only after having been digested by the elephant. The giant rat and the porcupine have known to propagate the oil palm (*Elaeis guineensis*)

Changing economic, socio-political, cultural

Nutritional, medicinal, economic value of forest foods like, cane rats, *Gnetum*, places some wild food products on high demand. Today some are domesticated and sold out of Cameroon. *Gnetum spp*, *Ricinodendron sp.*, *Irvingia* are wild food products commonly traded with countries around Cameroon.

Farms of snails, cane rats, frogs found in some regions, non-conventional breeding has been going on since 2007 and has proved very successful.

Innovations in Science & Technology

Mobile saw mill will process logs in forest illegally fast and avoid being taxed. Poaching will reduce population of wildlife species. There have been court cases and fines. Intensified research in non-conventional breeding because it has been successful since its introduction in 2007.

(10)

2.2. Effect of climate change on associated biodiversity

The generalized effect of climate change on associated biodiversity is seen to have negative trend on all forms of genetic resources although with varying degrees. Also various drivers affect biodiversity sectors in varying degrees.

Climate change in Cameroon is experienced in the following ways:

- Too much rains or severe draught adversely affects the production in crops;
- Heavy rainfall sometimes accompanied by thunderstorms and lightning;
- Flooded rivers and streams which erodes soils from nearby crop fields;
- Violent winds which throw down aerial crops like banana, rubber, millet, maize;

Effects of climate change are seen in:

- Heavy crop losses: the C.D.C. and HEVECAM report heavy crop losses during violent winds;
- Soil erosion especially along steep slopes results in loss of micro-organisms and even crops;
- Migrated birds and insects destroy the foliage of crops and results to poor harvest;
- Destruction of habitats results in threats and extinction of plant and animal species;
- Food scarcity resulting from poor harvestis reflected in food shortage and increase in food prices.

Severity

Prolonged Rainy season drastically affects settlements in the Marine Coastal Ecosystem. Floods have affected Douala (Littoral Region), Limbe (South-West Region) and Kribi (Central Region) causing losses in property and even human lives. In the Far North Region, river floods have been reported to have destroyed homes resulting to the displacement and re-location of several villagers; similarly, prolonged draught cases result in the lack of animal feed in cattle rearing areas resulting in the loss of animals.

Frequency

In Cameroon, climatic variations occur every year. Climatic change as experienced these days is unpredictable. This is why Cameroon emphasises on having an observatory and information on early warning Systems. The duration of changes is difficult to determine and harm and cost are sometimes difficult to determine.

(11)

Table 4: Effect of drivers on sector of biodiversity within production systems

Production Systems Code or name	Drivers ¹⁴	Effect of drivers on sector biodiversity for food and agriculture (2, 1, 0, -1, -2, NK, NA)			
		PGR	FGR	AnGR	AqGR
F1	Changes in land , water use and management	(2)	(1)	1	2
	Pollution and external inputs	(1)	(0)	NK	NK
	Over-exploitation and overharvesting	(1)	(-1)	2	2
	Climate Change	(-1)	(-1)	-1	-1
	Natural Disasters	(-1)	(-1)	-1	-1
	Pests, diseases, alien invasive species	(1)	(-1)	1	-2
	Markets, trade, and the private sector	(-1)	(0)	0	0
	Policies	(2)	(1)	-1	-1
	Population growth and urbanization	(1)	(-1)	2	2
	Changing economic, social political, and cultural factors	(1)	(0)	1	1
	Advancements and innovations in science and technology	(1)	(1)	2	0
Other (uncontrolled bush fires)	(-2)	(-2)	2	2	

(12)

2.3. Effect of Drivers of Change on Ecosystem Services

The effect of drivers on ecosystem services has not been measured systematically and scientifically. Table 5 shows the effect of drivers on some ecosystem services on a typically land-based system of production. From the indication in Table 5 it is evident that there is generally a negative impact on most of the ecosystem services in varying degrees depending on the production system. However, with the advancement and innovations in science and technology, there are changes in moving towards some positive impact of drivers on the ecosystem services

Table5:Major drivers and their effect on ecosystem services in production systems

Production System	Drivers	Effect of drivers on ecosystem services								
		(2, 1, 0, -1, -2, NK, NA)								
		Pollination	Diseases Pests and	Water purification	Natural hazard regulations	Nutrient recycling	Soil formation and protection	2Water cycling	Habitat provisioning	Production of oxygen
F1	Changes in land and water use	-2	1	-2	0	-2	NK	-1	-2	NK
	Pollination and external inputs	1	-1	-2	0	-2	-1	-1	-2	NK
	Over-exploitation/ over-harvesting	-2	-2	-1	NK	-1	-1	-2	-1	-2
	Climate change	NK	-1	-1	NK	-2	NA	NA	NA	NA
	Natural Disasters	0	0	0	NK	0	0	0	0	0
	Pests/diseases, alien invasive species:	-1	-2	0	0	1	0	0	-2	-1
	Markets, trade and private sector	NA	-1	0	-1	0	0	0	Nk	0
	Policies	1	-1	-2	-2	-2	0	-1	-1	-1
	Population Growth and urbanization	-1	-2	-2	0	-1	0	-1	-2	-1
	Changing economic, socio-political & cultural factors	-1	-2	-1	-1	1	1	2	1	1
Advancements & innovations in science	1	2	1	1	2	1	2	1	1	

	&technology									
C1	Changes in land and water use	NK	NK	NK	NK	NK	NK	NK	NK	NK
	Pollination & external inputs	NK	NK	-2	-2	0	NK	NK	NK	NK
	Over-exploitation/over-harvesting	NK	0	NK	NK	NK	NA	1	1	-2
	Climate change	-2	0	0	0	1	0	0	1	0
	Over-exploitation/ over-harvesting	0	-2	-2	0	2	-1	-2	-2	-2
	Natural Disasters	-1	-1	NA	NA	0	1	1	1	-1
	Pests/diseases, alien invasive species:	0	NA	NA	0	1	1	NA	0	NA
	Markets, trade and private sector	0	-1	1	NA	NA	0	NA	0	NA
	Policies	-2	-1	-2	-2	-1	0	-1	0	-1
	Population Growth and urbanization	NK	NK	NK	0	1	1	1	1	0
	Changing economic, socio-political & cultural factors	1	1	0	0	1	0	NK	1	1
	Advancements and innovations in science and technology	NA	NA	NA	NA	NA	NA	NA	NA	NA
C2	Changes in land and water use	NK	NK	NK	NK	NK	NK	NK	NK	NK
	Pollination and external inputs	NK	NK	NK	NK	NK	NK	NK	NK	NK
	Over-exploitation/ over-harvesting	NK	NK	NK	NK	NK	NK	NK	NK	NK
	Natural Disasters	NK	NK	NK	NK	NK	NK	NK	NK	NK
	Pests/diseases, alien invasive species:	NK	NK	NK	NK	NK	NK	NK	NK	NK
	Markets, trade and private sector	NK	NK	NK	NK	NK	NK	NK	NK	NK

	Policies	NK	NK	NK	NK	NK	NK	NK	NK	NK
	Population Growth and urbanization	NK	NK	NK	NK	NK	NK	NK	NK	NK
	Changing economic, socio-political & cultural factors	NK	NK	NK	NK	NK	NK	NK	NK	NK
	Advancements and innovations in science and technology	NA	NA	NA	NA	NA	NA	NA	NA	NA
C9	Changes in land and water use	0	NK	NK	NK	NK	NK	NK	NK	NK
	Pollution and external inputs	0	NK	NK	NK	NK	NK	NK	NK	NK
	Over-exploitation/ over-harvesting	NK	NK	NK	NK	NK	NK	NK	NK	NK
	Climate Change	-1	NK	0	NK	NK	NK	NK	NK	NK
	Natural Disasters	0	NK	-1	NK	NK	NK	NK	NK	NK
	Pests/diseases, alien invasive species:	0	NK	NK	NK	NK	NK	NK	NK	NK
	Markets, trade and private sector	0	NA	0	0	NA	NA	NA	NA	NA
	Policies	-1	0	-1	0	-1	0	0	1	0
	Population Growth and urbanization	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Changing economic, socio-political & cultural factors	0	1	0	0	1	1	1	1	0
Advancements and innovations in science and technology	1	1	0	1	1	1	0	1	1	

Sources: INS, MINADER, MINEPIA, MINEPAT, MINFOF, MINEPDED

(13)

Almost all the drivers identified in Table 5 have been seen to affect ecosystem services directly or indirectly. The following drivers and their effects have been identified:

Changes in land and water use and management

This driver has been known to affect the agricultural, fishery, livestock and the forestry production systems since success in them will depend on how well land and water are managed. In the southern regions of Cameroon, land settlement between farming communities has been the problem experienced by administrative and traditional authorities. The lower courts around the rural areas register many cases on land trespassing. The northern regions also have land conflicts but their greatest challenge is the availability of water for their crops and fish ponds which have to be backed by costly irrigation techniques.

Pollution and external inputs

This driver affects agricultural lands and water courses. The effects of chemical fertilizers and herbicides used in some industrial plantations, leach into streams that run through these plantations and destroy lives of aquatic organisms. At village level, Duncan et al, (1989) report the use of 16 forest plant species by village women of the Korup area in the SW Region to poison fish during fishing expeditions. Certainly, this form of pollution affects other species in that production system. Oil spills from the oil refinery in Limbe in the South-West Region had been reported a large stretch of the Atlantic coast but it was difficult to estimate the degree of damage caused to biodiversity.

Over-exploitation and overharvesting

This is common in the fishery, forestry and wildlife sectors. Government checks the effects of this driver through the use of the fishery forestry and wildlife regulations and the control staff with each sector having a separate ministry. Forests are over-exploited through illegal exploitation and poaching of wildlife species, fish stocks are over-harvested through uncontrolled fishing and the use of un-authorised equipment and non respect of fishery regulations.

Climate Change

Almost all production systems are affected by climate change except for livestock which can be restricted into enclosures and fed with fodder. Experiences of climate change have been felt through heavy rains and thunderstorms which have resulted in crop losses and food scarcity, soil erosion resulting to poor yields. Floods and wind erosion have also been reported by farmers in the northern part of the country resulted to losses in agricultural soils. Migratory species (birds and insects) have sometimes been responsible to crop losses especially within communities that are in close to the border with a neighbouring country.

Pests, diseases, alien invasive species:

This affects all components of all production systems and has been government's concern through the approval and implementation of the Cameroon Biosecurity Project. With regards to invasive species, the project has so far come up with:

- A survey of the Social, Cultural, Economic, Environmental and Biological Impact of Priority Invasive Species in Cameroon;
- A List of Priority Invasive Species in Cameroon;

- A Black and White List of Priority Invasive Species in Cameroon

The Project envisages improving capacities on the detection and management of invasive alien species. The final outcome will be for Cameroon to have National Monitoring and Control System for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS).

Changing Markets

Cameroon is a country with a wide range of trade commodities for the internal and export markets from the various biodiversity sectors. Cocoa, coffee, rubber, banana, cotton, timber are main export products. In 2008, MINFOF authorised 101 timber companies to export processed timber in 19 countries, (MINFOF,2008). Besides, there are demands within the internal market for food and wood and NTFPs. The prices of these commodities fluctuate like several other commodities which are affected by market forces. Importation of commodities produced within the country will surely affect the prices of products of Cameroon origin. The heavy imports of Rice from Asian countries affect the prices of the Cameroon Ndop and Yagoua rice.

Policies

Since sound resource management must be backed by good and current policies, every effort has been made to cover every production system with current policies and revised those that are out-dated. Alongside policies that are related to resource exploitation are laws and regulations to ensure their sustainable use. In relation to biological resource management, the following policies exist:

- an agricultural policy for managing agricultural resources;
- a fishery policy for managing fishery resources
- a forest policy for managing forest resources
- a wildlife policy for managing wildlife resources;
- a water policy for managing water resource;
- an environmental policy for managing the environment.

These policies are carefully drawn or otherwise revised to respect the norms of international agreements and conventions. That is why the CBD and other related conventions go along the lines of the policies related to the management of biological resources.

Population Growth and urbanization

This will affect all production systems because there will increase in the demand for products from biodiversity. Increase in population will have the following consequences:

- Greater forest destruction for increase in land for agriculture and livestock activities;
- The habitats for vertebrates, invertebrates and micro-organisms will be destroyed;
- There will be over-harvesting of growing stock in terrestrial and aquatic ecosystems;
- Occupation of fauna habitats by urban and industrial development;
- Streams and river courses will be polluted with waste from homes and industry;
- The prices of food commodities will rise leading to high cost of living;

Changing economic, socio-political and cultural factors

All production systems are affected.

Economic change will affect the demand and supply of products from all production systems.

- If market for food products cannot be found, then producers will lack income. This will adversely affect the micro-economy of the community.
- There will be un-employment and such a slow or stagnant economy can never lead to industrialisation.

Socio-politically, there should be a political system which will guarantee:

- Security for life and property;
- Encouragement and incentives for income-generating activities at all levels;
- Education for the young to make them hope for a brighter future;
- Respect for human rights and equality to all citizens.

Culturally, there is need to recognize the cultural values of all communities especially if such value are tied up with their economic activities. The following cultural values have to be recognised:

- Their way of life: customs, traditional knowledge and the means of preserving it;
- The rights to own land, property, work towards their economic progress;
- Their views should be respected, should not feel marginalised or rejected.

Advancements and Innovations in Science and Technology

All production systems should benefit from advancements in science and technology. Research results on modern production methods and the use of modern equipment to produce show that in a growing economy like that of Cameroon, economic operators can greatly benefit from modernisation and innovations. They will be able to take advantage of:

- Using better farming methods, use of agricultural machinery, fertilizers, improved planting material, etc.;
- Modern fishing methods, use of adaptable species for aquaculture;
- How to detect and better manage invasive species;
- Improve productivity and product standardisation to face competition in common markets
- Choice of appropriate capacity improvement programmes to enable sustainable use of available resources.

(14)

2.4. Effect of Drivers of change on wild foods

The effect of drivers of change on the availability, knowledge and diversity of wild foods has been seen to be negatively impacting on the availability of wild foods. Knowledge of wild foods is widespread especially among the rural communities in all the ecosystems but the diversity of these foods is

gradually being reduced by drivers of change like pollution and external inputs, population growth, natural disasters, etc. A positive effect is seen on those drivers with interventions in advancements and innovations in science and technology through research findings like the work done by ICRAF, CIFOR and IRAD in Cameroon and other areas in the Congo Basin. Table 6 shows some of the important effects.

Table 6: Drivers affecting availability, knowledge and diversity of wild foods

Drivers ¹⁷	Effect of drivers (2, 1, 0, -1,-2, NK, NA)		
	Availability of wild foods	Knowledge of wild foods	Diversity of wild foods
Changes in land, water use management.	(1)	(1)	(1)
Pollution and external inputs	(-2)	(1)	(-2)
Over-exploitation and overharvesting	(-2)	(2)	(-1)
Climate change	(-1)	(1)	(-1)
Natural Disaster	(-2)	(1)	(-2)
Pests, diseases, alien invasive species	(-1)	(NK)	(-1)
Changing markets	(-1)	(1)	(1)
Policies	(1)	(1)	0
Population growth and urbanization	(-1)	(NK)	(-2)
Changing economic, socio-political and cultural factors	(0)	(0)	(1)
Advancements and innovations in science and technology	(1)	(2)	(2)

(15)

2.5. Main drivers affecting availability, diversity and knowledge of wild plants and animals in Cameroon

Changes in land and water use & management

The rate of deforestation in Cameroon is quite high (200.000 ha/yr in 1996). The amount of land required for agriculture by the growing population is increasing every year. Women are the main cultivators of food products and their haphazard arable farms threaten many wild food species.

Pollution and External Inputs

Pollution through chemicals used in agriculture and occasional oil spills from oil companies threatens species of associated biodiversity. Continental waters are quite often polluted using plant materials. In the survey of the Korup Area, 15 plant species were recorded as being used for poisoning while fishing tadpoles, (Duncan et al 1989). Leaching into soils of farm soils containing wild food species can also affect their productivity of these species. Today *Irvingia gabonensis*, *Gnetum* spp. are cultivated along other food products.

Over-exploitation and Over-harvesting

Till date, many wild food species are not yet cultivated. Harvesting is usually done by collecting the ripe and fallen fruit or seed. The collectors are conscious of the notion of ensuring the sustainable harvesting of the products some of which are income-generating. In the Tropical Humid Forest Ecosystem, it is a crime to the community to fell species that produce wild food.

Natural Disasters

Torrential rains, volcanic activity, water erosion, landslides are some of the common disasters which can endanger wild food species.

Pests, Diseases, Invasive Alien Species

Many users of wild foods do not master the pests and diseases that affect the species that yield their products because they do not cultivate them and do not know the conditions in which they grow. Even if those diseases and pest are not spread, some studies are now undertaken by research organizations to know about growth characteristics of wild food species.

Market, trade and Private sector

The collection and marketing of wild food products is usually by the private sector. Most of the products are consumed internally; in the Central African sub region and a few like the leaves of *Gnetum*, (okok,) the fruits of *Irvingia* (bush mango) and seeds of *Ricinodendron* (Njangsang) are traded in Europe and the USA. The quantity of wild food products sold internally or exported is hardly recorded³.

Policies

Global, regional and national legislations on conservation, taxes and levies for ecosystem services do not have the desired effect on rural dwellers who live with the resources. The Access, Benefit and equitable sharing of the benefits principle has no meaning to the local communities and so their share is the individual harvesting of products from the wild at the appropriate season. They consider these products as their natural heritage placed by providence within their locality and so sometimes do not understand why regulations should be linked in exploiting them.

Population Growth and Urbanization

Population growth and urbanization increase the demand for products and ecosystem services. More land is used for arable farming and small scale hunting and livestock activities.

Changing economic, socio-political and cultural factors

Many rural dwellers have begun diversifying income-generating activities in order to improve their house-incomes. Perceptions have changed and today farmers of purely cocoa decide to inter-plant cocoa crop with plantains/banana, cassava, cocoyams or maize with beans and groundnuts. Traditional farmers are now listening to agricultural and livestock extension workers and have begun applying

³ There are huge amounts of unrecorded products from associated biodiversity which are regularly sent to relatives abroad in the form of dried snails, okok, bush mango, njangsang, cray fish, and assorted spices according to the traditional dishes and tastes of the tribe of the beneficiary. ,

modern techniques in farming and pastoral activities. In the Tropical Wooded Savannah Ecosystem, farmers blend coffee farming with fish farming.

Innovations in Science and Technology

Recent development and research results have provided the following findings:

- The need to conserve wild food resource through management and controlled exploitation;
- Discovery of the nutritional values and contents of some important wild food species. Analysis of the nutritional content of 6 wild fruits showed that they were rich in calcium, magnesium, iron, potassium and zinc, vitamins C, A, and E.,(Tieguhong et al., 2014). The study recommends that governments and NGOs should encourage communities to not neglect eating some wild fruits which have been found to be richer than some traditionally cultivated fruits.

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2.6. Drivers with significant effect on involvement of women

Among the drivers in which the influence of women is felt are the following:

Changes in land and water use and management

In agriculture, women use land principally for producing food crops. Besides, the commonly practiced system of shifting cultivation requires new farmlands all the time. Unfortunately, in many rural communities women do not exercise authority over land.

Pollution and External Inputs

A major activity in which women are involved in pollution is the use of plant pollutants for fishing in continental waters. Usually bound in a fishing expedition, the team adopts a traditional technique of poisoning river water known to contain fish or tadpoles which will be harvested and shared among members of the team. These practices are slowly dying away due to sensitization by the ministries concerned.

Over-Exploitation and over-harvesting

In many rural communities women belong to development groups to which the notion of resource and sustainable use is taught. The presence of representatives of biodiversity-related ministries up to village level influences women to be good resource conservers and sustainable users. Women are income earners from the resources they exploit.

Markets, Trade and the Private sector

It is of interest that good markets be identified for the products that women produce. In Cameroon, women have established commercial links from the rural woman producer to the city woman retailer and even the whole sellers in some of Cameroon's neighbouring country⁴. The well-known women's food seller organization fondly called "Bayam Sellam" is well established with headquarters in Yaounde makes the women's voice heard on issues that concern the marketing of food commodities.

Policies

⁴ In Ikata, Munyenge and Mbalangi villages in the South West Region, food buyers from Gabon enter farms and make advance payments for bunches of plantains even before they are ready for harvest.

There are policies that the Cameroonian woman worries about and which she would recommend re-examination and eventual revision.

➤ **From a general perspective**

- ***The issue of land ownership:*** women should be given the right to own land and dispose of it as their property.
- Should be given the right to exercise authority the same way that men do.
- The Ministry of Women's Empowerment has outlined measures which do not favour the woman and these are being discussed for consideration in higher circles.

➤ **From the Traditional Consideration**

- The practice (in some traditions) of women not inheriting family property when the husband dies need to be revised and has been seen to hinder progress.
- Other traditional customs (like genital mutilation) are under consideration even at national and community level.

Population Growth and urbanization

Women see increase in population as an advantage in raising their income for those who think and act commercial. There will be an increase in the number of women associations that can easily fight for their rights. The urban women will assist to improve on the lot of the rural woman.

Changing economic, socio-political and cultural factors

For the past 10 years, wild food products are being valued for their food, nutritional, medicinal and economic importance. Women take advantage of them because they do not need to be cultivated; they merely require processing and marketing. The rural woman does not want to depend on the income from cash crop(cocoa and coffee), controlled by males and whose revenue is generally too small for the growing family. Women groups have now started taking decisions relating to the exploitation of food from the wild including the fixing of prices and the choice of markets⁵.The Cameroonian woman strives to improve economically and wants to come out of the taboos and cultures that prevent her from keeping abreast with modernity.

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2.7. Drivers with most significant effect on use and maintenance of traditional knowledge

Changes in land and water use and management

Land which has forest and fishery resources provides valuable knowledge to its dwellers and they have traditionally incorporated that knowledge in their lifestyles. Every effort should therefore be done to preserve that knowledge as well as the biological and environmental conditions that provide the knowledge.

Pollution and external inputs

Pollution and external influence can affect traditional knowledge in the following ways:

⁵ Two women groups in Kumba, S.W. Region have joined the unconventional breeding of snails. "Top Ladies" CIG had 2000 snails while "Ambitious Women" CIG had 1500 snails

- The destruction of regularly used medicinal plant through the use of herbicides in the treatment of plant diseases;
- Destruction of plants which live in association with other useful plants;
- Introducing species which will invade or eliminate plants medicinally or culturally useful to a given community. This can apply in streams where a species of tadpole is used by tradi-practitioners or disappearance of a medicinal weed by cultivating a food crop species.

Over-exploitation & over-harvesting

This is common in communities where logging and mining are practiced. These activities remove some useful plant and animal species commonly used medicinally and culturally. Over-harvesting has been reported of medicinal plants which are for export⁶. This is evidenced by large exports of *Pygeum africana*, *Yohimbesp*.

Climate Change

The effect of climate change on TK has not been fully recorded since those who require medicinal products have not noticed the dangers of climate change. However, (in this context), vegetation permanently submerged by the creation of dams can be considered source of change of climate. Great amount of plant and animal species are thus affected and considerable TK is lost in the process. So far, up to 1998, there were already 167.000 ha of artificial lakes in the form of dams. Recent developments on hydro-electricity in Cameroon will increase in artificial lakes.

Markets, trade and private sector

Markets and trade related to TK will depend on factors like:

- Medicinal and nutritional properties of some species especially those with commercial values, including those which have received the attention of pharmaceutical industry;
- Knowledge of the market forces – demand and supply, quantity and quality demanded.
- Management of the species and ease of availability cannot fore-cast to buyer's quantity to be supplied since some of the products are from the wild and belong to everybody except those under agro-forestry production.
- More ethno-botany studies to cover all agro-ecological-regions.

Policies

Some policies need to be revised to meet the concerns of the local communities notably:

- Policy on land ownership: women in Cameroon are not fully authorized to own land. However, Government is looking into the best way of reviewing this policy so that women can own land, particularly for agricultural purposes.
- Authorizing women to exercise traditional rights; women are engaged in traditional healing in some communities. Some are local mid-wives and they complement with well-known plant species to be very efficient.

⁶ The illegal harvesting and over-harvesting of *Pygeum africana* (a heavily exported medicinal plant) along the slopes of Buea Mountain was the subject of control teams by the Ministry of Forest and Wildlife, (MINFOF, 2013).

- The research policy should aim at providing stronger collaboration and financial assistance to tradi-practitioners.
- There is need to re-examine the way the ABS regulations are applied at the level of every community.

Population Growth and urbanization

This may adversely affect the conservation of plants producing medicinal products through the extension of farm land and since the demand for food will continue to grow. There will be need to make land-use plans and ensure that they are properly followed.

Changing economic, socio-political, and cultural factors

Following the importance and increase in the demand of wild food products, it is important that all stakeholders linked with biodiversity activities collaborate. This will enable each group table his interest and the programmes for the sustainable supply of the products demanded. The high demand expressed in some useful and high economic plant and animal species can influence the revision of policies and laws⁷.

Advancements and innovations in science and technology

Biodiversity and its products has been the basis for research and technology in Cameroon in recent years. Considerable effort is underway to improve TK knowledge within some local communities, re-valorise the knowledge and improve the level of collaboration with these communities. Research is being done on:

- Identifying the food and agricultural sources from biodiversity in the wild through ethno-botanical studies;
- Examining their medicinal and nutritional contents;
- Research on the market value of products of economic importance; as well as collaborating with pharmaceutical companies for more research on plants seen to have medicinal value;
- Establishing trade partners to raise the economic value of some useful plants⁸.

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2.8. Drivers which significantly improve food security and sustainability

Changes in land and water use and management

Protection of species habitats, proper land-use planning and proper irrigation methods that had existed between various owners of arid lands all help to improve production and productivity. Allocation of specially designated lands for pasture and farming will assist in conservation of species, their habits and will ensure continuous availability of ecosystem services. The collaboration that exists between the

⁷ It is the monetary value of some products that guide taxation authorities to determine the taxes to be levied on a medicinal/food product from the wild.

⁸ Van Dijk identified 76 plants only for medicinal uses by dwellers around the Bipindi forest area while Duncan *et al* identified about 500 plants in the Korup forest used by communities around the Korup forest for curing various diseases, (Van Dijk, 1999; Duncan et al, 1989).

representatives of MINEPIA, MINFOF, MINADER and MINEPDED up to village level has brought understanding and reduced much of the conflicts.

Pollution and external inputs

Agricultural and forest soils should be free from toxic waste or leaching which can destroy micro-organisms. Soil compaction by heavy machinery for logging or mining should not be used in agricultural lands. Species in natural forest and inland waters (streams and lakes) should be given the opportunity to naturally regenerate and propagate to foster sustainable use.

Protected Areas now covering 9.124.666 ha about 19.20% of the national territory should be managed since many of them provide wild food and medicinal products to local communities in a sustainable manner.

Over-exploitation and over-harvesting

The practice of over-harvesting particularly economic important plant and animal species from the wild can result to the following problems:

- Threats and eventual extinction of the over-harvested species. Oil from Moabi *Baillonella toxisperma* is hardly found in the local communities which used to sell it because the tree has been over-exploited for timber;
- Upset of the ecological balance: traditional healers have complained about the scarcity of their common medicinal species which they earlier found abundant;
- Habitat destruction and degradation of the ecosystem has led to the disappearance of common wildlife species.

Climate Change and Natural disasters

In recent years, farmers have witnessed seasonal changes which have also affected wild food-producing species in various ecosystems of Cameroon. Floods, landslides and droughts effects have been reported in some parts of the country to have affected yields. Climate variability makes uncertain when the rains will come and when they will cease making planning difficult for the local communities. The Ministry of the Environment Nature Protection and sustainable Development in collaboration with biodiversity-related ministries have been educating the farmer/grazer population on the effects of climate variability and climate change and how to manage natural disasters when they occur.

Pests, diseases, alien invasive and private species

Incidents of pests, level of diseases, and prevalence of invasive species on species being managed must be well understood and appropriate measures taken to reduce the effect of any occurrences. Biodiversity stakeholders are advised to inform, be well informed and use the appropriate services of the MINADER, MINEPIA and MINRESI depending on the problem they want to address.

Market/ trade private sector

Products from Cameroon biodiversity vary from food, cash and medicine-producing species of plants and animals. Some of the products have attracted the internal and external market and have served as

sources of income. Food and cash crops have earned Cameroon the reputation with trade partners who have relied on Cameroon as an important producer of specially identified products. The Ministry of Trade has been watching on the competitiveness and quality of Cameroon' products and links its concerns with product-producer ministries.

Policy

To conserve, and sustainably benefit from ecosystem services in Cameroon, all policies enacted on bio-resources should focus on the sustainable use principle, participatory approach and Access to Benefit-sharing. There should be the additional possibility of sensitization of all biodiversity stakeholders and clearly making them understand and play their roles effectively. Policies should include the development of capacities to cope with the required man-power needs in every domain.

Changing economic, socio-political, and cultural factors

- Rural communities are now having new ideas about biological resources and many have begun responding to some important management recommendations.
- They recognize that biological resources make significant contributions to their food, medicinal and financial requirements;
- They know that the resources get depleted if not well managed;
- That they have, and must contribute to their management role if they have to continue to benefit from the resources;
- Many rural dwellers have admitted that there can be no better and affordable substitutes for the products from the wild;
- Both Government and rural dwellers know that benefits from the resources should be ploughed towards managing the resources for them to survive for future generations.
- The attribution of forests to council and local communities, the encouragement of fish farming, and the technical assistance provided by government are all aimed at teaching the rural population that biological resource management is everybody' concern⁹.

Advancements and innovations in science and technology

Recent moves in agricultural research, biotechnology and Cameroon ratifying several biodiversity-related conventions show the country's willingness to pursue all conservation and management activities leading to the safeguard and sustainable use of its products and services

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2.9. Counter-measures to reduce adverse consequences of drivers

The principal measures being taken to reduce adverse consequences of drivers on associated biodiversity, ecosystem services, and wild foods are tabulated below:

⁹ In Bakebe village in the S.W. Region of Cameroon, the village community manages their forest resources such that the community follows up and knows whatever an individual timber/game exploiter harvests from their forest. They declare fishing and hunting periods for their forests and rivers respectively.

Counter-measures to reduce adverse consequences of drivers

Driver	Associated Biodiversity	Ecosystem Services	Wild Foods
Changes in land and water use and management	<ul style="list-style-type: none"> ▪ Modern farming methods; ▪ Avoid slash and burn practices; ▪ Use organic manure; 	<ul style="list-style-type: none"> ▪ Limit deforestation and unplanned expansion; Encourage creation of protected areas, ▪ Encourage population to assist in control of existing Protected Areas; ▪ Undertake artificial regeneration even at family level 	<ul style="list-style-type: none"> ▪ Use forest mgt techniques; ▪ Apply Fishery, Wildlife and Forestry Regulation
Pollution and external inputs	<ul style="list-style-type: none"> ▪ Regulate against obsolete fertilizers ▪ Check validity of inputs sold to farmers 	<ul style="list-style-type: none"> ▪ Protection of species habitat ▪ Use cover crop and soil improvement legumes; ▪ Check introduction of IAS 	<ul style="list-style-type: none"> ▪ Prioritize resource inventory; ▪ Apply land-use plan; ▪ Encourage agro-industry
Over-exploitation & over-harvesting	<ul style="list-style-type: none"> ▪ Avoid use of methods that will deplete resource ▪ Regulate all harvesting; ▪ Plan all harvesting beforehand; ▪ Reduce or avoid post-harvest losses 	<ul style="list-style-type: none"> ▪ For logging use selected and not clear felling ▪ Greater recovery to avoid waste; ▪ Use only recommended size; ▪ Keep to quota as recommended 	<ul style="list-style-type: none"> ▪ Avoid felling species that yield foods; ▪ Keep to exploitation. Regulations
Climate Change	<ul style="list-style-type: none"> ▪ Note change caused by climatic changes; ▪ Inform users about any strange observation; ▪ Apply measures to contain changes 	<ul style="list-style-type: none"> ▪ Study changes caused by climate change ▪ Keep record of all experiences 	<ul style="list-style-type: none"> ▪ Adopt practical restoration measures; ▪ Train population to be adapted to effects of climate change; ▪ Learn to diversify in other income-generating activities
Natural disasters	<ul style="list-style-type: none"> ▪ Note nature of disaster and harm caused to biodiversity; ▪ What forms of biodiversity have been most affected 	<ul style="list-style-type: none"> ▪ Sensitize population concerned; ▪ Use early warning systems ▪ Consults specialists in that domain of disaster. 	<ul style="list-style-type: none"> ▪ Total effect of disaster on wild foods should be understood by communities using it; ▪ Re-locate cultivation of wild food species by agro-forestry practices
Pests, diseases alien invasive and private species	<ul style="list-style-type: none"> ▪ Know the prevalent pests, diseases and IAS for various species; ▪ Know how to manage diseases pests and IAS; ▪ Bio-security awareness and biotechnology techniques developed¹⁰ 	<ul style="list-style-type: none"> ▪ Use appropriate control measures which will sustain ecosystem services; ▪ Seek technical expertise 	<ul style="list-style-type: none"> ▪ Know the pests diseases and the vectors; ▪ Report incidents of attack on wild food species; ▪ Introduce domestication initiatives; ▪ Cooperate with research organizations.
Market, trade sector	<ul style="list-style-type: none"> ▪ Check available markets for your products; ▪ Control quality of products; ▪ What products are competing with yours? ▪ Always seek to improve 	<ul style="list-style-type: none"> ▪ Know the services available ▪ Do the best you can to sustain those services; ▪ Use indicator like frequency of tourists to judge service quality 	<ul style="list-style-type: none"> ▪ What products are marketed and for what profit? ▪ Number of customers who depend on your products; ▪ Take note of their

¹⁰Project on the development and institution of a national monitoring and control system for living modified organisms and Invasive Alien Species in Cameroon has been in execution since 2011 and will ultimately provide information for a "Cameroon Bio-security Act" which will regulate the handling and management of IAS in the country.

	<p>on your quality;</p> <ul style="list-style-type: none"> Keep watching the demand curve and retain your customers 		queries/suggestions
Policies	<ul style="list-style-type: none"> Enacted policies should include concerns of associated biodiversity and its users; Policies and laws to be developed with a participatory approach; Agric. Policies should include soil improvement measures, environmental policy should include protection of associated biodiversity 	<ul style="list-style-type: none"> Ensure proper management of all biological resources; Establish laws forbidding use of poisonous chemicals; Participation of national/international organizations on biodiversity issues; Cameroon has been implementing the CBD and other biodiversity-related conventions. 	<ul style="list-style-type: none"> Resource management and control regulations to be fully applied Proper remuneration of control personnel; The Access & Benefit Sharing principle should be considered and applied to context. Policies and regulations should be understood to those benefitting from wild foods.
Population growth and urbanizations	<ul style="list-style-type: none"> Sensitize population on water/soil conservation measures; Strict application of land-use measures; Revenue from taxes/fines used in management and control cost. 	<ul style="list-style-type: none"> Apply Environmental Impact Assessment before all urban expansion projects; Use success story of similar situations 	<ul style="list-style-type: none"> Control all wild foods exploited; Exploitation strictly on quota basis; Use agro-forestry practices Encourage domestication of proven species
Changing economic, socio-political, and cultural factors	<ul style="list-style-type: none"> Knowledge of principles of soil and water management; Agric. Extension services available country-wide Research teaching farmers on soil improvement methods 	<ul style="list-style-type: none"> Population encouraged to adopt modern farming, fishing, livestock techniques; Appropriate fertilizers and right applications demonstrated; Supervision of agro-industries against wrong use of fertilizers 	<ul style="list-style-type: none"> Registration of wild food exploiters; Strike the balance between multi-purpose species like the case of caterpillar <i>Imbrasia oyemensis</i> on <i>Entandrophragma cylindricum</i> and <i>Cirinaforda</i> on <i>Erythrophleum suaveolens</i>¹¹
Advancements and innovations in science and technology	<p>So far MINRESI has achieved:</p> <ul style="list-style-type: none"> Researches on management techniques and published results Innovations made nation-wide Share best practices with other biodiversity Stakeholders 	<ul style="list-style-type: none"> IRAD has research stations in all agro-ecological regions; Research programmes suit users requirements; Interacts with other world research bodies; Demonstration of techniques and innovations; <i>IRAD processes Cameroon Coffee, biscuits from maize and rice and sells to the public;</i> The soil micro-biology lab. In University of Yaounde¹ and University of Buea affords soil improvement techniques for farmers country wide. 	<p>Studies have been undertaken to:</p> <ul style="list-style-type: none"> Identify various wild food species; Various communities sensitized Agro-forestry programmes underway Attribution of community forests Research on medicinal plants and collaboration with tradi-practioners; Bio-technology research well advanced in Cameroon¹²

¹¹ The economic advantage between wild food faunal species living in association with tree species of commercial timber value has been investigated in the tropical forests of the Democratic Republic of Congo by Bioersivity International working with COMIFAC, CIFOR, IRAD, cbff, CIGAR IRET.

¹² The Biotechnology Centres attached to University of Yaounde¹ and University of Buea have been running programmes related to Cameroon's biological resources.

CHAPTER 3: THE STATE AND TRENDS OF BIODIVERSITY FOR FOOD AGRICULTURE IN CAMEROON

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3.1. Cameroon biodiversity: status, trends and threats

3.1.1. General Characteristics

Cameroon's biodiversity has the following characteristics: abundant and diverse, endemism of species, threats, over-exploitation, under-studied, invasiveness and new discoveries.

➤ Abundant and Diverse

The flora comprises 250 families which are 1179 genera and 7850 species, (Onana, 2010, 2011) amongst which you have trees, shrubs, herbs. This abundance exists in both domesticated and wild plant and animal species. In floral diversity, two families show species abundance. The *Rubiaceae* has 789 species while the *Graminae* has 479 species.

The fauna is grouped into mammals, reptiles, amphibians, fishes, birds mollusks and micro-fauna (Onana, 2011). In faunal diversity, Cameroon ranks 16th in the diversity of mammals and nearly half of the bird species in Africa are found in Cameroon; there are 335 mammals' species, 913 birds species and 542 fresh and brackish water fish species. Microorganism (bacterial, viral and fungal) and protozoan are abundant.

➤ Endemism

Some forest ecosystems in Cameroon are pristine and so have endemic plants and animal species. The Korup National Park contains the oldest tropical rainforest forest in the world and new plant and animal species have been described from there. Lake Barombi has 11 species of fish endemic to that lake while Lake Bene has 9 endemic species of *Tilapia*; the richest fresh water site for fish species worldwide. Lakes Manenguba and Bakossi host the richest assemblage of chameleons' species in Africa with nine species being endemic (Cheek et al, 2004). Some cattle breeds (Kapsiki, Namchi and Kuri) are endemics.

➤ Threats

Many species are threatened with extinction and threats have continued to rise following the population pressure on biological resources. The heavily threatened species are mentioned in the table below.

Main threats and causes in Cameroon's biodiversity

BIODIVERSITY TYPE	MAIN THREAT	CAUSES
Ecosystems	- Poor land-use systems	- No land-use plans
	- Loss of rangelands	- Slash & Burn farming
	- Loss of habitat	- Deforestations
		- Soil erosion, flooding
		- Human encroachment of Protected Areas
Floral Diversity	-Species loss	-Pests and diseases
	-Exposure of surface soil	-Over-exploitation
	-Migration of avian species	-Uncontrolled burning
Faunal Diversity	-Loss of animal species	-Pests and diseases,

	-Reduced animal population. -Migration of avian species	-destruction of natural habitat, -poaching -Presence of IAS -Logging activities, - climate changes -human settlements - random crossbreeding
Microbial Diversity	-Soil degradation - Habitat loss	-Pollution of the soil and water -Erosion by wind and water -Surface soil exposure through deforestation -Mining by exposure of soil micro-organism to drastic weather condition -Logging activities through soil compaction and exposure by heavy machinery

Information from various country biodiversity reports

➤ **Over-exploitation**

Some plant and animal species in Cameroon are over-exploited for economic reasons. The lack of inventories of exploitable species renders them threatened with extinction. The highly commercialized *Gnetum spp* with exports through Nigeria, to Europe and to the USA has been under intense exploitation for over 10 years without inventories or management principles to sustain its availability. In 2007 and 2008 only, *Triplochiton schleroxylon* (Obeche) and *Erythrophleum suaveolens* (Tali) both made up 68% of timber exports in Cameroon, (Forestry Department, 2010).

➤ **Under-studied**

Biological resource investigators confirm the discovery of unknown species, varieties and breeds not yet described. In Bali Ngemba Forest Reserve (10km²), John De Marco (2004) stated that each hill and valley contained some unknown plant species. In Kupe Manenguba, 98 plant species were collected and 10 of them were unknown to science (Cheek et al, 2004).

➤ **Invasiveness**

Recent surveys on invasive species in Cameroon show that both wild and domesticated species of plants and animals are victims. Natural ecosystems as well as crops are invaded by introduced, pest-infested or disease prone organisms which affect the productivity of the favoured species. The mangroves of Bakassi are seriously threatened by the competitive alien *Nypa* palm species, and so there is need to take the conservation of the indigenous species seriously. However studies are underway to have a list of invasive species in Cameroon.

➤ **New Discoveries**

Wildlife and botanical surveys over the years have revealed discoveries of new species of animals. Between 2002 and 2011, investigators have recorded 83 new plant species (Onana, 2011; Cinquième rapport national sur la biodiversité, 2014).

➤ **Domestication**

There are increasing efforts at domesticating the economic plant and animal species. MINADER and MINEPIA are encouraging this initiative (MINEPIA, 2007). Domesticated species are marketed in and out of Cameroon. The level of domestication so far is summarized below.

Species Domestication in Cameroon*

BIODIVERSITY COMPONENT	SPECIES	WHERE	REMARKS
Plants	<i>-Irvingia spp.</i>	Tropical Dense Ecosystem	Humid Forest Agro-forestry
	<i>-Ricinodendron heudelotii</i>	Tropical Dense Ecosystem	Humid Forest Agro-forestry
	<i>-Butyrospermum parkii</i>	Tropical Woodland Savannah Ecosystem	Agro-forestry
	<i>-Gnetum spp.</i>	Tropical Dense Ecosystem	Humid Forest Experimental Farms
Animals	<i>Cane Rats</i> <i>Frogs</i> <i>Quails</i> <i>Giant rats</i> <i>Bees</i> <i>Snails</i> <i>Rabbits</i>	Tropical Dense Ecosystem All forest ecosystems	Humid Forest Un-conventional Breeding
Micro-organisms	Various mycorrhizal fungi	Research institutes	Soil improvement programmes (biofertilizers)

*List of species mentioned is not exhaustive

➤ **Biological Wealth**

Biodiversity's economic importance is seen in its contribution to family income and national economy. About 70% of the people engaged in Agriculture and 98% of the rural population depend on biodiversity. In 2007, biodiversity contributed to 40.6% of the country's GDP, (MINEP, 2010).

3.2. Biodiversity status

The status of Cameroon's biodiversity can be better understood through a study of the ecosystems, habitats and the variety of the floral and animal species. Information about ecosystem characteristics has been adequately treated in under "Changes and Trends in Biodiversity Components"

3.2.1. Ecosystems

The Cameroon NBSAP II (MINEPDED, 2012) was elaborated following the "Ecosystem Approach" which classified the country into six ecosystems. From the south to the north they are:

i. Marine and Coastal Ecosystem:

Having 402 km of coast line, the Mangrove zone is a warm humid climate with volcanic soils. It occupies parts of the South-West, South and Littoral Regions. This special habitat occupies about 250,000 hectares in the coastal belts of the Littoral Region comprising the following:

- The Estuarine of Rio Del Rey.....128,899.69 ha (55.02%)
- The Estuarine of Wouri.....103,817.00 ha (37.76%)
- Estuarine of Rio du Ntem.....1,573.53 (0.67%)

They are characterized by the following features:

- Extent.....250.000 ha
- Population.....250.000 inhabitants
- Men.....52%
- Women.....48%

Activities: Centered around fishing

- Fishing Population.....41%
- Fish smoking25%
- Agriculture.....8%
- Sale of timber.....13%
- Canoe production.....6%
- Others.....7%

Despite the rapidly disappearing scenario for mangrove witnessed in other places such as in the Mabetta coast in Tiko, the Bakassi mangroves are relatively intact and alone cover approximately 100.000 ha of the 250.000 ha of the remaining Cameroon mangrove. In Cameroon, mangroves are important at various levels:

- at the local level, mangroves are an important source of income and support economic development;
- they provide the best spawning ground for several fish species;
- at the national level, they form part of Cameroon’s protected area network;
- at the international level, they are the most distinct, giant, architecturally and morphologically diverse mangroves in Africa;
- globally, they store considerable amounts of carbon, thus mitigating the effects of climate change.
- the Country mangroves provide permanent and temporary shelter for a host of endemic species.

Considering the above listed importance of mangroves and considering that mangrove ecosystems in Africa are rapidly disappearing and that much of West and Central Africa is rich in hydrocarbons, their protection is a high priority. Equally, the mangroves of Bakassi are constantly threatened by the competitive alien palm species, and so there is need to take the conservation of the indigenous species seriously.

ii. Tropical Humid Dense Ecosystem

This comprises the Littoral, or Atlantic humid forest, Biafran forest, Guinea Congolian forest, Swamp Flood forest. Administratively, it occupies the South-West, Littoral, the Central, South and East Regions. Rainfall obeys two patterns with temperatures between 23° and 32°C. Soils are granitic and metamorphic and the vegetation is predominantly trees, shrubs and herbs.

iii. Tropical Woodland Savannah Ecosystem

It comprises trees, woodland savannah in the Littoral, South-West, North-West, West and the Adamawa Regions. Soils are volcanic and granitic. Average annual temperature is 19.4°C with a mean annual rainfall of 2000mm.

iv. Semi-Arid

It comprises Steppes, large open land savannah and scrubland prairies, “Yaeres” and bores. It occupies the North and Far North Regions of the country. Temperatures are between 17°C and 40°C. Soils are volcanic, sedimentary and granitic.

v. Montane Ecosystem

This comprises sub Alpine, Afro-montane and sub-montane belts in the Littoral, North-West, South-West and West regions. At altitudes of about 4095m (Mount Cameroon), temperatures are 4°C; soils mainly volcanic and the mountains are known to be active volcanoes. The first vegetation to colonize lava is usually made of lichens and orchids followed by different species of ferns. It is a very diverse ecosystem (NBSAP II, 2012)

vi. Fresh Water Ecosystem

In Cameroon, fresh water ecosystems include limnological continental lakes, which occur either in volcanic craters (Lake Nyos) or in depressions (Lake Ejagham). Fresh water is also found in continental rivers that may cross two or more ecosystems.

3.2.2. Habitats

Following studies carried by MINEPDED (NBSAP II, 2012) four broad habitat groups were identified in Cameroon as shown in the following table with their corresponding ecosystems and location.

Habitat Types in Cameroon

No.	Major Group	Habitat Type	Ecosystem	Location
1	Aquatic	Marine water, fresh water, brackish water, lakes, artificial ponds, swamps	Marine coastal; Fresh Water	Southwest, South, Littoral
2	Forest/Savannah	Natural forest, Artificial Forest, Agricultural lands, Savannah, Desert	Tropical Humid. Dense; Tropical Woodland Savannah; Semi-Arid	Adamawa, South, Northwest, North, West and Far North
3	Montane	Montane Forests, Highland Forests	Montane, Tropical Woodland, Savannah	Southwest, Northwest, Adamawa
4	Soils	Forest soils, Agricultural soils, Marine soils, Lake soils, Savannah soils, Desert soils, Mountain volcanic soils	All Ecosystems	All Regions

Compiled from NBSAP, National Report on Biodiversity Cameroon

3.2.3. Species

Species diversity in Cameroon is justified by the variety of ecosystems, the soil types, climatic variations and altitudinal differences. Some of these variations explain the presence of the same plant genera in different ecological zones. The case of *Lophira alata* grows to about 10 -12m tall in the Tropical Dense Humid Forest while *Lophira lanceolata* is a shrub not exceeding 4 m in the Tropical Woodland Savannah Ecosystem. Plant and animal species are adapted to the biotic and abiotic environment. Species diversity classified into the main groups of plants, animals and micro-organisms shown below.

Species diversity in Cameroon

FLORA (Vascular plants)		WILD FAUNA		DOMESTICATED FAUNA		MICRO-ORGANISMS	
Type	Number	Type	Number	Type	Number	Type	Number
Families	235	Mammals	303	Cattle breeds	6000,000,	Soil Fungi	
Genera	1179	Reptiles	285	Horse breeds	17,430	Families	58
Species	8,000	Amphibians	199	Donkey breeds	45272	Genera	110
Quality spp		Fish	618	Sheep	3500,000	Species	271
Vegetable spp	150	Birds	968	Goats breeds	3,500,000	BACTERIA	
Edible Fruits	300	Insects: Terrestrial Aquatic	2084 217	Pigs	1700.000	Species	45
Oil Processing sp	7	Crustacea Crabs	3 genera 12	Poultry	14,000,000	Lichens Mushrooms	105 NK
Natural Drinks	24	Molluscs	34	Giant Rats breeds Cane rats breeds	?	VIRUS	Human and Animal Hepatitis Cattle/Pork
Stimulants	5			Rabbits	47,277		

Source: MINEF, MINEPIA, IRAD, Nwaga 2008, Brooks et al, 2011.

3.3. Trends

In addition to its characteristics and composition, biodiversity in Cameroon has been undergoing many changes. These changes are attributed to human activities such as agriculture, infrastructure development, hunting, logging, damming etc, as well as natural phenomena like floods, volcanic eruptions, and climate change. All these singly or severally give rise to the threats and even extinctions some of which are not observed. Some plant and animal species are being domesticated to reduce pressure from the over exploitation and protect ecosystem integrity.

The General Situation

An examination of the forest estate shows that in 2011 the national forest coverage stood at 17.5 hectares. Land occupied by agriculture, loggingurbanisation in the dense forest area wasabout 55% of the forest area. The permanent forest estate is estimated at 16 million hectare (35%) of the national territory, (MINFOF, 2013). In 2011, the total area occupied by UFAs was 7.1 million hectares while 1

million hectares were attributed as Community Forests, (Mertens et al. 2012) By 2012, 6 million hectares had been reserved for biodiversity conservation (Protected Areas) and 8 million hectares is sustainably managed as production forests in which 6.5 million hectares have been leased in 90 concessions comprising 114 Forest Management Units (UFAs) MINFOF, (2013).

- In spite of these efforts, negative trends have been noticed notably: the reduction of forest reserves by 32%
- Rate of deforestation in Cameroon was seen to be increased to 270.000 ha/yr (OIBT, 2011)
- In 20 years, about 3000 ha of mangrove and the associated coastal forest had been degraded

Studies and surveys

About 3000 plant specimens have been described and stored in the national herbarium and survey intensity estimates 3specimens /100km² (Onana,2011). It is reported that 233 families, 1720 genera and 7500 species have been described. Studies undertaken within 40 years show that, 7850 of vascular indigenous and exotic plant species have been described. Up to 2011, 815 species of flowering plants are threatened to exist, (Onana et Cheek, 2011). Onana (2013), reports that 870 species of plants have been declared endemic and sub-endemic and 1609 species were of interest to conservation programmes.

About 1150 have been documented, (Douanla Mali 2010) and about 32 species are used for food, (Eyi-Ndong et al 2011). Elaborate accounts of mycorrhizal mushroom activities among tropical forest trees have been discussed (Ongene et al 2004)

From bird studies conducted by Fotsa et al (2009) and Fotsa (2012), the bird species have been seen to be abundant and unique. Languy et al (2003) in surveying birds in the Takamanda Forest Reserve in the South West Region reported two bird species newly seen in Cameroon. They are: the Ussher's Flycatcher (*Muscicapa ussheri*) and the Sooty Flycatcher (*Muscicapa infusate*). The rich fauna comprises 303 species of mammals, 285 species of reptiles, 199 species of amphibians, 613 species of fish and 968 bird species

The insect population is very rich but not well known, two endemic species have been reported in the Swallow and milk butterfly, and a new species of mosquito (*Orthopodomyia ototomoensis*) was discovered in Ototomo (Huang et al 2013).

The negative trends in wildlife can be seen in the threats of some of the species through poor management, illegal hunting, over harvesting (especially the aquatic resources).The following groups of species have been under threat: Mammals (38), Birds (25), Amphibians (55), fish (112), Reptiles (5), molluscs (11), other invertebrates (14).

Trends in Cameroon biodiversity

Trends	Plants	Wild Fauna	Domestic Fauna
ENDEMISM	126	11 mammals spp 57 spp of fish	
THREATENED OR ENDANGERED		40 mammals 9 spp of turtle	4 kapsiki/namchi cattle 1 black belly sheep
DOMESTICATED	5 species - <i>Gnetum spp</i> - <i>Irvengia gabonensis</i> - <i>Cola spp</i> - <i>Ricinodendron spp</i> - <i>Baillonella toxosperma</i>	4 species - <i>Tryonomys swinderianus</i> - <i>Achatina achatina</i> - <i>Conruana spp</i> - <i>Oryctolagus cuniculus</i>	
NEW DISCOVERIES	83 spp	20 rotifer	
EXTINCT			1 Bamileke cattle

Source: Onana, J. M.2011, MINEPIA, MINFOF, MINEPDED

3.3.1. Conservation

- **In the forestry domain**, conservation is achieved through the following measures.
 - Habitat recovery programmes;
 - Creation of Protected Areas, Forest Reserves and wildlife sanctuaries;
 - Control of wildlife, forestry activities and bush fires;
 - Artificial regeneration programmes;
 - Domestication of wildlife and forest species of economic importance;
 - Genetic Resource Recovery and Conservation Programmes;

Various studies were conducted on 20 wild species between 2008 and 2012. The species were selected in relation to their uses for food and agriculture. Gommadjie et al. (2012) have outlined the objectives of the research conducted on the following species: *Allanblackia floribunda*, *A. gabonensis*, *A. Stanrana*, *Carapa spp*, *Baillonella toxisperma*, *Dacrydes edulis*, *distemonanthus benthamianus*, *Erythrophleum ivorensis*, *E. suaveolens*, *Gnetum spp*, *Greenwayodendron suaveolens*, *Haumania spp*, *Melicia excelsa*, *pericopsis alata*, *Polystchya sp.*, *Prunus africana*, *Psycotrya*, *Santiria trimera*

- **In Agro-biodiversity**, the following programmes have been undertaken in IRAD:
 - Rice: About 50 varieties were described between 1951-2013;
 - Maize: About 30 varieties were described between 1980-1990;
 - Sorghum & Millet: About 20 varieties were obtained between 1965-2000;
 - Groundnuts: About 16 varieties were obtained and distributed from 1960-1980;
 - Cow peas: About 27 varieties were obtained and distributed since 1981;
 - Soja: About 9 varieties were obtained and distributed since 1980;
 - Cassava: About 30 varieties were obtained;
 - Irish Potatoes: About 15 varieties were obtained and distributed;
 - Yams: About 100 clones were under collection;
 - genetic resources recovery programmes;
 - Genetic banks.

➤ **Other Crops**

- Macabo: 1 hybrid, Taro 4 varieties developed and distributed;
- Banana/Plantain: About 16 cultivars tested and distributed;
- Banana: 4 varieties were selected for export since 1989 ;
- Cocoa: Over 150 varieties developed from 1930-2009;
- Coffee: 1 variety of coffee Arabica with 12 clones of Coffee Robusta from 1981-2008;
- Rubber: 17 clones distributed since 2010;
- Tea: About 50 clones spread between 1965-2000;
- Oil Palm: 14 categories of high-yielding seeds since 2009;
- Fruits: Over 200 varieties were under cultivation;
- Pineapples: 2 varieties;
- Mangoes: 40 varieties;
- Pears: 20 varieties;
- Other fruits: 10 varieties.

➤ **Livestock and Fisheries**

- Bovine: 8 strains;
- Poultry: 11 strains;
- Rabbits: 4 races selected;
- Fish: 4 races selected.

3.3.2. Habitat Recovery Measures

The creation of the MINEP in 2004 saw the establishment of the Department of Nature Protection which has so far achieved the following habitat restoration programmes:

- Operation Green Cities;
- Green Sahel;
- Protection of Benue water catchment ;
- Water hyacinth (*Eichhornia crassipes*) invasive species fighting programme;
- Mangrove Restoration Programme.

National Habitat Recovery measures include:-

- Forest regeneration (ANAFOR has national regeneration programmes);
- The protection of sacred forests for cultural and traditional practices;
- Monitoring and Evaluation;
- the setting up of a national observatory;
- Communication, education and public awareness;
- International agreements, the CBD, UNFCCC, UNCLOS, UNCCD, RAMSAR and CITES.

Creation of Protected Areas

The law guiding the management of Protected Areas is an effective measure to conserve the biodiversity of the area under the protection Act.

Situation of Protected Areas in Cameroon

STATUS	NATIONAL COVERAGE (ha)	% NATIONAL LAND AREA
Protected Area, IUCN Rating	3,482,741	7.00
Forest Reserves	920,000	1.90
Protected Area Under Creation	975,091	2.10
Total Area under Protection	5,377,832	11.00
Safari Hunting Zones	3,333,285	0,70
Total Protected/managed	8,711,117	11,7

Source: Dept. of Wildlife and Protected Areas, MINFOF 2013.

Control of Wildlife and Forest Exploitation

Forest exploitation regulations must comply with the following conditions:

- all forest concessions are awarded on the basis of Forest Management Unit called UFA;
- UFAs must have pre-exploitation inventories approved management plans;
- Exploiters must keep to minimum species diameter for trees and approved quotas for wildlife species;
- Offenders are sanctioned, fined and could even face court action.

3.3.3. Artificial Regeneration Programmes

Domestication of Plant and Animal Species

Some wildlife and plant species are now exploited at commercial scales. There is great need to domesticate these species particularly as their economic value is increasing. Among the wild species under domestication programmes, we cite the following: *Trichobatrachus robustus*, *Achatina achatina*, *Gnetum africana* (Project in MINADER, IRAD, ICRAF).

3.4. Changes and Trends in Biodiversity Components

The changes and trends in biodiversity can be perceived much easily if we consider each of the six ecosystems. Each ecosystem will be examined and described in respect to its physical characteristics, biological nature, species kind and their composition.

3.4.1. Marine Coastal Ecosystem

Physical Characteristics

It stretches the whole length of the 402 km long Atlantic coastline of Cameroon. Rainfall varies between 3000mm to 12000mm (Debundsha); average temperatures are 25°C.

Flora

The principal flora here includes, amongst others sea grass, mangrove forests with species of *Avecinia*, *Rhizophora*; coastal forest and some coastal wetlands.

Fauna

There are fish species, cetacean spp., marine and coastal mammals (manatee) marine turtles, migratory and non-migratory water birds, aquatic mammals (whales, dolphins), reptiles, molluscs,

phytoplankton, cytoplankton, and zooplankton. Some of the floral and faunal species have been declared vulnerable while others are considered endangered.

Protected Area coverage

There are 10 protected areas which cover 428,014km².

3.4.2. Tropical Humid Dense Forest Ecosystem

This is divided into the Lowland Rain Forest estimated at 16,467,570 ha and the Montane Forest estimated at 270,540 ha. Other well distinguished divisions are:

- Sub Montane.....900-1500m asl.....270,540 ha
- Montane.....1500 m asl.....17,685 ha
- Mangrove.....120,340 ha
- Swamp Forests.....Un estimated

Most of Cameroon's biodiversity is found in the Tropical Humid Dense Forest Ecosystem. This covers a land surface area of about 17 million hectares.

Biological Features

The Low Land Guinea Forest is renowned for its high number of endemic species of plants and animals. They are the country's biological hot spots.

Flora

It contains 235 plant families with 1179 genera, 8500 -10000 species, of which 411 are exotic, 808 are endemic (Onana, 2007), 11 are invasive. In the forest ecosystems, there are 650 trees, 850 shrub 750 lianas, 15 ferns, 400 orchids. There is no information on lichens. The following are lists of different forest types:

- Checklist for Southern Western Cameroon497 tree species (Thomas et al 2003)
- Checklist for Douala-Edea Forest.....450 tree species (Gartlan 1996)
- Checklists for Dja Forest.....380 species (Sonke et al 2007)
- Checklist for Campo-Maan Forest.....2000 species (Tropenbos)
- Checklist for Lobeke Forest.....not known
- Checklist for Korup Forest.....not known
- Checklist for Mbalmayo Forest.....not known

Fauna

The faunae are rich and diverse. There are 340 species of mammals, 920 species of birds, 247 species of reptiles (represented by species of snakes, lizards and crocodiles), 200 species of amphibians and 1050 species of insects. Primates and birds are under threat and new animal species have been described. The Cross River Crocodile, the chimpanzee and the Forest elephant are critically endangered.

Protected Areas

There are 89 Protected Areas covering 3,926,391ha including hunting zones. Six other areas (264 075 ha) have been proposed to be gazetted.

3.4.3. Tropical Woodland Savannah Ecosystem

Characteristics

Found in the Adamawa, North-west and West Regions, vegetation is tree and Woodland, altitude is 1000-1600m. Average temperatures are 19.4°C with a mean annual rainfall of 2000 mm. The soils are granitic and ferrallitic, irrigated by the Sanaga, Noun, River Niger and their tributaries and lakes.

Flora

Woody plants, shrubs, herbaceous cultivated plants (food and cash crops: maize, rice, beans, groundnuts, cassava, yams, vegetables and plums). Some of the species are: tree for Arabica gum, *Jatropha* species for planned bio-fuel requirements.

Fauna

Wild mammals, Hyena sp, Golden Cat (*Profelis aurata*), Buffalo (*Syncerus sp*)

Domesticated: Cattle (*Bos indicus*), sheep, goats, pigs, Rabbits, horses, donkeys, non-conventional breeding demonstrated with cane rats.

Avian Species

There are 437 bird species (Decoux et al, 1997), 58 migratory. The Bamenda Apalis (*Apalis bamendae*) is endemic and vulnerable.

Insects:

There are numerous ground insect species: hoppers, butterflies and termites; all are important for food security.

Invasive Alien Species

African swine fever virus, Foot and Mouth Disease, Bird Flu, etc. Micro-organisms exist but adequate information is not available.

Protected Areas

There are 38 Protected Areas covering 3 643 850 ha and 58.39% yet to be gazetted.

3.4.4. Montane Ecosystem Characteristics:

There are 28 mountains in Cameroon located in the Western half of the country distributed as follows:

- Submontane.....1 200-1 600 m
- Afromontane.....1 600-3 000 m
- Sub alpine.....3 000-4 000 m

Flora

Wild: This consists of different vegetation types varying according to attitudes.

Discovery of new species: New species of flora have been discovered and these include: *Coffea bakossior*, *Coffea montekupensis* and *Myranthus fosi* (Cheek et al, 2004). They also cited 16 new species in 2003, 12 in 2004, 9 in 2005 and 8 in 2006. These plant species have been seen to belong to 22 families of which 11 are endangered, 2 critically endangered, and 9 being very vulnerable.

Fauna

There are 392 bird species (Decoux et al, 1997), 256 resident and 36 migratory, 48 endemic, classified as the highest number of endemic species in the world; 15 birds are classified as threatened, (Vie et al 2009).

Reptiles and Amphibians

There are 7 species of endemic chameleons. Toads and frogs occur but there is no precise information on species number.

Insects

Diversity of insects includes termites, grasshoppers, millipedes, miriapods, centipedes, honey bees (*Apis mellifer*). Most of these are necessary for food security.

Invasive Alien Species

African Swine fever, Foot and Mouth disease, Bird Flu, Cassava Root Scale, Mango Meally Bug, Bracken Fern, (*Pteridium sp*).

Micro-organisms

A host of micro-organisms exist which, like in other ecosystems, have significant contributions to the food security of the regions.

Protected Areas:

There are 5 existing Protected Areas covering an area of 74.117 ha and 5 proposed for gazetting covering 164.928 ha.

3.4.5. Semi-Arid Ecosystem

Characteristics

It covers the North and the Far North Regions.

Vegetation, Climate & Relief:

The vegetation here is mainly steppe, large open grassland, woodland savannah, shrub land and prairies, pasture. There are two seasons; the rainy season with rainfall between 900-1000mm during 4 to 5 months. Extensive flood plains "Yaeres" can be found in both the Benue and Chad basins. The dry season takes 7-8 months. Some parts of this mainly plain area are mountainous e.g. Poli, Atlantik, Mandara Mountain Range.

Flora

It includes savannahwoody plants andherbaceous shrubs(Andropogon species, *Hyperenia Spp*).

Cultivated:cereals(sorghum, millet, corn and rice), roots tubers (cassava, yams, sweet potatoes andIrish potatoes), oil seed (groundnuts, Soya beans and cotton)

Fauna

Wild: There are Parks (Bouba Ndjida, Waza), wherelions, elephants, monkeys, buffalos and Rhinos are abundant. The Rhinos are almost going to extinction because of poaching for their horns.

Domesticated: The main occupation of the population here is cattle rearing(Zebu and Taurine), small ruminants (goats and sheep), horses, donkeys and camels.

Freshwater Fish:There are 179 species of fish and crustaceae of which 25 are endemic (Musa, 2008)

Amphibians: They includeOphidians andreptiles (snakes, lizards, frogs and toads).

Insects:This ecosystem is rich in insect life and we can identifybees, ants, millipedes, centipedes, simuline (vector of river blindness). We can also cite here desert locust.

Avian:There are 316 bird species reported of which 57 are migratory (Decoux *et al*, 1977)

Invasive Alien Species: *Striga spp*,*Chromolaena odorata*, Water Hyacinth (*Eichhornia crassipes*) and other introduced species.

Micro-organisms: There have been no extensive studies but several act as agents of disease while others such as *Rhizobium* and*Micorhiza*are important in soil fertility.

Some mycorhiza fungi associations have key roles in the preservation of the forests ecosystems and of the preservation of some NTFP like *Gnetum spp*. Researchers of IRAD and lecturers of the Yaoundé University 1 have identified more than 125 mycorhizas divided in two types of mycorhiza associations: timber mycorhizas and ectomycorhizas, (Onguene et al, 2004).

Specific case of *Gnetum ectomycorrhizas*

Gnetum is a perennial climber which occurs abundantly in the humid forest of Cameroon. The heavy exploitation of the natural stock coupled with its habitat degradation, the species is threatened with extinction in Cameroon forests. Rich inproteins and minerals, the leaves of *Gnetum* are eaten as vegetables. A survey carried out on the exploitation and commercialization of *Gnetum* leaves show thatmore than a thousand tons of *Gnetum*leaves were collected annually from the Cameroonian forest for a value of more than 2 billion francs CFA (\$US400.000) (Bokwe et al, 1994). However, the exploitation is not yet on a large scale to sustain a regular market supply due to the absence of suitable conditions that could encourage artificial regeneration. Another study was conducted in 25 localities in Cameroon to determine the mycotrophic status of *Gnetum* with a view to improve the efforts being made in its domestication (Bechem and Alexander, 2012a).

Apparently, *Gnetum*does not occur in the North, Far North, West, and North-West of Cameroon and the species has been found to grow in a great variety of ferralitic acidic soils poor in calcium, N, P, and found

in undisturbed ecosystems notably of the primary secondary forests coco farms and farms containing food crops(Onguene, 2000;Bechem and Alexandre, 2012b). There are two morphologically distinct types of ectomycorrhizas on the roots of *Gnetum*, the yellow type, and the white type.

The yellow form of ectomycorrhiza is quantitatively dominant and was identified as *Scleroderma sinnamariense* and is seen to be found within the first 30 cm of soil depth. All domestication programmes of *Gnetum* should consider this symbiosis. This consideration should also include all programmes of reforestation.

Protected Area: There are 7 Protected Areas covering 805.900 ha and yet 1(one) with a surface area of 264.075 ha to be gazetted.

3.4.6. Fresh Water Ecosystem

The water resources in this ecosystem contribute to the survival of species and habitats in other ecosystems. The five river basins cover 463.550km² of the land territory and influence biodiversity-support activities especially through irrigation and also serves as a major source of hydro-electrical energy. The renewable fresh water resources have been estimated at 283.18km³ with a dependency ratio of 4.4% showing that most of the renewable water is internally produced. Ground water resource in Cameroon is estimated at 55.98km³(MINEE &GWP Cam2009).

Characteristics

It is generally made up of limonological continental lakes and Lithological continental rivers and wetlands. The aquatic systems are rich in biodiversity components.

Flora: Comprises

- Raphia Swamps – comprise Raphia associations, *Raphia hinzilis*, *R. hookeri*;
- River bank vegetation – may be dense along river banks, contains about 100 species;
- Swamp Forests – high proportion of *Uapaca paludosa*, *Afromonium sp.*
- Herbaceous Swamps – Transition between forest and savannah, periodically flooded;
- Herbaceous Flood plains – Prolonged flood plain, depth can reach 2 metres, grasses predominant – *Oryza barthii*, *Echinochloa pyramidalis* with other free floating species.

Fauna: Includes aquatic fauna, mammals, birds, reptiles, amphibians, crustacea and gastropods.

Benthic Fauna – macro-invertebrates – worms, molluscs, insects (24 species of insects, 10 species of molluscs).

Mammals: Common mammals here include lamartine (*Trichechus senegalensis*, *Hippopotamus amphibious* and other large mammals (*Syncerus cafffer* generally there exist over 150 animal species.

Birds: There are 312 bird species with 216 resident and 96 migrants. Waza-Logone has 320.000 water birds from 104 species while Lake Chad and wetlands have 200.000 birds (Lake Maga alone has 20.000 water birds (Ramsar,2012; (Birdlife Int, 2012), Many lakes along these rivers harbour migratory birds, owls, eagle, skimmers, darters, herons,

Reptiles: There are 3 species of crocodiles: *Crocodyces cataphractus*, *C. niloticus*, *Osteolamo tetrapsis*, 13 aquatic and semi-aquatic snakes, 4 species of tortoise.

Amphibians: Frogs and tadpoles, mostly *Amphilius spp*, *Trichobatrachus robustus* are found in some streams and rivers. The goliath Frog (*Conruana goliath*) along the Sanagariver can attain body length of over 30.48cm.

Fish: This is the richest ecosystem with about 496 species of fresh water fish 78 of which are endemic (Vivien, 1992, Kandem, 1998). Lake Barombi in the South-west Region has 11 species and one sub-species of endemic fish (Trewavas et al, 1972). Lake Disoni in the Rumpi Hills harbours one endemic species, (*Procapotus lacustris*). The Semi-Arid has above 179 species and 25 endemic (Musa 2008). MINEPIA 2012 reports the decline of fish yield within the wetlands in the lakes. There are 26 threatened fish species with 11 highly threatened.

Crustaceae: Amongst the crustaceae we can cite the Giant African River prawn (*Macrobrium vollenhovenii*) and the small species *M. macrohacriion* (Gabche et al, 2001). Lake Barombi Mbo has one endemic but undescribed shrimp (*Caridina spp*) (Trewavas et al, 1972). *Palaemonidae* in estuarine brackish water is highly exploited by fishing fleet. Since the late nineties, *Peneaus monodon* (Asia origin) has been accidentally introduced (through aquaculture activities) in the Wet African coastal waters including Cameroon. Brooks et al (2011) state that there are 7 species of fresh water crabs in Southern Cameroon.

Gastropods: There is a high diversity of clams, mussels and Molluscs some of which are endangered.

Micro-Organisms: zooplankton and phytoplankton influences fish growth. There are about 60 species of zooplankton and 20 species of rotifers (mostly Lecanidae and Brachionidae), 67 species of copepods mostly cyclopoida. Over 100 species of zooplankton are reported (2 species in the Korup National Park).

Protected Areas

Within the past 10 years, the wildlife policy has been to have 30% of the national territory under Protected Area coverage. In 2012, the coverage so far has been 3.659.199 ha.

(21)

3.5. Changes in various production systems in components of associated biodiversity

The trends as indicated in all production systems show a marked degradation in micro-organisms, invertebrates, vertebrates, and plants within all the systems. Changes occur because of the constant use of the land for agriculture and aquatic ecosystems for fishing. Food requirements and economic activities of the growing population are reflected in all the production activities. Hence the regular changes in trends of the various organisms many of which are exploited for required products and ecosystem services.

Table 7: Trends in the state of components of associated biodiversity within production systems

Production Systems Code or name	(Trends in last 10 years (2,1,0,-1,1,2,NK,NA))			
	Micro-organisms	Invertebrates	Vertebrates	Plants
F1	1	1	NK	2
L1	0	0	-1	-2
L5	-2	-1	-2	0
A1	0	0	-1	-2
A5	-1	-1	-1	-1
A9	-2	-1	-1	-1
A13	0	-1	0	-1
M1	-1	-1	-1	-1

*These trends are applicable mostly in Protected Area

(22)

Changes or Trends in Diversity recorded in Table 7

The information given in Table 7 is rather general. The absence of baseline data makes the measurement of changes difficult even for researchers changes conducted by research organisations or during project activities do not cover large portions of the production systems, and only be indicative. Some of such examples are:

- Tree distribution, Maps, Diameter Tables and Species Documentation of the 50-hectare Korup Dynamics Plot, (Duncan *et al*, 2003)
- Various species assessments in the Takamanda Forest Reserve Cameroon: vegetation, butterfly fauna, oronate fauna, reptiles, birds, large mammals, fisheries, (Komiskey *et al* 2003)
- Land cover changes in the Takamanda Forest Reserve between 1986 and 2000 show that half of the secondary forest has been cleared within the past 14 years and that more studies (satellite imagery) were needed to determine when patches of forest were converted into farms, (Dan Slayback, 2003).
- Habitats generally undergo degradation due to man's activities: deforestation for agriculture, logging, bush fires, pollution of streams, infrastructure for urbanisation and development. Generalised changes in production systems cited in Table 7 are noticed in the following:
 - F1: Changes in forest cover are caused by logging, deforestation, poaching and farming;
 - L1, L5: Changes in species population are attributed by animal diseases, poor feeding, draught and poor management techniques;
 - A1, A5, and A13: Changes are unstable and can arise from differences between growth and harvest periods. Unharvested fields of cereal crops: maize, rice, sorghum bloom with growing crops while harvested fields are bare and expose to all forms of weather.
 - A9: Fed aquaculture changes in diversity will vary with levels of fish stocking and level of harvesting as well as pollution of ponds by artisanal fisher folk.

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Changes to support ecosystem services

Changes to support ecosystem services have been demonstrated within the following biodiversity sectors:

Agriculture: Measures are taken to enable extension workers to sensitize farmers on modern farming methods and the use of improved planting materials in order to improve their yields.

Apiculture: Bee-keepers have embarked on a “Pollination Information System” to encourage the protection and conservation of pollination agents, bees, bats, butterflies as well as the plant species which attract pollinators. Enviro-Protect publish an information paper for pollinators called “Pollinisateurs Infos”. This initiative was supported by recognised biodiversity establishments such as COMIFAC, CHM Cameroon, CHM Belgique, DGCD and IRScNB.

Livestock: The conservation and protection of rangelands and improvement of suitable pasture for the upkeep of healthy domesticated animals. In the savannah ecosystems where water is scarce, water-depleting species like *Eucalyptus* are avoided.

Forestry:

- The creation of various forms of Pas in all the ecosystems including marine Pas
- Recruitment of eco-guards and training of forestry and wildlife staff
- Application of Wildlife & Forestry regulations

Fisheries: Measures have been taken to better manage the fishery resources. In collaboration with the MINEPIA, the MINFOF has embarked on the proper management of the mangrove habitats of the Wouri and Bakassi areas through project financing. The projects are aimed at sensitising the local population towards mangrove restoration activities.

Agro-Forestry: In order to improve and sustain the availability of wild food resources, agro-forestry is encouraged in all the agro-ecological zones. Thus many farmers benefit from wild and cultivated plant species.

Mixed Farming: The use of animal waste as crop manure and fish farming is gaining recognition by poultry and piggery managers in Cameroon. Some farmers are progressively avoiding the use of chemical fertilizers as they are not affordable and hardly available when required.

Table 8 indicates the measures taken to improve the ecosystem services.

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Table 8: Trends in the state of regulating and supporting ecosystem services

Production systems	Trends in the last 10 years (2,1,0,-1,-2,NK,NA)								
Code or Name	Pollination	Pest & Disease regulations	Water purification	Natural hazard regulation	Nutrient cycling	Soil formation	Water cyclic	Provisioning offhabitat	Production of oxygen
F1	2	2	1	NK	2	2	2	2	NK
F5	2	2	1	NK	2	2	1	0	NK
L1	NK	1	NK	NK	0	0	NK	1	NK
C9	1	2	0	NK	2	1	1	0	NK
C5	1	2	1	NK	2	1	1	0	NK
A1	0	0	1	NK	1	0	1	1	NK
A9	0	0	0	NK	1	0	1	1	NK
M1 (Agro-forestry)	2	2	1	NK	2	2	2	2	NK
M1 (livestock and fisheries)	0	2	2	NK	2	0	2	2	0

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Evidence of impact of change on biodiversity

Table 9: Impact of changes in biodiversity for food & agriculture on ecosystem services

Production systems	Changes	Impact of changes in biodiversity for food& agriculture on ecosystem services(2, 1, 0, -1, -2, NK, NA)								
		Pollination	Pest& disease regulation	Water purification	Natural hazard regulation	Nutrient cycling	Soil formation	Water cycling	Habitat provisioning	Production of oxygen
F1, F5	Changes in animal genetic resources	--	2	0	0	0	-1	0	2	-
C9	Changes in crop genetic resources	2	-1	1	0	1	2	0	1	1
A13	Changes in forest genetic resources	2	1	1	1	2	2	2	2	2
A1	Changes in aquatic genetic resources	0	1	1	0	0	0	0	1	0
	Changes in micro-organisms genetic resources (associated biodiversity)	-	1	-2	0	2	2	0	1	11
	Changes in invertebrate genetic resources	-	-2	0	0	2	2	0	1	0
	Changes in vertebrate genetic resources (associated biodiversity)	--	1	0	1	1	1	0	1	0
	Changes in plants genetic resources(associated biodiversity)	2	2	0	1	2	2	1	2	2

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Impact on Ecosystem Services

It is important to define the nature of changes stated in Table 9. In Cameroon changes in biodiversity for food and agriculture can be positive or negative and the impact on ecosystem services will depend on the nature and degree of change.

- Pollination is achieved by insects (bees, butterflies) and birds. Protecting more of these species will encourage bee farmers to progress in their business. The Association of North West Cooperative of Honey Producers (ANCO) conserve and even regenerate an identified species of plants which the bees like to pollinate.
- Increase in animal genetic resources will create incidents of pests and diseases. The greater the diversity of animals the greater the diversity of pests and diseases;
- Increase in crop genetic resources will favour pollination but detrimental to incidents of pests and diseases. More plants will increase soil quality; vegetative material will be converted to manure.
- Conservation of forest genetic resources will improve soils, restore habitat and ecosystems, improve underground water, increase nutrient recycling whereas removal of forest cover will destroy wildlife habitat impoverishing the soils for lack of soil micro-organisms.
- Increase in micro-organisms and invertebrates improve the soil quality through the action of soil bacteria notably the azotobacteria and mycorrhiza
- Increase in the number of vertebrates in a given area will have the following effects:
 - Bad consequences to the animal population in the event of an epidemic;
 - Destruction of vegetation and crops as it happens with elephants destroying crops and villages:
 - In parks too many animals will destroy their habitat and reduce the carrying capacity.

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Table 10: Associated biodiversity species actively managed to support ecosystem services

Ecosystem service provided	Actively managed spp	Production system	Availability of diversity information	Source of information
Pollination	Bees <i>Apis mellifera</i>	M1	Y	ANCO, 2012
Pests & disease regulation	Plants/animals	C9, C5	Y	IRAD
Water purification & waste treatment	NA	NA	NA	NA
Natural Hazard Regulation	NA	NA	NA	NA
Nutrient cycling	Soil bacteria Mycorrhiza	F5,C9	Y	University of Yaoundé1

Soil formation and protection	Eucalyptus planted as protective measure	F5	N	
Water cycling	NA	NA	NA	NA
Habitat Provisioning	Eucalyptus for timber in Menda Nkwe, Buea Fuel Plantation	F5	N	
Production of oxygen/ gas	NA	NA	NA	NA

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3.5.1. Monitoring activities related to biodiversity.

Both government and institutions engaged in biodiversity activities have a follow-up system in which through which they monitor their activities and report to their various administrations. The table below shows the administrative breakdown and the presence of the research institution up to the village levels.

Monitoring process of biodiversity-related activities

SECTOR	ADMINISTRATIVE REPRESENTATION				
	VILLAGE	SUB DIVISION	DIVISION	REGION	CENTRAL ADMINISTRATION
Agric Livestock/Fisheries Forestry& Wildlife	Chief of Post	Sub-Div. Delegate	Divisional Delegate	Regional Delegate	Minister
Research:	There are research structures all over the country. There is a regional research centre in every agro-ecological zone, 4 regional and international centres, 12 multi-purpose centres, 4 specialised stations, 30 relay stations and 30 reference laboratories				
Universities:	Seven (7) of the state universities can assist in reporting biodiversity issues				
International NGOs:	Some report on biodiversity activities				
National NGOs:	many work with the local population on biodiversity related issues				

In all biodiversity related ministries, government has ensured full representation through location of services up to village level. Table below shows the mandates of the main institutions involved in biodiversity management.

Institutions of Primary Importance to Biodiversity (Updated from Chiambeng, 2006)

Institution	Principal Role in Biodiversity
Presidency	- Promulgating the laws enacted by parliament. Through decrees, he regulates government policies relating to coastal management, sets up and organises administrative structures with well-defined roles in marine and Coastal area management
Senate	- As the upper house of the assembly they also advise and recommend towards the legislation on international conventions, protocols and treaties to which Cameroon is a signatory,
National assembly	- Advise towards the legislation on international conventions, protocols and treaties to which Cameroon is a signatory,
Coordinating organs	
A/ the Inter-ministerial Commission for the Environment (ICE)	- Ensures and coordinates the involvement of all ministries in the management of the Coastal and Marine environment and its resources.
B/ The National Environment and Sustainable Development Advisory committee (NESDAC)	- Provides an appropriate platform for effective participatory approach to Marine and Coastal area management.
C/ The Permanent Secretariat for the Environment created by decree No. 96/224 of 101/10/96	Takes care with management of Marine and Coastal area and controls management of the National Environmental and Sustainable Development Fund (NESDF)
D/ The National Environmental and Sustainable Development Fund (NESDF) setup by the Environment Framework law of 1996	A funding structure for the implementation of the National Environmental Management Plan (NEMP)
Ministries	
- MINEPDED (Ministry of Environment, Nature Protection and Sustainable Development)	- Management and co-ordination of activities related to the environment), - Coordination of inter-ministerial/multi-sectorial committees established within MINEP on policy issues related to environmental protection, Focal point: CBD, CPB UNCCC, etc
MINADER (Ministry of Agriculture and Rural Development)	- Elaboration and realisation of government policy in the agricultural sector, - Soil conservation, plant protection.
MINEE (Ministry of Water and Energy)	- Control of noxious industrial installations, pollution, hygiene and safety measures,
MINEPIA (Ministry of Livestock, Fisheries and Animal Husbandry).	Ensures management, conservation and development of freshwater and marine species, domesticated animals.
MINDUH (Ministry of Urban Development and Housing):	Improvement of the immediate habitat and rational occupation of land, conservation of landed property and natural ecosystems; elaboration and execution of land ownership, urbanisation/housing policies; Ensures waste disposal management etc
MINRESI (Ministry of Scientific Research and Innovation)	- Elaboration of national policy on science and technology and its implementation
MINESUP/MINEDUB/MINESEC (Ministry of Higher education/ Ministry of Basic Education and	-Elaboration of training programs in biodiversity and related issues.

Ministry of Secondary Education)	
MINTRANS (Ministry of Transport)	Coordinating development activities related to land, sea and air transportation. - Recording meteorological data on climate Provides funding for biodiversity.
MINFI (Ministry of Finance)	- Provides funding for biodiversity
MINCOM (Ministry of Communication)	- Facilitates dissemination/exchange of biodiversity information
MINPOSTEL (Ministry of Post and Telecommunication)	- Facilitation of electronic communication.
MINSANTE (Ministry of Public Health)	Promotes health of man enabling him to protect biodiversity.
MINTOUL (Ministry of Tourism and Leisure)	- Elaboration of national tourism policy
MINAC (Ministry of Arts and Culture)	- Elaboration of policy to promote national cultures
MINREX (Ministry of External Relations)	- International conventions, treaties and protocols on the environment including Marine and Coastal zone
MINTP (Ministry of Public Works)	- Responsible for evaluating the environmental impact of major construction works
MINCOMMERCE (Ministry of Commerce)	Regulating and controlling industrial activities and thus pollution from these activities in Marine and Coastal area.
MINDEF (Ministry of Defence)	Safety over national territory and in Marine and Coastal area.
MINPROFF (/Ministry of Women's Affairs)	Multi-sectorial policy of integrating women in development, integrating environmental concerns in women projects and programmes.

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Threats on Componentsof Associated Biodiversity

Components of Associated Biodiversity are subject to various degrees of threats which may be critical, vulnerable, endangered, near threatened, according to the IUCN system of classification. The main threats arise from the way the land is used and the kind of the resource being handled. Table 11 outlines the main threats and their degree of threat.

Table 11: Main Threats of Associated Biodiversity at risk

Associated Biodiversity spp	Degree of threat	Main threat	Reference or source of information
MICRO-ORGANISMS			
Soil Bacteria	NK	Through slash and burn practice	Nwaga 1997
Mushrooms	NK	Deforestation	Nwaga 1997
Mycorrhiza	NK	Soil exposure to sun	Nwaga 1997
Others	NK	Pollution, Fungicides, Herbicides	MINEPIA, MINADER

INVERTEBRATES			
Snails	NK	Over-harvesting	MINEPIA
(Goliath Frog)	NK	Over harvesting	MINEPIA
Caterpillars (edible forms) <i>Carnina forda</i> <i>Imbrasia oyemensis</i>	NK NK	Timber exploitation Timber exploitation	Tieguhong et al 2014
Insects <i>Crickets</i> <i>Grasshoppers</i>	NK NK	Over harvesting Over harvesting	MINFOF,2013
Bees <i>Apis mellifera</i> <i>Trigona spp.</i>	NK NK	Habitat destruction	ANCOR, 2012
Butterflies <i>Neptis clareii</i> <i>Leptosia alsesta inalsesta</i> <i>Catuna crithea</i>	NK NK NK	Habitat destruction Habitat destruction Habitat destruction	Larsen, 1996
Termites	NK	Mining, agriculture	MINFOF,2013
VERTEBRATES			
Mammals	NK	Habitat destruction Over-harvesting	MINFOF2013
Reptiles	NK	Over-harvesting	MINFOF2013
Amphipians	NK	Over-harvesting	Van Dijk
Birds	NK	Habitat destruction	MINFOF 2013
AQUATIC BIODIVERSITY			
Sea mammals	NK	Draught	MINEPIA
Fish – Tilapia spp	NK	Pollution	MINEPIA
Shrimps	NK	Over harvesting	MINEPIA
Crabs (river crabs)	NK	Over harvesting	MINEPIA
Crabs (sea crabs)	NK	Pollution, draught	MINEPIA
Fresh water fish spp.	NK	Pollution, draught	MINEPIA
Wild Flora			
<i>Irvingia. gabonensis</i>	NK	Logging, deforestation for agriculture	MINFOF 2013
<i>Piper guineensis</i>	NK	Deforestation for agriculture	MINFOF 2013
<i>R. heudelotii</i>	NK	Deforestation for agriculture	MINFOF 2013
<i>Calamus spp</i>	NK	Over-harvesting for furniture	MINFOF 2013

<i>Rhizophora racemosa</i>	NK	Over-harvesting for fish smoking	MINFOF 2013
<i>Raphia montbuttorum</i>	NK	Over-harvesting for various uses	Van Dijk 1999
<i>Raphia vinifera</i>	NK	Over-harvesting for various uses	MINFOF 2013
<i>Musanga cecropioides</i>	NK	Over-harvesting for various uses	Van Dijk 1999
<i>Coula edulis</i>	NK	Over-harvesting for various uses	Van Dijk 1999

The actual situation of Protected Areas in the country is summarized below.

N°	Protected Areas/types of Protected Areas	Number	Area (ha)
01	National Parks	19	2 971 828
02	Faunal Reserves	07	859 667
03	Animal Sanctuaries	05	104 754
04	Zoological Gardens	03	8.07
05	Botanic Gardens	01	44
06	ZIC	46	4 125 797
07	ZICGC	25	1 535 158.5
Total		119	9 597 256.57

Source: MINFOF 2015

The actual situation of protected Areas under gazetting is also presented below.

N°	Name	Area (ha)
01	Marine National Park of Manyangenu Elombo Campo	126 053
02	National Park of TCHABAL MBABO	150 000
03	National Park of NDONGORE	230 000
04	National Park of KOM	68 905
05	National Park of EKOM	100 000
06	National Park of Douala-Edea	296 000
07	National Park of MEFOU	1044
08	Integral Ecological reserve of KUPE	4676
09	MOUNT BAMBOUTOS Reserve	2500
10	Integral Ecological reserve of MOUANEGUMBA	5252
11	Reserve of MOUNT NLONAKO	2500
12	RUMPI HILL Sanctuary	45 675
13	SANAGA NYONG Sanctuary	14
Total		1 032 619

Source: MINFOF 2015

3.5.2. The Challenge on Protected Areas

It must be understood that some of the Protected Areas are facing protection problems arising from the growing population around them. They encroach in the parks and use the land to farm, graze and build. The PAs which were earlier established did not foresee the population growth problem and in many cases, buffer zones were not provided. The Wildlife Administration is aware of this challenge and is

addressing it through allocation of compensatory zones into lands which have less population pressure and not suitable for agriculture.

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3.5.3. *Ex-situ* conservation activities on associated biodiversity in Cameroon

In Cameroon, *ex-situ* conservation activities involve the management of certain species of plants, invertebrates, vertebrates and micro-organisms as seen in Table 12 below:

Table 12: Ex-situ Conservation Activities in Cameroon

Components of associated biodiversity	Organisms species & sub species	Size of collection	Conservation condition	Objective(s)	Characterisation/E valuation status
Micro-organisms	Mycorrhiza for bio-fertilizers	NK	In research experimental plots	Research/teaching	NK
Invertebrates	<i>Achatina achatina</i> (Snails)	NK	In farms	For food	NK
	<i>Conrauna robusta</i> (Torrent frog) <i>Trichobatrachus robustus</i> (hairy frog)	NK	In private ponds	For food	NK
	<i>Apis mellifera</i> (Honey bees)	NK	In private farms		NK
Vertebrates (Variety of species)	Mammals Reptiles Amphibians Birds		Zoological gardens	For leisure and research	NK
	Cane rats(<i>Tryonomys swinderianus</i>)	NK	Individual farms	For food & commerce	NK
Plants	Crop species Cash crops Food crops	NK NK	gene banks	Research	NK
			farms/gardens	Food/commerce	

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3.5.4. *In-situ* Conservation on associated biodiversity

Cameroon has programmes which support the maintenance of associated biodiversity. Conservation within Protected Areas involves the protection of micro-organisms, invertebrates, vertebrates and various plant species. The importance of micro-organisms in *in-situ* conservation is in their involvement

in mycorrhizal association with a variety of forest tree species and the creeper *Gnetum spp.* Studies in the natural forest have shown that at least 232 tree species are in association with treemycorhiza and protected area regulations forbid human activities within Protected Areas. Plant species associate with *Gnetum* as ectomycorhiza. Table 13 provides some information on conservation.

Table 13: In-situ conservation or management activities for associated biodiversity

Components of Associated Biodiversity	Organisms species & sub species	Site name and location	Production systems involved	Conservation objectives	Specific actions that secure associated biodiv./ecosystem services
Micro-organisms	Various species of bacteria nitrogen fixing Mycorrhizal association	PA coverage (9.124.666 ha)	F1, F5, CS, M1	protection of biodiversity	Protected Area regulations forbid human activities
Invertebrates	Insect larvae Tadpoles, Frogs Fish cruch	Inland waterways	F1,A1	For food For Research For preservation of species	Avoid agriculture and mining activities that can polluate waterways
	<i>Achatina sp</i>	Forest floor farms/plantations	F1, C9	For food	Harvesting only mature ones
Vertebrates	Mammals Reptiles Amphibians Birds	In parks and reserves	F1	For income For food For Research For preservation of species	protected area regulations forbid human activities; special hunting seasons in parks and Reserves peripheral zones and in hunting zones
Plants	Various plants	In parks and reserves, botanic gardens	F1 ,F5	Ecosystem services	Protected Area regulations forbid human activities

(32).

Maintenance of Traditional Knowledge of Associated biodiversity in Cameroon

The following activities focus on the maintenance of traditional knowledge in Cameroon.

- Government cooperates with tradi-practitioners through the Institute of Medicinal and Medical Plants to conduct analysis on medicinal plants and valorise their properties;
- Traditional healers in Cameroon operate freely and collaborate among themselves to the extent of having associations of Tradi-practitioners;

- Studies on ethno-botany have been conducted in many parts of the country and IK of some tribal groups has been recorded and serves as research materials;
- Some traditional leaders have identified families in their communities which are known to possess some form of traditional knowledge; some are attempting to record some knowledge which otherwise would have been lost;
- The Ministry of Culture is collecting and recording some information on TK of some communities and storing them in the National Museum in the form of books, artfices, pictures, carvings;
- There is regular sale of locally manufactured materials in artisanal and handicraft centres of some towns. Some of this material show aspects of the TK of the community that has produced the material some of which has often served as tourist attractions;
- The West African Commonwealth Traditional Healers Association was formed in 1981 in Limbe under the initiative of the Commonwealth Science Council with Nigeria, Ghana, Sierra Leone, Gambia and Cameroon as members. Their objective is to encourage member countries to recognise, valorise and document traditional knowledge;
- In most local and village communities there are sacred forests where traditional rites and cultural performances are conducted. Although the knowledge in these forests is regarded sacred and secret, the indigenes of those communities conserve the forests as huge stores of traditional knowledge.
- Agro-forestry practices in Cameroon recognize the need to valorize TK since some of the species conserved or planted in crop farms have medicinal, food and cultural values. .

(33).

Information on Gender Dimension on maintenance and knowledge about associated biodiversity

In all rural fishing, forest, crop cultivating and animal rearing communities, men and women play specific roles in knowing and maintaining biodiversity components including all forms of associated biodiversity. Both men and women detect the presence of some useful species of plants and animals as well as important sites and habitats for supporting the existence and growth of useful plants and animals. Some plants and animal species are seen to live in association or in symbiosis with others. It is known by most forest dwellers that where the plant *Barteria fistilosa* and or *B, nigritan* there are brown stinging ants living in symbiosis with the plant, (Keay, 1989). Gender dimension involves some task partitioning as seen in various production systems:

IN FOREST COMMUNITIES:

Men's Role:

- Clearing thick forest before establishing farm or house;
- Planting and maintenance of cash crops – cocoa, coffee, oil palm, rubber;
- Hunting game, building family home with suitable species;
- Tool handles, local drums, roofing materials, furniture making, bag weaving carpentry;
- Traditional healing and cultural practices
- Educating the boy child on best forest practices especially the use of appropriate species for specific uses –know the species to be used for roofing houses, fencing, furniture, etc.

Women's Role:

- Farming food crops: cassava, plantains, cocoyam, vegetables
- Weeding food farms
- Fishing in streams within forest environment
- Weaving small nets for fishing in streams
- Collecting fire wood and wild foods
- Maintaining wild food species in farms as agro-forestry practice
- Educating the girl child on best forest practices especially on species to be used for female rituals and for all that is expected of the girls or the woman in such an environment.

IN FISHING COMMUNITIES**Men's Role**

- Men are engaged in canoe carving;
- Fishing net weaving and repairs;
- Actual fishing in the high seas
- Sale of fresh fish to fish smokers and smaller traders

Women's role: Little Land- Based Activities

- Fish smoking
- Selling smoked fish
- Gathering firewood for smoking fish and boiling food
- Sale of food to fishermen
- Purchase of food item from land-based communities

IN LIVESTOCK COMMUNITIES**Men's Role**

- Purchase of animals
- Feeding animals: carrying them to pastoral lands;
- Ensure health of animals arrange for vaccination;
- Arrange sale of animals: whole or butchered
- Educate the boy child on his masculine responsibility

Women's Role

- Sale of dairy products: milk, butter
- House-hold care
- Wood gathering
- Sale of food to herdsman

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3.6. State and trend of wild resources for food

3.6.1. Wild species used for food and agriculture

A variety of wild plant species have been found useful for food and agriculture by various communities in Cameroon. The table provides groups of wild species used for food and agriculture

Groups of Wild Species used for food in the tropical rain forest Ecosystem

PLANT USE CATEGORIES	N°. of SPECIES	ANIMAL USE CATEGORIES	N° of SPECIES
Condiments &spices	32	Hunted Animals	98
Oil products	6	Mammals	48
Vegetables	33	Birds	32
Food wrapping	14	Reptiles	18
Fruits	33	Fish/Crustaceans	61
Nuts	16	Molluscs	10
Tubers	9	Insects	16
Beverages	31		
Mushrooms	29		

Source: van Dijk, 1999

Non timber forest products serve as important food constituent and make considerable contribution to the country economy. The table below illustrates the economic value of the major non timber forest products in various ecosystems in Cameroon.

Species	Annual value (\$)	Ecosystem
<i>Gnetum africanum, G. bulchholzianum</i>	12,197,503	dense humidtropical forest
<i>Irvingia gabonensis, I.wombulu</i>	8,089,503	humid tropicalforest
<i>Prunus africana</i>	2,874,928	mountain
<i>Dacryodes edulis</i>	989,504	dense humidtropical forest
<i>Pausinystalia johimbe</i>	847,182	dense humidtropical forest
<i>Ricinodendron heudelotii</i>	730,325	dense humidtropical forest
<i>Voacanga africana</i>	585,586	dense humidtropical forest
<i>Lacosperma secundiflorum, L. robustum, Eremospatha macrocarpa</i>	284,013	dense humidtropical forest
<i>Cola acuminata</i>	269,083	dense humidtropical forest
<i>Garcinia Kola</i>	249,938	dense humidtropical forest
<i>Garcinia lucida</i>	171,175	dense humidtropical forest
<i>Baillonella toxisperma</i>	11,868	dense humidtropical forest
<i>Piper guineensis</i>	78.9	dense humidtropical forest
<i>Acacia Senegal, A. polyacantha</i>	4,040,000	semi-arid
<i>Raphia sp</i>	1,574,661	dense humidtropical forest, woodedtropicalsavannah, mountain
<i>Tetrapleura tetraptera</i>	124,483	dense humidtropical forest, woodedtropicalsavannah
<i>Rauvolfia vomitoria</i>	94,803	dense humidtropical forest

Source: Ingram et al, 2010

Surveyors of food and agricultural products from the wild in Cameroon have examined them with respect to their importance in food and nutrition, mode of exploitation, storage/processing, marketing, sustainable use.

Nutritional value of wild foods

The contribution of wild species for food and nutrition has been shown in studies carried out in the Congo Basin forest by Biodiversity International involving Cameroon, Gabon and the Democratic Republic of Congo in a project called, "Beyond Timber". Studies involving analysis of fruits of six wild species: *Baillonella toxisperma*, *Trichoscypha abut*, *Pentaclethra macropylla*, *Poga oleosa*, *Gambeya africana* and *Dacryodes buettnerri*, The six species were found to be rich in calcium, magnesium, iron, potassium, zinc including the presence of Vitamin C, A and E. The study recommends the sensitization people on the nutritional value of some NTFP which could be richer than even some of the cultivated ones and for more research be made on other wild foods¹³. The importance of these products has been seen in their uses for food primary health care, farming tools, cultural uses, traditional crafts crop protection and spiritual beliefs.

3.6.2. Exploitation of wild foods

Exploitation and the amounts being harvested is regulated by seasonal variations, forest clearing and the conflict of interest regarding of some plant species. The following tree species have conflicted with the desire of rural dwellers as they serve as commercial timber:

- *Baillonella toxisperma* an important timber tree produces valuable oil;
- *Guibourtia tessmannii* an important timber tree valuable for religious and magic belief;
- *Ricinodendron heudelotii* an important timber tree which also produces the much cherished fruit Njansang;
- *Pycnanthus angolense* important for building wood and the leaves used medicinally for stomach ache.

3.6.3. Processing and conservation of wild foods

Most of the wild products for food and agriculture store well since many are sun or fire- dried before being transported to city markets. Except the leaves of *Gnetum* spp which are exported fresh, others are in the forms of dried fruits, seeds and barks. Bush mango (*Irvingia gabonensis*) is industrially processed in Nigeria, (Henkemans, 1995) and industrially transformed in the United States of America (Oben, 2008) but only manually in Cameroon.

3.6.4. Marketing and economic value

Marketing is mostly undertaken by women. A survey carried out showed that 94% of the traders were women, (Ndoye, 1995), though transportation is done by men. Prices usually drop after harvesting season. It is reported that retailers lack capital and are not consistent in collecting and trading on the same product. Total value of NTFPs marketed for half a year for 31 markets was estimated at 643.6 million FCFA (\$US 1.3 million), (Ndoye, 1995), estimated volume of Bush Mango exported to Gabon and Equatorial Guinea amounted to 6.9 million FCFA and the value in Ebolowa is estimated at 3.5 million FCFA/year (Tieguhong et al 2014).

¹³ Analysis showed that *Poga Oleosa* fruit contains 263mg/100g of calcium, 17mg/100g of iron 384mg/100g of potassium while *Carica papaya* contains only 24mg/100g of calcium and barely 10mg/100g of magnesium

3.6.5. Sustainability of wild foods

The continuous availability of food products from the wild can be possible through:

- The strict application of forest management principles contained in the Forestry Law N°94/01 of the 20 January 1994;
- Use of Agro-forestry farming methods where species yielding food and agricultural products will not be felled;
- Cultivation of the species especially those exploited in commercial quantities. Among the 76 plants identified for medicinal uses, 17 were seen to be cultivated in the forest zone areas,
- For animal products, hunting laws should be applied and control measures strictly followed. Non-Conventional breeding should be encouraged among the rural dwellers to prevent them from hunting rare animal species within their forest zones;
- More research to improve knowledge on the food and ecosystems values of the species

3.6.6. Wild resources used for food

Table 14 shows the species of plants and animals known to be hunted, captured or gathered for food in Cameroon. The choice of food will vary according to what is available in each ecosystem and also depending on the taste preferences of the inhabitants in each zone. In Table 14, the wild food resources have been grouped into plants and animals. The plants have been regrouped into seeds, fruits, green vegetables, root vegetables while animals have been regrouped into: mammals, fish, amphibians, reptiles, crustacean, molluscs, birds and insects.

Many food plants and insects species currently consumed in various ecosystems are still unknown.

Table 14: Wild species used for food

Local Names*	Scientific Names	Production System	Changes in its state	Differences between identified species	Source of Information
PLANTS: Seeds &Fruits					
Bobdi (Fou)	<i>Adansonia digitata</i>	F1	(-2)	Y	Vivien & Faure 1996
	<i>Afromomum citratum</i>	F1	(-2)	Y	
	<i>Afromomum daniellii</i>	F1	(-2)	Y	
	<i>Afromomum giganteum</i>	F1	(-2)	Y	
ndong (Ew); Ndondo' a mounda (Do); Ketchou (Bang)	<i>Afromomum melegueta</i>	F1	(-2)	Y	
	<i>Afromomum polyanthum</i>	F1	(-2)	Y	
	<i>Afromomum sulcatum</i>	F1	(-2)	Y	
Abam (Ew)	<i>Afrosersalis afzelii</i>	F1	(-2)	Y	
	<i>Afrosersalis cerasifera</i>	F1	(-2)	Y	
Olom bewa (Ew); adjembé (Bang)	<i>Afrostyrax lepidophyllus</i>	F1	(-2)	Y	
Egide (Fou)	<i>Alfania senegalensis</i>	F1	(-2)	Y	
Nsangomo (Ew) Eboungo matatolo (Do); nyonne (Bas)	<i>Allanblackia floribunda</i>	F1	(-2)	Y	
	<i>Allanblackia gabonensis</i>	F1	(-2)	Y	
	<i>Allanblackia stanerana</i>	F1	(-2)	Y	
	<i>Allanblackia stanerana</i>	F1	(-2)	Y	
	<i>Alsodeiopsis staudtii</i>	F1		Y	
	<i>Alsodeiopsis zenkeri</i>	F1	(-2)	Y	
Jigarehi (Fou)	<i>Amblygonocarpus andonengensis</i>	F1	(-2)	Y	
Zek (Bu)	<i>Ananas comosus</i>	F1	(NK)	Y	Van Dijk 1999
	<i>Ancistropyllum secundiflorum</i>	F1	(NK)	N	MONFOF 2013

*Index to local names used in the table: Douala (Do), Bangangté (Bag), Foulfouldé (Fou), Ejagham (Eja) Bassa (Bas), Bakossi: (Bako), Bakweri (Bakw), Bulu (Bu), Fang (Fa) and Ewondo (Ew)

	<i>Ancylboyhthys amoena</i> (<i>landolphia amoena</i>)	F1	(-2)	Y	Vivien & Faure 1996	
Dalouha (Fou)	<i>Andira inermis</i>	F1	(-2)	Y		
	<i>Angilocalx talbotii</i>	F1	(NK)	Y	MINFOF2013	
Abam (Ew)	<i>Aningeria altissima</i>	F1	(-2)	Y	Vivien & Faure 1996	
Abam (Ew); Tolongo (Bang)	<i>Aningeria robusta</i>	F1	(-2)	Y		
Kolong (Do)	<i>Annona glabra</i>	F1	(-2)	Y		
nkowkelok(Bag); doukouloulade (Fou)	<i>Annona senegalensis</i>	F1	(-2)	Y		
Ebom (Ew); bom (Bas)	<i>Anonidium manii</i>	F1	(-2)	Y		
Damoba (Ew)	<i>Anthoclitandra robustior</i>	F1	(-2)	Y		
Tsiboli gorki (Fou)	<i>Antidesma venosum</i>	F1	(-2)	Y		
Angongui (Ew)	<i>Antrocyron micraster</i>	F1	(-2)	Y		
Angongui (Ew(;bongongui (Do); lingonga (Bas);	<i>Antrocyron klaneanum</i>	F1	(-2)	Y		
	<i>Aphanosylis manii</i>	F1	(-2)	Y		
	<i>Artocarpus altilis</i>	F1	(-2)	Y		
	<i>Artocarpus heterophyllus</i>	F1	(-2)	Y		
Ozakong (Bu); Zakong (Fa)	<i>Artrocaryn klaneanum</i>	F1	(NK)	N		MINFOF2013
Adjap(Ew); njabi (Do); ofo (Eja); njap (Bas); djap (Bu)	<i>Baillonella toxisperma</i>	F1	(-2)	Y		Vivien & Faure 1996
	<i>Beilschmedia anacardioides</i>	F1	(-2)	Y		
	<i>Beilschmedia mannii</i>	F1	(-2)	Y		
Kanda (Ew)	<i>Beilschmedia obsura</i>	F1	(-2)	Y		
Abai (Ew); Feso (Fou)	<i>Bligha sapinda</i>	F1	(-2)	Y		
doubi (Fou)	<i>Borassus aethiopum</i>	F1	(-2)	Y		
Amzagi (Fou)	<i>Boscia angustifolia</i>	F1	(-2)	Y		
Anzagi (Fou)	<i>Boscia senegalensis</i>	F1	(-2)	Y		
Ncha ncha (Bang); boroborohi (Fou)	<i>Bridelia ferrunginea</i>	F1	(-2)	Y		
mvan(Ew)	<i>Buchholzi coriacea</i>	F1	(-2)	Y		
Mvan (Ew)	<i>Buchholzia thilloniana</i>	F1	(-2)	Y		
Miamingomo (Ew)	<i>Caloncoba welwitschii</i>	F1	(-2)	Y		

	<i>Calpocalyx brevibracteatus</i>	F1	(-2)	Y	Vivien & Faure 1996
Abel (Ew); Sao eyed (Do); Wotwa(Bakw); Mbeu) Bang; héhé(Bas)	<i>Canarium schweinfurthii</i>	F1	(-2)	Y	
	<i>Canophyllum giganteum</i>	F1	(-2)	Y	
tombo (Ew); nkan atana (Eja)	<i>Capolobia alba</i>	F1	(-2)	Y	
Gorko (Fou)	<i>Capparis fascicularis</i>	F1	(-2)	Y	
Djadjihi (Fou)	<i>Capparis sepiaria</i>	F1	(-2)	Y	
Engang (Ew); Hom (Bas)	<i>Carapa procera</i>	F1	(-2)	Y	
Tchaboule bali (Fou)	<i>Carissa edulis</i>	F1	(-2)	Y	MINFOF2013
	<i>Carpolobia lutea</i>	F1	(NK)	N	
Djiho (Fou)	<i>Celtis intergrifolia</i>	F1	(-2)	Y	Vivien & Faure 1996
	<i>Chrysobalanus icaco</i>	F1	(-2)	Y	
Abam ekuk (Ew); Abam (Do)	<i>Chrysophyllum spp</i>	F1	(-2)	Y	
	<i>Chytranthus atrovioleaceus</i>	F1	(-2)	Y	
	<i>Chytranthus carneus</i>	F1	(-2)	Y	
	<i>Chytranthus edulis</i>	F1	(-2)	Y	
	<i>Chytranthus mortehanii</i>	F1	(-2)	Y	
	<i>Chytranthus talbotii</i>	F1	(-2)	Y	
	<i>Clamydocola clamydantha</i>	F1	(-2)	Y	
	<i>Clitandra cymulosa</i>	F1	(-2)	Y	
Abolodji (Fou)	<i>Cochlospermum planchonii</i>	F1	(-2)	Y	
Abeu (Ew); Ambénou (Do)	<i>Cola acuminata</i>	F1	(-2)	Y	
	<i>Cola anomala</i>	F1	(-2)	Y	
	<i>Cola ballayim</i>	F1	(-2)	Y	
Eneblokon (Ew)	<i>Cola caricaefolia</i>	F1	(-2)	Y	
	<i>Cola hispide</i>	F1	(-2)	Y	
Emvoé, emvoye, (Ew)	<i>Cola lepidota</i>	F1	(-2)	Y	
Efok (Ew)	<i>Cola millenii</i>	F1	(-2)	Y	
Kom (Ew)	<i>Cola pachycarpa</i>	F1	(-2)	Y	
Koélé (Ew)	<i>Cola rostrata</i>	F1	(-2)	Y	
Abeu afan(Ew)	<i>Cola verticillata</i>	F1	(-2)	Y	

Lilibadjé (Fou)	<i>Cordia africana</i>	F1	(-2)	Y	Vivien & Faure 1996
Tiamanohi (Fou)	<i>Cordia myxa</i>	F1	(-2)	Y	
Douka (Fou)	<i>Cordyla pinnatai</i>	F1	(-2)	Y	
Ewomé (Ew); Wokomea (Bakw); (Bas) Omol; Voula (Do)	<i>Coula edulis</i>	F1	(-2)	Y	
Lamdam (Fou)	<i>Crateva adansonii</i>	F1	(-2)	Y	
assa(Ew); sao; (Bakw) shoue (Bang); sah (Bas); (Do) Sao eyidi	<i>Dacryodes edulis</i>	F1	(-2)	Y	
	<i>Dacryodes igagana</i>	F1	(-2)	Y	
Nom ebap (Ew)	<i>Dacryodes klaneana</i>	F1	(-2)	Y	
Atom (Ew)	<i>Dacryodes macrophylla</i>	F1	(-2)	Y	
Ekonaka (Eja)	<i>Danettia tripetala</i>	F1	(-2)	Y	
Oman(Ew); bwiba (Doà; Iman (Bas)	<i>Desbordesia glaucescense</i>	F1	(-2)	Y	
Konkéhi (Fou)	<i>Deterium microcarpum</i>	F1	(-2)	Y	
Koumbelé (Ew)	<i>Dialum dinklagei</i>	F1	(-2)	Y	
Ahom avom(Ew)	<i>Dictophleba ochracea</i>	F1	(-2)	Y	
	<i>Dinophora spenneroides</i>	F1	(-2)	Y	
Olombang (Ew)	<i>Diogoia zenkerii</i>				
	<i>Dioscoreophyllum cumminsii</i>	F1	(-2)	Y	
bong(Ew); Pene(Bas)	<i>Diospyros barteri</i>	F1	(-2)	Y	
Olomevini (Ew)	<i>Diospyros canaliculata</i>	F1	(-2)	Y	
	<i>Diospyros cinnabarina</i>	F1	(-2)	Y	
nom olomevini (Ew); pinde pinde (Do); finde finde (Bakw)	<i>Diospyros dendo</i>	F1	(-2)	Y	
Bong-afoum (Ew)	<i>Diospyros kamerunensis</i>	F1	(-2)	Y	
Baheli (Fou)	<i>Diospyros mespiliformis</i>	F1	(-2)	Y	
Ossanga (Ew)	<i>Diospyros suaveolens</i>	F1	(-2)	Y	
	<i>Diospyros viridicans</i>	F1	(-2)	Y	
Abam (Ew)	<i>Donella pruniformis</i>	F1	(-2)	Y	
	<i>Drypetes floribunda</i>	F1	(-2)	Y	
	<i>Drypetes gilgiana</i>	F1	(-2)	Y	

Olelang (Ew)	<i>Drypetes gossweieri</i>	F1	(-2)	Y	Vivien & Faure 1996
lia (Bakw); melen (Bakos); elem ebhi (Ej)	<i>Elaeis guinensis</i>	F1	(-2)	Y	
Eyong (Ew), Bonge (Do); Ekonge (Bakw); Elom (Bas); Obeya nono (Eja)	<i>Eriobroma oblongum</i>	F1	(-2)	Y	
	<i>Eugenia brasiliensis</i>	F1	(-2)	Y	
	<i>Eugenia jambolana</i>	F1	(-2)	Y	
	<i>Eugenia jambos</i>	F1	(-2)	Y	
	<i>Eugenia malaccensis</i>	F1	(-2)	Y	
	<i>Fadogia cienkowskii</i>	F1	(-2)	Y	
Bouhebehi (Fou)	<i>Faretia apodanthera</i>	F1	(-2)	Y	
Danehi (Fou)	<i>Ficus abutilifolia</i>	F1	(-2)	Y	
	<i>Ficus artocarpoides</i> = <i>F. elegans</i>	F1	(-2)	Y	
Bbi gehi (Fou)	<i>Ficus asperifolia</i>	F1	(-2)	Y	
Tsékéhi (Fou)	<i>Ficus barteri</i>	F1	(-2)	Y	
Palli (Fou)	<i>Ficus capreaefolia</i>	F1	(-2)	Y	
Tsékéhi (Fou)	<i>Ficus glumosa</i>	F1	(-2)	Y	
	<i>Ficus ingens</i>	F1	(-2)	Y	
	<i>Ficus lutea</i> = <i>F.vogelii</i>	F1	(-2)	Y	
Doundehi (Fou)	<i>Ficus platyphylla</i>	F1	(-2)	Y	
Litadji (Fou)	<i>Ficus polita</i>	F1	(-2)	Y	
Bidjahi (Fou)	<i>Ficus populifolia</i>	F1	(-2)	Y	
Ibbi debbi (Fou)	<i>Ficus sycomorus</i>	F1	(-2)	Y	
Tchekehi danehi (Fou)	<i>Ficus thonningii</i> = <i>F.dekdekena</i>	F1	(-2)	Y	
Gelobahi (Fou)	<i>Ficus trichopoda</i>	F1	(-2)	Y	
	<i>Ficus vallis-choudae</i>	F1	(-2)	Y	
	<i>Flacourtia flavescens</i>	F1	(-2)	Y	
	<i>Flacourtia indica</i>	F1	(-2)	Y	
Abam (Ew)	<i>Gambeya africana</i>	F1	(-2)	Y	
	<i>Gambeya albida</i>	F1	(-2)	Y	
Abam (Ew)	<i>Gambeya lacourtiana</i>	F1	(-2)	Y	
Abam (Ew)	<i>Gambeya perpulchra</i>	F1	(-2)	Y	

Abotzok (Ew)	<i>Garcinia africana</i>	F1	(-2)	Y	Vivien & Faure 1996
	<i>Garcinia afzelii</i>	F1	(-2)	Y	
	<i>Garcinia epuntata</i>	F1	(-2)	Y	
Onié(Ew); Ebongagnagne (Do); ejare (Ejag), nya	<i>Garcinia kola</i>	F1	(-2)	Y	
Essok(Ew); Lano (Bas)	<i>Garcinia lucida</i>	F1	(-2)	Y	
	<i>Garcinia mangostana</i>	F1	(-2)	Y	
Ebam(Ew); Ébongo maya(Do)	<i>Garcinia mannii</i>	F1	(-2)	Y	
	<i>Garcinia xanthochymus</i>	F1	(-2)	Y	
Evem (Ew); Dingale debbi (Fou)	<i>Gardeia erubescens</i>	F1	(-2)	Y	
Ekobem (Ew)	<i>Gilbertiodendron dewevri</i>	F1	(-2)	Y	
Eli (Fou)	<i>Grewia barteri</i>	F1	(-2)	Y	
Bamberou (Fou)	<i>Grewia bicolor</i>	F1	(-2)	Y	
Goursoumhi (Fou)	<i>Grewia cissoides</i>	F1	(-2)	Y	
Goursoumhi (Fou)	<i>Grewia flavescens</i>	F1	(-2)	Y	
Kelli batoki (Fou)	<i>Grewia venusta</i>	F1	(-2)	Y	
Goursoumhi (Fou)	<i>Grewia villosa</i>	F1	(-2)	Y	
Oveng (Bu)	<i>Guibourtia tessmannii</i>	F1	(NK)	Y	Van Dijk 1999
Toursouhi (Fou)	<i>Haemetostaphis barteri</i>	F1	F1	Y	Vivien & Faure 1996
Evem (Ew); Atama (Eja)	<i>Heinsia crinite</i>	F1	(-2)	Y	
owé(Ew); leoué (Bas)	<i>Hexalobus crispiflorus</i>	F1	(-2)	Y	
Boeli (Fou)	<i>Hexalobus monopetalus</i>	F1	(-2)	Y	
Messe mokuoué (Ew)	<i>Histeria parvifolia</i>	F1	(-2)	Y	
	<i>Histeria trillesiana</i>	F1	(-2)	Y	
Tom minko (Ew)	<i>Histeria zimmereri</i>	F1	(-2)	Y	
gellohi (Fou)	<i>Hyphaene thebaica</i>	F1	(-2)	Y	
Andok (Ew)	<i>Irvingia excela</i>	F1	(-2)	Y	
andok (Ew); Etou (Bakos); bwiba bambale (Do); Nsen (Ejag); bopala (Bak)	<i>Irvingia gabonensis</i>	F1	(-2)	Y	
(Ew) Andok ngoué; bwibanjok(Do)	<i>Irvingia grandifolia</i>	F1	(-2)	Y	
Andok	<i>Irvingia robur</i>	F1	(-2)	Y	
	<i>Irvingia smithi</i>	F1	(-2)	Y	

	<i>Irvingia wombolul</i>	F1	(-2)	Y	Vivien & Faure 1996
Ngon (Ew); ngondo (Do)	<i>Klainedoxa gabonensis</i>	F1	(-2)	Y	
	<i>Landolphia congolensis</i>	F1	(-2)	Y	
Ogam (Ew)	<i>Landolphia dulcis</i>	F1	(-2)	Y	
avom (Ew)	<i>Landolphia foretiana</i>	F1	(-2)	Y	
	<i>Landolphia glabra</i>	F1	(-2)	Y	
	<i>Landolphia hirstula</i>	F1	(-2)	Y	
	<i>Landolphia jumellei</i>	F1	(-2)	Y	
wouoma (Bakw)	<i>Landolphia landolphioides</i>	F1	(-2)	Y	
	<i>Landolphia manii</i>	F1	(-2)	Y	
	<i>Landolphia owariensis</i>	F1	(-2)	Y	
	<i>Landolphia parvifolia</i>				
Farouhi (Fou)	<i>Lannea acida</i>	F1	(-2)	Y	
Farouhi (Fou)	<i>Lannea microcarpa</i>	F1	(-2)	Y	
Ekoa (Ew)	<i>Lannea welwitschii</i>	F1	(-2)	Y	
Ekouloungom (Ew); kéla(Do); Ngongori (Bas)	<i>Lavegeria macrocarpa</i>	F1	(-2)	Y	
Oloa (Ew)	<i>Lecaniodiscus cupanioides</i>	F1	(-2)	Y	
Essong (Ew)	<i>Leea guineensis</i>	F1	(-2)	Y	
	<i>Litchi sinensis</i>	F1	(-2)	Y	
Okoka (Ew); Bongossi (Do); Djomgi (Bakw); Ndongué; Hos (Bas)	<i>Lophira alata</i>	F1	(-2)	Y	
Saktohi (Fou)	<i>Lophira lanceolata</i>	F1	(-2)	Y	
	<i>Maesobotrya barteri</i>	F1	(-2)	Y	
	<i>Maesobotrya dusenii</i>	F1	(-2)	Y	
	<i>Maesobotrya staudtii</i>	F1	(-2)	Y	
Nkangela (Ew); Esegne (Bakw)	<i>Maesopsis eminii</i>	F1	(-2)	Y	
Evot (Ew); kogo (Bas); Ekom (Ejag)	<i>Magnistipula tessmannii</i>	F1	(-2)	Y	
Abotzok (Bu)	<i>Mamea africana</i>	F1	(NK)	Y	Van Dijk 1999
Abam (Ew)	<i>Manilkara lacera</i>	F1	(-2)	Y	Vivien & Faure 1996
Asila oman	<i>Maranthes glabra</i>	F1	(-2)	Y	

	<i>Melicocca bijuga</i>	F1	(-2)	Y	Vivien & Faure 1996
	<i>Monanthes schwenfurthii</i>	F1	(-2)	Y	
nding belobi (Ew); orou (Eja)	<i>Monodora brevipes</i>	F1	(-2)	Y	
Ding(Ew), nding; ikoma(Bas); ebé (Do)	<i>Monodora myristica</i>	F1	(-2)	Y	
	<i>Morelia senegalensis</i>	F1	(-2)	Y	
Bouri genderou (Fou)	<i>Moringa oleifera</i>	F1	(-2)	Y	
	<i>Morus alba</i>	F1	(-2)	Y	
Ossel (Ew)	<i>Morus mesozygia</i>	F1	(-2)	Y	
	<i>Mussaenda arcuata</i>	F1	(-2)	Y	
	<i>Mussaenda elegans</i>	F1	(-2)	Y	
Engokom (Ew); Mengame (Fa); wakaka (Bakw); Angom (Bas); Bokeku (Do); Eci mbok (Eja)	<i>Myrianthus arboreus</i>	F1	(NK)	N	MONFOF2013
Engakom (Ew); ngokom; wakaka(Bakw); (Do) bokeku; eci mbok (Ejag)	<i>Myrianthus arboreus</i>	F1	(-2)	Y	Vivien & Faure 1996
	<i>Napoleonaea imperialis</i>	F1	(-2)	Y	
	<i>Napoleonaea vogelii</i>	F1	(-2)	Y	
Andingding (Ew)	<i>Nauclea pobeguini</i>	F1	(-2)	Y	
Akandok (Ew); Moukonja ma moundi (Do); Ikanlip-an (Bas)	<i>Nauclea diderrichii</i>	F1	(-2)	Y	
Bakouréhi, kauli (Fou)	<i>Nauclea latifolia</i>	F1	(-2)	Y	
	<i>Nauclea vanderguchtii</i>	F1	(-2)	Y	
	<i>Nephelium lappaceum</i>	F1	(-2)	Y	
Ozek (Ew)	<i>Odyndyea gabunensis</i>	F1	(-2)	Y	
Ban ofan (Ew)	<i>Olax latifolia</i>	F1	(-2)	Y	
Olom bekoué (Ew)	<i>Olax subscorpioidea</i>	F1	(-2)	Y	
	<i>Orthandra cirrhosa</i>	F1	(-2)	Y	
	<i>Orthandra schweinfurthii</i>	F1	(-2)	Y	
	<i>Oubanguia alata</i>	F1	(-2)	Y	
	<i>Pachystela brevipes</i>	F1	(-2)	Y	
Abam (Ew)	<i>Pachystela msolo</i>	F1	(-2)	Y	
	<i>Pancovia laurentii</i>	F1	(-2)	Y	

Afane; Panda (Do)	<i>Panda oleosa</i>	F1	(-2)	Y	Vivien & Faure 1996
	<i>Parinari congensis</i>	F1	(-2)	Y	
goro soulabe (Fou)	<i>Parinari curatellifolia</i>	F1	(-2)	Y	
asila akoung	<i>Parinari excelsa</i>	F1	(-2)	Y	
Naréhi (Fou)	<i>Parkia africana</i>	F1	(-2)	Y	
Nlom (Ew)	<i>Paulinia pinnata</i>	F1	(-2)	Y	
Ebaye (Ew); Kombolo (Do); Bamba (Bas); Nsana bhale (Eja)	<i>Pentaclethra macrophylla</i>	F1	(-2)	Y	
Nom onié (Ew)	<i>Pentadesma butyracea</i>	F1	(-2)	Y	
	<i>Pentadesma grandifolia</i>	F1	(-2)	Y	
anding (Ew); dibinohi (Fou)	<i>Phoenix reclinata</i>	F1	(-2)	Y	
anding (Ew); dibinohi (Fou)	<i>Phoenix dactylifera</i>	F1	(-2)	Y	
	<i>Phyllobotryon sptulatum</i>	F1	(NK)	N	MINFOF2013
Abomedjang (Ew); Lobo (Do); Idoko (Bakw); Ndong (Bakos)	<i>Piper guineense</i>	F1	(-2)	Y	Vivien & Faure 1996
	<i>Podococcus barteri</i>	F1	(-2)	Y	
Angélé ngalé (Ew); Pobo (Do); mpoi (Bas); njore (Eja)	<i>Poga oleosa</i>	F1	(-2)	Y	
Kohi (Fou)	<i>Prosopis africana</i>	F1	(-2)	Y	
Nkanélé (Ew)	<i>Pseudospondias macrocarpa</i>	F1	(-2)	Y	
	<i>Psidium cattleianum</i>	F1	(-2)	Y	
	<i>Raphiostylis beninensis</i>				
(Ew) Essesang; Esangasanga (Bakw); Isangé (Bakos) ; Njangsang (Do)	<i>Ricinodendron heudelotii</i>	F1	(-2)	Y	
Nianare gadourou (Fou)	<i>Saba comorensis</i>	F1	(-2)	Y	
	<i>Salicia callilei</i>	F1	(-2)	Y	
	<i>Salicia erecta</i>	F1	(-2)	Y	
	<i>Salicia nitida</i>	F1	(-2)	Y	
	<i>Santaloides afzelii</i>	F1	(-2)	Y	

ebap(Ew); tomgtok (Bas)	<i>Santiria trimera</i>	F1	(-2)	Y	Vivien & Faure 1996
Edi (Fou)	<i>Sclerocarya birrea</i>	F1	(-2)	Y	
Olom(Ew); (Do) bobinbi	<i>Scorodophloeus zenkeri</i>	F1	(-2)	Y	
tchamé tchami (Fou)	<i>Securinega virosa</i>	F1	(-2)	Y	
	<i>Sherbournia amaraliocarpa</i>	F1	(-2)	Y	
	<i>Sherbournia bigniiflora</i>	F1	(-2)	Y	
	<i>Sherbournia calycina</i>	F1	(-2)	Y	
	<i>Sherbournia hapalophylla</i>	F1	(-2)	Y	
	<i>Sherbournia zenkeri</i>	F1	(-2)	Y	
Ozozom (Ew); Dongo njoh (Do)	<i>Solanum torvum</i>	F1	(-2)	Y	
Ebab (Ew)	<i>Sorindea juglandifolia</i>	F1	(-2)	Y	
Okeke be (Ew)	<i>Sorindea warneckeii</i>	F1	(-2)	Y	
Ndik (Ew)	<i>Spathandra blackeoides</i>	F1	(-2)	Y	
Esusuk (Bu); Evuvon (Fa)	<i>Spathodea campunulata</i>	F1	(NK)	Y	Van Dijk 1999
Edi (Fou)	<i>Spondias birrea (Sclercayra birrea)</i>	F1	(-2)	Y	Vivien & Faure 1996
kassimanga (Bas)	<i>Spondias cytheria</i>	F1	(-2)	Y	
mouganga(Do); Chabouli (Fou); maka	<i>Spondias monbin</i>	F1	(-2)	Y	
Mbonda (Bu)	<i>Staudtia kamerunensis</i>	F1	(NK)	N	Van Dijk 1999
	<i>Stipularia africana</i>				
Djatibolohi (Fou)	<i>Strychnos innocua</i>	F1	(-2)	Y	Vivien & Faure 1996
Narbatanahi (Fou)	<i>Strychnos spinosa</i>	F1	(-2)	Y	
Mangeng esele (Ew)	<i>Strychnos ternate</i>	F1	(-2)	Y	
	<i>Synsepallum dulchificum</i>	F1	(-2)	Y	
	<i>Synsepalum longecunaetum</i>	F1	(-2)	Y	
Asouarahi (Ew) ; tchankwop (Bang); assouarahi (Fou)	<i>Syzygium giuneense var.</i>	F1	(-2)	Y	
Ebobok (Bu)	<i>Syzygium malaccense</i>	F1	(NK)	N	MINFOF 2013
Djabi (Fou)	<i>Tamarindus indica</i>	F1	(-2)	Y	Vivien & Faure 1996
	<i>Teclea afzeli</i>	F1	(-2)	Y	
	<i>Telfairia occidentalis</i>	F1	(-2)	Y	

nkat (Ejag); Ngag (Bang)	<i>Tetracarpidium conophorum</i>	F1	(-2)	Y	Vivien & Faure 1996
Akpa (Ew); Esséssé (Do); eseseksèke (Bakw); ekok (Ejag); saa (Bas)	<i>Tetrapleura tetraptera</i>	F1	(-2)	Y	
	<i>Thaumatococcus daniellii</i>	F1	(NK)	N	MONFOF2013
Nom Adjap elang (Ew)	<i>Tieghemella africana</i>	F1	(-2)	Y	Vivien & Faure 1996
Etoup (Ew); Bwembe (Bakw); Mfin, Ofin (Eja) Etu (Bu)	<i>Treculia africana</i>	F1	(-2)	Y	
Kofelhi (Fou)	<i>Trichilia emetic</i>	F1	(-2)	Y	MINFOF2013
Amvout (Ew)	<i>Trichoscypha acuminata</i>	F1	(NK)	N	
Osang mvou (Ew)	<i>Trichoscypha abut</i>	F1	(NK)	N	CGIAR
Amvout (Ew)	<i>Trichoscypha acuminata</i>	F1	(-2)	Y	Vivien & Faure 1996
Ekong (Ew)	<i>Trichoscypha arborea</i>	F1	(-2)	Y	
Nom ekong (Ew)	<i>Trichoscypha patens</i>	F1	(-2)	Y	
	<i>Trichoscypha preussii</i>	F1	(-2)	Y	
Osomzo (Ew), Otomba	<i>Trilepisium madagariens</i>	F1	(-2)	Y	
	<i>Tristema mauritanium</i>	F1	(-2)	Y	
Assam (Ew); Bossombi (Do); Lisamba (Bas)	<i>Uapaca guineensis</i>	F1	(-2)	Y	
Assam djerem	<i>Uapaca heudelotii</i>	F1	(-2)	Y	
assam	<i>Uapaca palludosa</i>	F1	(-2)	Y	
Assam lomié (Ew); bosambi (Do)	<i>Uapaca staudtii</i>	F1	(-2)	Y	
Assam nlong(Ew); (Foul) bakourehi	<i>Uapaca togoensis</i>	F1	(-2)	Y	
	<i>Uvaria versicolor</i>	F1	(-2)	Y	
	<i>Vahadenia laurentii</i>	F1	(-2)	Y	
	<i>Vangueria madagascariense</i>	F1	(-2)	Y	
Kekombichop (Bang); Karehi (Fou)	<i>Vitellaria paradoxa = Butyrospermum parkii</i>	F1	(-2)	Y	
Ngalbihi (Fou)	<i>Vtex cienkowiskii</i>	F1	(-2)	Y	
Galbihi (Fou)	<i>Vtex donoiana</i>	F1	(-2)	Y	
Evoula (Ew); Teyak (Bas)	<i>Vtex grandifolia</i>	F1	(-2)	Y	
	<i>Vtex madiensis</i>	F1	(-2)	Y	
Menioumebe (Ew)	<i>Vtex rivularis</i>	F1	(-2)	Y	

Boumehi (Fou)	<i>Vtex simplicifolia</i>	F1	(-2)	Y	Vivien & Faure 1996
Tsabolhi (Fou)	<i>Ximena americana</i>	F1	(-2)	Y	
kwi (Ew); ikoli (Bas); Ebongo mbonji (Do); ara (Eja)	<i>Xylopia aethiopica</i>	F1	(-2)	Y	
Odlobi (Ew); Mbatou'ou (Bag)	<i>Xylopia parviflora</i>	F1	(-2)	Y	
	<i>Zanha golugensis</i>	F1	(-2)	Y	
Bongo (Ew); Elongo (Do)	<i>Zanthoxylum leprieuri</i>	F1	(-2)	Y	
Djabi (Fou)	<i>Ziziphus mauritiana</i>	F1	(-2)	Y	
Djabi fourou (Fou)	<i>Ziziphus mucronata</i>	F1	(-2)	Y	
Kournahi (Fou)	<i>Ziziphus spina christi</i>	F1	(-2)	Y	
Green Vegetables					
	<i>Acanthus montanus</i>	F1	(NK)	N	DUNCAN 1989
	<i>Alternanthera sessilis</i>	F1	(NK)	N	
Folong (Bul)	<i>Amaranthus cruentus</i>	C9, M1	(NK)	N	Iroume 2001
Folong (Bul); Folong (Fa)	<i>Amaranthus spinosus</i>	F1, C9, M1	(NK)	N	Van Dijk 1999
	<i>Anchomanes difformis</i>	F1	(NK)	N	DUNCAN 1989
	<i>Ancistocarpus densispinosus</i>	F1	(NK)	N	DUNCAN 1989
Zeng (Bu)	<i>Asplenium sp</i>	F1	(NK)	N	DUNCAN 1989
Nkondenu (Bu); Ngummngum (Fa)	<i>Chromonella odorata</i>	C9, M1	(NK)	N	Van Dijk 1999
kelang Kelang (Bu); Keleng Keleng (Fa)	<i>Cocorus olitorius</i>	F1 C9, M1	(NK)	N	MINADER
Miam (Fa)	<i>Costus spp</i>	C9, M1	(NK)	N	Van Dijk 1999
Zeng (Bu)	<i>Cyathea camerounaina</i>	F1	(NK)	Y	
Okok (Bu); Eru (Eja) Okwa (Fa)	<i>Gnetum africanum</i>				Van Dijk 1999
Okok (Bu); Eru (Eja); Okwa (Fa)	<i>Gnetum bucholzianum</i>	F1	(NK)	Y	
	<i>Heinsia crinite</i>	F1	(NK)	Y	
Esang (Bu); Esang (Fa)	<i>Hibiscus acetocella</i>	F1	(NK)	N	F Van Dijk 1999
	<i>Hibiscus esculentus</i>	C9, M1	(NK)	N	MINADER
	<i>Hibiscus sabdarifa</i>	C9, M1	(NK)	N	Iroume 2001
	<i>Impatiens sp</i>	F1	(NK)	N	DUNCAN 1989
	<i>Lasianthera africana</i>	F1	(NK)	N	

	<i>Penisetum purpurium</i>	C9, M1	NK	N	Van Dijk 1999
	<i>Phytolacca dodecandra</i>	F1	NK	N	DUNCAN 1989
	<i>Plumbago zeylandicum</i>	F1	NK	N	
Zeng; Zeng	<i>Pteridium aquilla</i>	F1	NK	N	
	<i>Scaphopetalum</i>	F1	NK	N	
Zom (Bu)	<i>Solanum aethiopicum</i>	C9, M1	NK	N	Van Dijk 1999
Ossang (Bu); Bikabala (Fa)	<i>Solanum nigrum</i>	F1	NK	N	DUNCAN 1989
	<i>Solanum macrocarpon</i>	C9, M1	NK	N	Iroume 2001
	<i>Solanum scabrum</i>	C9, M1	NK	N	
akung bele (Bu); Angzong (Fa); dongo njoh (Do); Ozozom kombé (Ew)	<i>Solanum torvum</i>	C9, M1	(NK)	N	Van Dijk 1999
	<i>Struchium sparganophora</i>	F1	(NK)	N	Van Dijk 1999
Elok super (Bu)	<i>Talinum triangulare</i>	F1,C9, M1	(NK)	N	MINADER
Ayolo (Bu); metet; Yoloyolo/Bitaka (Fa); Ndolé (Do)	<i>Vernonia amygdalina</i>	C9, M1	(NK)	Y	Iroume 2001
Abangak(Bu); Abenga (Fa)	<i>Vernonia hymenolepsis</i>	F1	(NK)	Y	
Spices					
Adjom (Bu); Adjom (Fa)	<i>Afromomum citratum</i>	F1	(NK)	Y	DUNCAN 1989
	<i>Afromomum hanburyl</i>	F1	(NK)	Y	
Ngong (Bu)	<i>Afromomum melaguata</i>	C9, M1	(NK)	N	Van Dijk 1999
Esun (Bu)	<i>Afrostryax lepidophyllus</i>	F1	(NK)	Y	
Okpwate (Fa)	<i>Ageratum conozoides</i>	C9, M1	(NK)	N	
	<i>Anona senegalensis</i>	F1	(NK)	N	KEAY 1989
Onwongo(Bu); Onwongo(Fa)	<i>Bambusa vulgaris</i>	F1	(NK)	N	Van Dijk 1999
Kanda/Nsii (Bu)	<i>Beilschmetidia</i>	F1	(NK)	Y	DUNCAN 1989
	<i>Butyrospermum parkii</i>	C9, M1	(NK)	N	KEAY 1989
	<i>Combetum glutinosui</i>	C9, M1	(NK)	N	
	<i>Dannetia tripetala</i>	F1	(NK)	Y	DUNCAN 1989
Fio/Mto (Bu); Pio (Fa)	<i>Enantia chlorantha</i>	F1	(1)	N	
	<i>Erib oblongaroma</i>	F1	(-2)	N	

	<i>Hymeocardia acida</i>	C9, M1	(NK)	N	KEAY 1989
	<i>Lophira lanceolata</i>	F1	(NK)	N	
Okakon (Bu); Okakwi (Fa)	<i>Megaphrynium macrostachyum</i>	C9, M1	(NK)	N	Van Dijk 1999
Abominjang (Bu); Enan ndik (Fa)	<i>Piper guineensis</i>	F1, C9		Y	
Abominjang (Bu) : Abominjang (Fa)	<i>Piper umbellatum</i>	F1	(NK)	N	DUNCAN 1989
Esombo(Bu); Esomo (Fa)	<i>Rauwolfia caffra</i>	C9, M1	(NK)	N	Van Dijk 1999
Obaton (Bu); oyemtwe (Fa)	<i>Rauwolfia vomitoria</i>	C9, M1	(NK)	N	
	<i>Rhaphiostyllis sp</i>	F1	(NK)	N	DUNCAN 1989
Angwafan (Bu); Angokwi (Fa)	<i>Sarcophrynium prionogonium</i>	C9, M1	(NK)	N	Van Dijk 1999
Obaton (Bu)	<i>Voacanga obtuse</i>	C9, M1	(NK)	N	
Nkala (Bu); Oyong (Fa)	<i>Xylophia aethiopica</i>	F1	(NK)	N	DUNCAN 1989
Koko (Bu); bianko (Fa) Jinga	<i>Zingiber officinale</i>	C9, M1	(NK)	N	Van Dijk 1999
Root Vegetables					
	<i>Dioscorea dumentorum</i>	F1	(1)	N	MINFOF2013
Okumen (Bu); Nko'o kumen (Fa)	<i>Dioscorea magnenotiana</i>	F1	(1)	Y	Van Dijk 1999
Abang (Fa)	<i>Dioscorea prachensis</i>	F1, C9	(NK)	N	
Andia (Bu)	<i>Dioscorea claessensi</i>	F1, C9	(NK)	N	
	<i>Dioscorea sansibarensis</i>	F1, C9	(NK)	N	
Edible mushrooms					
	<i>Amanita rubescens Pers.S.l.</i>	F1	(NK)	Y	Eyi Ndong et al
	<i>Armillaria heimii Pegler</i>	F1	(NK)	Y	
	<i>Auricularia cornea Ehrenb.</i>	F1	(NK)	Y	
	<i>Cantharellus congolensis Beeli</i>	F1	(NK)	Y	
	<i>Cantharellus luteopunctatus (Beeli) Heinem</i>	F1	(NK)	Y	
	<i>Cantharellus rufopunctatus (Beeli) Heinem var. rufopunctatus</i>	F1	(NK)	Y	
	<i>Cookeinia speciosa (Fr) Denis</i>	F1	(NK)	Y	
	<i>Crarerellus aures Berk. & M.A. Curtis</i>	F1	(NK)	Y	
	<i>Gerronema hungo (Henn.) Degreef & E</i>	F1	(NK)	Y	

	<i>Gymnopilus zenekeri (Henn.) Singer</i>	F1	(NK)	Y	Eyi Ndong et al
	<i>Lactorius acutus Heim</i>	F1	(NK)	Y	
	<i>Lactorius gymnocarpus Heim ex Singer</i>	F1	(NK)	Y	
	<i>Lactorius inversus Gooss.-Font;& Singer</i>	F1	(NK)	Y	
	<i>Lactorius sesemotani (Beeli) Buyck</i>	F1	(NK)	Y	
	<i>Lentinus sajor-caju (Fr)</i>	F1	(NK)	Y	
	<i>Lentinus squarrosulus Mont.</i>	F1	(NK)	Y	
	<i>Macrolepiota africana (Hiem) Heinem</i>	F1	(NK)	Y	
	<i>Marasmius arborescens (Henn.) Beeli</i>	F1	(NK)	Y	
	<i>Marasmius bekolacongoli Beeli</i>	F1	(NK)	Y	
	<i>Pleurotus flabellatus (Berk. & Br) Sacc</i>	F1	(NK)	Y	
	<i>Pleurotus tuber-regium (Rumph.ex Fr.) Singer</i>	F1	(NK)	Y	
	<i>Polyporus tenuiculus (P.Beauv.) Fr.</i>	F1	(NK)	Y	
	<i>Schizophyllum commune Fr.</i>	F1	(NK)	Y	
	<i>Termitomyces aurantiasus.sp.nov</i>	F1	(NK)	Y	
	<i>Termitomyces clypeatus Heim</i>	F1	(NK)	Y	
	<i>Termitomyces globules Heim&Gooss.-Font</i>	F1	(NK)	Y	
	<i>Termitomyces letestui (Pat.) Heim</i>	F1	(NK)	Y	
	<i>Termitomyces mammiformis Heim</i>	F1	(NK)	Y	
	<i>Termitomyces mboudaeina.sp.nov</i>	F1	(NK)	Y	
	<i>Termitomyces microcarpus (Berk. & Br) Heim</i>	F1	(NK)	Y	
	<i>Termitomyces robustus (Beeli) Heim</i>	F1	(NK)	Y	
	<i>Termitomyces schimperi (Pat.) Heim</i>	F1	(NK)	Y	
	<i>Termitomyces striatus (Beeli) Heim S.I.</i>	F1	(NK)	Y	
	<i>Termitomycessubclypeatus.sp.nov</i>	F1	(NK)	Y	
	<i>Volvariella volvacea (Bull.) Singer S.I.</i>	F1	(NK)	Y	
Food wrapping					

	<i>Megaphrynium macrostachyum</i>	F1	(NK)	N	DUNCAN 1989
Bu: Afobezam	<i>Mitragyna ciliate</i>	F1	(-1)	Y	
	<i>Sarcophrynium sp</i>	F1	NK)	Y	
	<i>Thaumatococcus daniellii</i>	F1	(NK)	N	
Palm Wine & Local Gins					
Ako (Bu)	<i>Raphia vinifera</i>	F1	(2)	Y	DUNCAN 1989
Alen (Bu)	<i>Elaeis guineensis</i>	F1 C9, M1	(2)	Y	MINADER
Andjim(Bu)	<i>Raphia hookeriana</i>	F1	(2)	Y	DUNCAN 1989
	<i>Raphia regalis</i>	F1	(2)	Y	
Adding to palm wine					
	<i>Carapa procera</i>	F1	(NK)	N	DUNCAN 1989
Afumbi (Bu)	<i>Citrus (sinensis)</i>	F1 C9, M1	(2)	N	
Ngonbang (Bu); Ngonbang (Fa)	<i>Citrus limon</i>	F1 C9, M1	(2)	N	Van Dijk1999
Abeng (Fa); Mandarine (Bu)	<i>Citrus reticulata</i>	F1 C9, M1	(2)	N	
Adum (Bu); Adum (Fa)	<i>Cylocodiscus gabunensis</i>	F1	(-2)	Y	
	<i>Fagara macrophylla</i>	F1	(1)	N	
Onyai (Bu); Onie (Fa)	<i>Garcinia cola</i>	F1	(1)	N	
Essok (Bu)	<i>Garcinia lucida</i>	F1	(NK)	N	
	<i>Garcinia nobilis</i>	F1	(NK)	N	
	<i>Paulinia pinata</i>	F1	(NK)	N	Van Dijk1999
	<i>Phyllanthus reticulatus</i>	F1	(NK)	N	DUNCAN 1989
	<i>Saccoglottis gabunensis</i>	F1	(-2)	Y	
	<i>Sacosperma sp</i>	F1	(NK)	N	

Wild Fauna

. The variety of wild foods is related to feeding practices depending on the ecosystem and tribal customs. Thus some insect species recognized as food substances by inhabitants of the Tropical Woodland Savannah and the Semi-Arid Ecosystems, like Grasshoppers (*Zonocerus variegatus*), Crickets (*Locusta migratoria*.) are eaten by communities in all ecosystems. The black forest floor ants (*Dorylus gribodoi*) are acceptable as food and medicinal products by inhabitants within the Tropical Forest Ecosystem. Among the faunal species which are used as food by different communities in Cameroon are: mammals, fish, crustacean, amphibians, reptiles, birds, insects, molluscs and arthropods; see continuation of Table 14 below. Most of the species of the mega fauna have been recorded as they serve as rich sources of proteins.

ANIMALS

M a m m a l s

Ngoui (Ew); Ngouy (Bas)	<i>Anomalurops beecrofti</i> (Beecroft's flying squirrels)	F1	(-2)	Y	Depierre et al 1992
Boussarou ndiam (Fou);nyong-lep (Bas)	<i>Aonyx capensis</i>	F1	(NK)	Y	
Boussarou ndiam (Fou);nyong-lep (Bas)	<i>Aonyx capensis</i> (Clawless otter)	F1	(NK)	Y	
Ngom (Ew); Nguép metié (Bang); Ngoum (Bakos)	<i>Atherurus africanus</i> (African bush-tailed porcupine)	F1	(-2)	Y	
Ebouboo (Bakos);	<i>Bdeogale nigripes</i> (Black-footed Mongoose)	F1	(NK)	Y	Van Dijk 1999
Soundou (Fou)	<i>Canis aureus</i> (Bush dog)	F1	(NK)	Y	Depierre et al 1992
karehi (Fou); Mvin (Ew)	<i>Cephalophus calypigus</i> (Peter's Duiker)	F1	(NK)	Y	
	<i>Cercocebus albigena</i> (Grey checked mangabey)	F1	(NK)	Y	Van Dijk 1999
Nkakoum (Bakos); Kago koy (Bas)	<i>Cercocebus torquatus</i> (Collard Mangabey)	F1	(NK)	Y	Depierre et al 1992
Avem (Ew); Mbinda (Bas); Ahendé (Bakos); Avembé (Bu); Nko (Bang)	<i>Cercopithecus nictitans</i> (Greater white-noosed monkey)	F1	(NK)	Y	
Ossok (Ew); Nko (Bang); Hissongui koy (Bas) Nsop (Bakos)	<i>Cercopithecus cephus</i> (Moustached Monkey)	F1	(NK)	Y	
Ngoté (Bakos); Nko (Bang); Tjomb koy (Bas)	<i>Colobus guereza</i> Guereza Colobus ()				
Mvon (Bu); Bondo koy (Bas)	<i>Colobus polykomos satanas</i> (Black & White Colobus)				
Mvin Koessi (Ew) Doumbourou (Fou) Mbandou (Bang)	<i>Cricetomys gambianus</i> (Giant Gambian rat)	F1	(-2)	Y	MINFOF2013
	<i>Crosidura manengubae</i> (Crosidura Shrew)	F1	(NK)	N	
okouam (Bakos); Yogui (Bas); Niok (Ew)	<i>Dendryhax arboreus</i> (Tree Hyrax)	F1	(-2)	Y	Depierre et al 1992
Mvo (Ew); Koo'mbak (Bang)	<i>Epixerus ebii</i> (Palm squirrel)	F1, F5, C9	NK	Y	

Ossan (Ew); Kakpou (Bang)	<i>Euxerus erythropus</i> (Striped ground squirrel)	F1, F5, C9	NK	Y	Depierre et al 1992
mvo Akos(Ew): Sip; Ko'ové (Bang)	<i>Funisciurus Isabella</i> (Lady burton's squirrel)	F1	(1)	N	MINFOF
Nji (Bu); Ngwi (Ew); Pagui (Bas)	<i>Gorilla gorilla</i> (Gorilla)				
Nkot (Bakos); Koo'mbak (Bang); Mvo (Ew)	<i>Heliosciurus gambianus</i> (Gambian sun squirrel)	F1 F5, C9	NK	Y	Depierre et al 1992
Koo'mbak (Bang); Paa (Bas); Mvo (Ew)	<i>Heliosciurus rufobrachium</i> (Red-legged sun squirrel)	F1	(-2)	Y	
Sangaldé (Fou)	<i>Hystrix cristata</i> (N.Afr. porcupine)	F1, F5, C9	(NK)	Y	
Ngoui (Ew); Ngouy (Bas)	<i>Idiurus macrotis</i> (Long Eared flying mouse)	F1	(-2)	Y	
gnioua (Fou)	<i>Loxodonta Africana</i> (African Elephant)	F1	(NK)	Y	
Zo akeu (Ew); Ka (Bang); Hemsiel (Fou); Njok ka (Bas)	<i>Manis gigatea</i> (Giant Pangolin)	F1	(-2)	Y	
Ka'a (Ew); Ka (Bang); Lé (Bakos)	<i>Manis tetradactyla</i> (Long-Tailed Pangolin)	F1	(-2)	Y	
Ka'a (Ew); Ka (Bang); Lé (Bakos)	<i>Manis tricuspis</i> (Tree cusped Pangolin)	F1	(-2)	Y	
embom(Ew); sassiel (Fou)	<i>Mellivora capensis</i> (Honey Ratel)				
	<i>Mycosciurus purmilio</i> (Pygmie squirrel)	F1, F5, C9	NK	Y	
Mvia; Mbè	<i>Nandinia bonotata</i> (Two-spotted palm civet)	F1	(NK)	Y	
Zeu (Ew); Nkeu (Bu); Ngeu Nghou (Bakos); Tchirgou (Fou)	<i>Panthera pardus</i> (Leopard)	F1	(NK)	Y	
Seuk/Nzombo (Bu); som koy (Bas)	<i>Papio sphinx</i> (Mandrill)				
Mvo (Ew); Paa (Bas)	<i>Paraxerus poensis</i> (Small gereen bush squirrel)	F1, F5, C9	NK	Y	
Awoum (Bu); Djoum (Bas) Bakos: ndené	<i>Perodicticus potto</i> (Potto)	F1	(NK)	Y	Van Dijk 1999

Dses (Ew); Hyel hyobi (Bas)	<i>Potamogale velox</i> (Giant Otter)	F1	(-2)	N	MINFOF2013
Ngoe (Ew)	<i>Potamochoerus porcus</i> (Red river hog)	F1	(NK)	Y	Depierre et al 1992
Mvo (Ew); Mbo (Bakos); Ko'ové (Bang); Nyam 'paa (Bas)	<i>Protoxerus stangeri</i> (Giant forest squirrel)	F1	(-2)	Y	Van Dijk 1999
Nyat(Ew); Nyed (Bas); Ngmgi (Bang)	<i>Syncerus caffer</i> (African Buffalo)	F1	(NK)	Y	Depierre et al 1992
Emvoul (Ew); kap (Bu); Tchenop (Bang); Lioung (Fou)	<i>Tragelaphus spekii</i> (Sitatunga)	F1	(NK)	Y	Van Dijk 1999
Essona	<i>Tragephalus euryceros</i> (Bongo)	F1	(NK)	Y	Depierre et al 1992
Onkok (Ew); Mvane (Bakw); Nkok (Bu); mvané (Bakos) Djama thirga (Fou)	<i>Tragephalus scriptus</i> (Bush buck)	F1	(NK)	Y	Van Dijk 1999
Nzip (Bang); moukdéré (Fou); Mvep (Ew)	<i>Trhyonomys swinderianus</i> (Cane rat)	F1, F5,	(-2)	Y	Depierre et al 1992
Zoué(Bu); Adoussouro (Fou); Easo (Bakos) Tchoup (Bang); Yoy (Bas)	<i>Viverra civetta</i> (African civet)	F1	(NK)	Y	Van Dijk 1999
	<i>Vulpes pallidus</i> (Sand fox)	F1	(NK)	Y	Depierre et al 1992
Fish					
Tilapia	<i>Tilapia bakossiorum</i>	A1	(NK)	Y	Cheek et al 2004
	<i>Tilapia bermini</i>	A1	(NK)	Y	
	<i>Tilapia bythobates</i>	A1	(NK)	Y	
	<i>Tilapia flava</i>	A1	(NK)	Y	
	<i>Tilapia gutturosa</i>	A1	(NK)	Y	
	<i>Tilapia imbriferina</i>	A1	(NK)	Y	
	<i>Tilapiaspongotroktis</i>	A1	(NK)	Y	
	<i>Tilapia synderae</i>	A1	(NK)	Y	
	<i>Tilapia thysi</i>	A1	(NK)	Y	
	<i>Aphyosemion cinamoneum</i> (Killifish)	A1	(NK)	N	MINEPIA
Efila (Bu); Efila (Fa)	<i>Ctenopoma</i> sp	A1	(NK)	N	Van Dijk1999
Ezimba (Bu); Nzima (Fa)	<i>Parachanna obscura</i>	A1	(NK)	N	
Mvas (Bu); Mbe (Fa)	<i>Clariallabes longicauda</i>	A1	(NK)	N	

Ngo'o Ngol (Bu); Ngo (Fa)	<i>Claria camerunensis</i>	A1	(NK)	N	Van Dijk1999
Nkpwa'a mva (Bu)	<i>Barbus spp</i>				
Esingi/Ezindi (Bu)	<i>Labea annectans</i>	A1	(NK)	N	
Esamba (Bu)	<i>Raiamus bucholzi</i>	A1	(NK)	N	
Kanga (Bu); Akanga (Fa)	<i>Heterotis niloticus</i>	A1	(NK)	N	
Amphibians					
Mvong (Bu)	<i>Bufo spp</i> (Various toad species)	A1	(NK)	N	Van Dijk1999
	<i>Conrauna goliath</i> (Goliath Frog)	A1	(-2)	Y	MINEPIA
	<i>Conrauna robusta</i> (Torrent Frogs)	A1	(NK)	N	
	Tadpoles of the <i>Conrauna sp</i>	A1	(NK)	N	
	Tadpoles of <i>Trichobatrachus sp.</i>	A1	(NK)	N	
Abep (Bu)	<i>Scotobleps gabonicus</i>	A1	(NK)	N	Van Dijk1999
	<i>Trichobatrachus robustus</i> (Hairy Frog)	A1	(NK)	Y	MINEPIA
Reptiles					
akpe (Bu)	<i>Bitis gabonica</i> (Gabon viper)	F1	(NK)	Y	Van Dijk1999
Nkam (Bu)	<i>Crocodylus cataphractus</i>	F1	(NK)	Y	
Ayang (Bu); Ayang (Fa)	<i>Dendroaspis jamesoni</i> (Mamba)	F1	(NK)	Y	
Ku/kulu (Bu)	<i>Kinixys spp</i> (Tortoise)	F1	(NK)	Y	MINFOF2013
Okung/evindi Nyo (Bu); Evindi nyo (Fa)	<i>Naja melanoleuca</i> (Spitting cobra)	F1	(NK)	Y	Van Dijk1999
Nkom (Bu)	<i>Osteolaemus tetrapis</i> (Dwarf crocodile)	F1	(NK)	Y	
Mvom (Bu); Mvom (Fa)	<i>Python sabae</i> (Forest python)	F1	(-2)	Y	
Mvom (Bu); Mvom (Fa)	<i>Python regius</i>	F1	(-2)	Y	
Nka'a (Bu)	<i>Varanus niloticus</i> (Nile monitor lizard)				
Crustaceae					
	<i>Callinectes litimatus</i>	A1	NK	Y	Crosnner, 1964
	<i>Euparpeus africanus</i>	A1	NK	Y	
	<i>Ocypoda ippeus</i>	A1	NK	Y	
	<i>Palaemon hastus</i>	A1	NK	Y	MINEPIA

Ngos (Bu)	<i>Panaeids</i> (Shrimps)	A1		Y	MINEPIA
	<i>Panaeus duorarum</i> (Crabs)	A1	NK	Y	Crosnier, 1964
	<i>Parapanaeopsis atlantica</i>	A1	NK	Y	
Molluscs					
Nsondo(Bu)	<i>Achatina achatina</i> (Forest snails)	F1	(-1)	Y	MINFOF2013
Along (Bu)	<i>Aestheria sp.</i> (Clams)	A1	(NK)	Y	MINEPIA
Ngon (Bu)	<i>Arachatina marginata</i> (Forest snails)				
Ebos (Bu)	<i>Arachatina camerunensis</i> (Forest snails)	F1	(NK)	Y	Van Dijk1999
Ebong (Bu)	<i>Potodoma freethii</i> (Forest snails)	A1	(NK)	Y	MINEPIA
	<i>Potodoma spp</i> (Small water snails)	A1	(NK)	Y	
Esoabong (Bu)	<i>Pseudoachatina sp</i> (Forest snails)	A1	(NK)	Y	
Birds					
Alloloke (Bu); Ekologo (Fa)	<i>Pteronetta harlaubii</i> (Hartlaub's Duck)	F1	(NK)	Y	Van Dijk1999
Miam (Bu); Miam (Fa)	<i>Bycanistes subcylidricus</i> (Black & White casqued Hornbill)	F1	(NK)	Y	
Ongung (Bu); Ongung (Fa)	<i>Ceratogymma atrat</i> (Black casqued Hornbill)	F1	(NK)	Y	
Okpwekpekwai (Bu)	<i>Tockus camurus</i> (Red-billed Hornbill)	F1	(NK)	Y	
Zanga miam (Bu)	<i>Tockus erythrorynchus</i> (Red-beaked Hornbill)	F1	(NK)	Y	
Konjo (Bu)	<i>Tropicamus albocristatus</i> (White crested Hornbill)	F1	(NK)	Y	
Ekuku (Bu); Ngumo (Fa)	<i>Lybius sp</i> (Barbet species)	F1	(NK)	Y	
Zum (Bu); Dzum (Fa)	<i>Streptoletia semitorquata</i> (Red-eyed Dove)	F1	(NK)	Y	
Ndjung (Bu)	<i>Tortur brehmeri</i> (Blue-headed dove)	F1	(NK)	Y	
Odu Bikotok (Bu); Odu Bikot (Fa)	<i>Tutur afer</i> (Red-billed dove)	F1	(NK)	Y	
Odu minjong (Bu)	<i>Tutur tympnistria</i> (Tambourine dove)	F1	(NK)	Y	
Emnbang (Bu); Mbang (Fa)	<i>Corvus albus</i> (Pied Crow)	F1	(NK)	Y	

Du'u (Bu); Dugu (Fa)	<i>Centopus leucogaster</i> (Black- throated coucal)	F1	(NK)	Y	Van Dijk 1999
Obam (Bu)	<i>Accipiter melanoleucus</i> (Great Sparrowhawk)	F1	(NK)	Y	
Ndoy(Bu); Ndwi (Fa)	<i>Aquila walbergi</i> (Wahlberg's Eagle)	F1	(NK)	Y	
Zosol oswe (Bu)	<i>Podica senegalensis</i> (Finfoot)	F1	(NK)	Y	
Kunduk (Bu)	<i>Corytheola crystatta</i> (Great Blue Touraco)	F1	(NK)	Y	
Nso'so (Bu); Ze so (Fa)	<i>Nectariana spp</i> (Sunbirds)				
Kubakok (Bu)	<i>Agelastes niger</i> (Black Guinea fowl)	F1	(NK)	Y	
Mvem (Bu); EKo mvem (Fa)	<i>Guttera plumifera</i> (Plumed Guinea fowl)	F1	(NK)	Y	
Okpwa/mvem (Bu) okwa, Okpwa (Fa)	<i>Francolinus squamatus</i> (Scaly Francolin)	F1	(NK)	Y	
Nkan (Bu)	<i>Numida meleargisi</i> (Grey-breathed Helmet Giun. –fowl)	F1	(NK)	Y	
Obo'o mikumba (Bu)	<i>Campethera punctuligera</i>	F1	(NK)	Y	
Kos (Bu)	<i>Psittacus erithacus</i> (Grey Parrot)	F1	(NK)	Y	
Otok (Bu)	<i>Andropadus spp</i> (Bulbal species)	F1	(NK)	Y	
Nkulengwi (Bu)	<i>Himantornis haematopus</i> (Nkulenga rail)	F1	(NK)	Y	
Akung (Bu)	<i>Bubo leucosfictus</i> (Owl species)	F1	(NK)	Y	
Nduk (Bu)	<i>Bubo poensis poensis</i> (Fraser's Eagle Owl)	F1	(NK)	Y	
Bu: Okpweng(Bu)	<i>Kpweng</i> (Starling species)	F1	(NK)	Y	
Insects					
	<i>Carina forda</i> (Caterpillars)	F1	(1)	Y	CGIAR
	<i>Imbrasia oyemensis</i> (Caterpillars)	F1	(1)	Y	
	<i>Gryllus bimaculatus</i> (grillon)	F1 C9, M1	(NK)	Y	MINADER
	<i>Zonocerus variegatus</i> (Grasshoppers)	F1 C9, M1	(NK)	Y	
	<i>Apis mellifera</i> (Bees)	F1 C9, M1	(NK)	Y	ANCOR

	<i>Trigona sp</i>				
	<i>Locusta migratoria</i> . (Crickets) <i>Ruspolia differens</i>	F1 C9, M1	(NK)	Y	MINADER
Larvae					
Fos (Fa)	<i>Rhynchophorus phoenicis</i>	F1 C9, M1 F1 C9, M1	(NK)	Y	IRAD

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3.6.7. Wild food resources at risk

Most of Cameroon's wild food species are at risk and some threatened with extinction. This applies mostly to those species which are not covered with protected area status and where the land is subjected to agriculture, hunting, grazing and any other human activities. Forest reserves do not have the same protection status like national parks and sanctuaries and so the level of threat will vary. It is likely that un-controlled exploitation of NTFPs within unprotected forests will increase the degree of risk of those commonly used species. Table 15 outlines the threatened wild food species in Cameroon and their degree of threat.

Table 15. Main threats to associated biodiversity identified as at risk.

Wild Food (Scientific name)	Degree of threat	Main threat (Indicate)	Information Source
FLORA			
Mega Flora			
<i>Gnetum</i> spp.	Very high	Over exploitation for food and trade	MINFOF 2013
<i>Dracenia arborea</i>	Very high	Exploited for boundaries/culture	MINFOF 2013
<i>Piper guineensis</i>	Very high	For food and trade	MINFOF 2013
<i>Garcinia kola</i>	Very high	For food and trade	MINFOF 2013
<i>Cola crispiflora</i>	Very high	For food and trade	Van Dijk 1999
<i>Cola acuminata</i>	Very high	For food and as snack	Van Dijk 1999
<i>Bailonella toxisperma</i>	Very high	Tree exploited for timber without replanting	MINFOF
<i>Ricinodendron heudelotii</i>	High	Tree exploited for timber without replanting	MINFOF
<i>Raphia vinifera</i>	Very high	For wine and roofing	
<i>Irvingia</i> spp.	Low	exploitation of seed	MINFOF
<i>Hymenocardia acida</i>	High	Over exploitation of firewood	MINFOF
<i>Vitex doniana</i>	high	Over exploitation of seed	MINFOF
<i>Adansonia digitata</i>	high	Over exploitation of leaves	MINFOF
Micro-flora			
<i>Tremella fusiformis</i>	NK	Deforestation and bush fires	MINFOF
<i>Lentinus</i> spp	NK	Deforestation and bush fires	Peglar
<i>Podocycophia invulula</i>	NK	Deforestation and bush fires	MINFOF
WILD FAUNA			
Mega Fauna			
Mammals			
<i>Funisciurus issabella</i>	High	Deforestation and bush fires	MINFOF
<i>Dendryax dorsalis</i>	High	Deforestation and bush fires	MINFOF
<i>Manis gigantean</i> (G. Pangolin)	High	Deforestation and bush fires	MINFOF
<i>Anthurus africanus</i> (Porcupine)	High	Deforestation and bush fires	MINFOF
<i>Tragelaphus euryceros</i> (Bongo)	High	Excessive hunting, deforestation	MINFOF
Amhibians			
<i>Conraura robusta</i>	Very high	Over-fishing	MINEPIA
<i>Conraura goliath</i> (Giant Frog)	high	Over-fishing	MINEPIA

Reptiles <i>Naja melanoleuca</i>	Very high	Over-hunting, skin exported	MINFOF
Birds <i>Tilopachus petrosus</i> (Stone partridge) <i>Verreauxia Africana</i> (Wood pecker) <i>Iceratogymna artrata</i> (Hornbill) <i>Psittacus psittacus</i>	Very high Very high Very high Very high	Deforestation and bush fires Deforestation and bush fires Deforestation Birds traded for export	villager MINFOF MINFOF
Fish <i>Tilapia</i> (Mud Fish) <i>Clarias gariepinus</i>	High	Over-fishing Over-fishing	MINEPIA MINEPIA
Insects Crickets Black forest ants <i>Imbrasia oyemensis</i> (Sapelli caterpillar) <i>Cirina forda</i> (Tali caterpillar)	Low High for both species	Over-hunting Demand is only for medicinal use Threatened by exploitation of both trees (Sapelli and Tali) for timber	villager villager CGIAR
Micro-organisms Soil Micro-organisms	Very high	Deforestation Fertilizers Burning Flooding	

Impact on livelihoods of loss of wild foods

Most rural communities depend on wild foods for subsistence and family incomes. Loss of wild foods will cause the following harmful effects:

- Prevent them from having income from the sale of wild food products as well as valuable nutritional benefits.
- Forced migration of the rural population who depended on wild food products for their livelihood.
- Refuge to areas of other communities will cause problems of land acquisition and peaceful co-existence and could cause inter-tribal conflicts;
- Poverty, misery and crime can result from loss of income sources
- Difficulty in adapting to new menu and traditional live styles due to loss of traditional products.

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3.7. Conservation of wild resources used for food

The conservation of wild food resources is achieved through in-situ and ex-situ activities in the country.

3.7.1.Ex-Situconservation management activities

Conservation

There are limited *ex-situ* conservation programmes for wild foods in Cameroon. These could be seen from the collections found in IRAD which do not include wild food collections. The collections that figure in IRAD are:

- a) Insect collections: IRAD Nkolbisson Entomology Laboratory and Dschang University;
- b) Forage Gene Banks:(Leguminous and non leguminous) IRAD (Wakwa, Garoua, Nkolbisson and Bambui);
- c) Green Gene Banks: IRAD (Dschang, Bertoua and Maroua);
- d) Fruit trees gene Banks: IRAD (Njombe, Ekona, Barombi Kang, Foubot, Garoua).

Table 16: Activities/Programmes on conservation and management of *ex situ* Wild Foods:

Wild Food Species	Level of Collections	Conservation State	Objectives	Evaluation/state of characterisation
Forage Gene Bank (grasses, legumes)	Experimental	In trial plots	For improvement of fodder, soil enrichment	NK
Research on various forest species	19 forest tree species	NK	Characterisation, microsatellite loci,, clonal variations, phenotypic diversity, etc	Most of the research has been completed
Vegetable Gene Bank Gnetum spp	Experimental	In trial plots	For food	NK

Management Programmes

Management activities are essentially:

- a) Breeding: non-conventional breeding of selected species, such as Cane rats, snails, guinea pigs, quails and frogs.
- b) Provision of Rhizobia fertilizers for legumes;
- c) Mushroom Inventory, (Onguene, 2000).
- d) Control of weedy species which could become invasive;
- e) Introduction of proven plant and animal species and the distribution of planting material.

Non-conventional breeding in Cameroon (2008)

PROVINCE	Centre	East	West	S. West	Total	Average	
Species	Cane Rats	8947	104	1042	308	10401	2600.25
Information	Guinea Pigs	4168	127	2543	56	6894	1723.50
	Snails	3940	150	4218	Over30000	40000	10000

Source: PAPENOC/MINEPIA, 2008

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3.7.2. *In-situ* Management Activities

In-situ conservation of wild foods involves both plant and animal species. This is achieved by:

- Conservation measures in Protected Areas in both terrestrial and aquatic ecosystems;
- Propagation of vegetative materials in farms and in the wild;
- Research programmes in species habitat sites by CIFOR, ICRAF, IRAD;
- Agro-forestry farmers conserving wild food bearing species;
- Traditional fixing of hunting and fishing periods are also resource management methods for sustainable use of products.

Table 17: Activities/Programmes on conservation and management of *in situ* Wild Foods

Wild Food Species	Name of Site/location	Level and Environment	Conservation objectives	Measures Taken
Plant/animal species listed for wild foods (Table 14)	In Protected Areas	Under full protection	Food Medicine Trade Research	Protected Area regulations, Control measures Involvement of foreign partners Sensitising population on need for sustainable use

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3.8. Preservation of traditional knowledge

As a Party to the CBD, Cameroon is conscious of the provisions of Art. 8(j) of the Convention and has been designing ways and means to implement Decision 11/9 on Forest and Biodiversity which emphasizes on the preservation and maintenance of traditional knowledge, innovations and practices of indigenous and local communities, (UNEP, 1999).

Traditional Knowledge in Cameroon has a great potential although not fully exploited. It is, however, used for research programmes by national and international research bodies. There are hardly any mutually agreed terms between researchers and the holders of the knowledge. Within the rural communities where much of the knowledge abounds (since they live and interact with biodiversity components, TK is jealously kept on family basis, unrecorded and handed to generations usually of the same family. In the process, much of the knowledge is lost. The absence of protection, non-valorisation, no regulations on TK and the exclusion of the local communities from benefiting from the proceeds of genetic resources discourages rural community dwellers from collaborating in conservation and sustainable use programmes, (MINEPDED, 2012).

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Gender dimension on knowledge about food species

In some rural communities, women monitor the existence, growth and the ripening of important wild food and medicinal plants in their forest and farm lands. When preparing land for cropping, they make sure that the important plants are kept and maintained. Women are the principal conservator agents of such plant species. They know even the phenology of plant species like *Irvingia gabonensis*, *Ricinodendron heudelotii*, *Cola edulis*, *gacinia cola*, *Vernonia amygdalina* vegetables and mushrooms. Women master the seasons for edible mushrooms. There are attempts at propagating wild food species like *Gnetum* in crop farms.

Traditional male/female healers and local mid-wives know the variety of medicinal plants required for their various uses. Using agro-forestry practice, favoured plant species are usually seen standing in farmlands and family members are informed of their importance and the need to conserve them. This knowledge is handed down to future family generations. Today, in addition to uses for food proceeds from these plants have also helped to improve the family incomes of rural dwellers. This has been the case with *Irvingia gabonensis*, (bush mango), *Butyrospermum parkii* (shear butter tree). *Vernonia amygdalina* (Bitter leaf) is a shrub commonly conserved in farmlands and known by all family members as a cherished vegetable country wide. In most of the eco-regions, women can be attributed to the following responsibilities with regards to wild foods:

- Knowledge of the fruiting and ripening period of the various wild food species;
- The harvesting methods, usually careful to ensure sustainable harvesting.
- Undertake the processing and conservation of the product and make it ready for household use or for the market;
- Women collect from the fallow bushes while men collect from far into the forest.
- Ensure better methods of transportation since some of the product are of commercial value in city markets and out of Cameroon. Several tons of the leaves of *Gnetum bucholzianum* (a vegetable from the wild) are exported to Europe and the USA every year.

Some spiritual beliefs associated with products from the wild

Traditional medicine is associated with spiritual beliefs and operations. The tree *Guibourtia tessmannii* is important in religious and cultural aspects of healing-believed to protect people from evil spirits. Pregnant women and young children tie a string of the liana *Stephania spp* Edjibili around their belly to protect themselves or the foetus. The use of the ash of a tree which was hit by lightning to treat headache. The use of sticks which were used by chimpanzees to help them climb a tree and also to stimulate children to start walking. The dwarf antelope is said to transmit epilepsy. In some tribes, it is believed that, harvesting the very first fruit from a fruit tree with a big basket with induce subsequent high productivity of that tree in the long run.

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3.9. Natural or human-made disasters and biodiversity for food and agriculture

3.9.1. Information on disasters and its effect on biodiversity

Cameroon has experienced both natural and man-made disasters which affected biodiversity. In a tropical environment characterized with heavy rains and thunder storms, frequent floods and soil erosion account for heavy losses in soil and even vegetation. Such losses are common on steep slopes

and bare ground. Mount Cameroon is an active volcano and when it erupts, lava destroys vegetation and wildlife along its path. The last eruption in 2000 resulted in the destruction of 61 hectares of the Green Valley palm plantations and several more of natural montane forest.

Cases of man-made disasters are illustrated in:

- Fish poisoning through village fishing methods involving the use of toxic plant species;
- Uncontrolled forest fires by grazers in the quest for fresh pastures or as a hunting method for honey and bush meat.
- There have been reported cases of oil spills at the coast of the Atlantic where oil exploration and exploitation is going on.
- There are losses of aquatic animals around the areas affected by the oil spills.

Table 18 provides some information on disasters in Cameroon.

Table 18: Natural/Human made Disasters with significant effect on biodiversity

Disaster description	Production system affected	Effect on overall biodiversity for food and agriculture	Effect on ecosystem services
Mt Cameroon eruption	F1, C9, M1,	-1	-2
River floods	F1, A1, C9 M1	-1	NK
Land slides	F1, C9, M1	-1	-1
Forest fires	F1,F5	-2	-2

3.9.2. Evidence of impact of natural disaster on biodiversity.

Some information on natural disasters has been shown on Table 18.

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Information on Natural Disasters in Cameroon

- Mount Cameroon lastly erupted in 2000 and the lava destroyed vegetation and wildlife;
- Lake Monoun poisonous gas took place in 1984 and destroyed both human and animal lives in the West Region of Cameroon;
- -Maga, Ndop and Doumé floods that took place in 2012 have destroyed biodiversity.
- Lake Nyos poisonous gas emissions took place on 23 August 1986 and destroyed human and animal lives;
- Lake Barombi water poisoning took place in 2013 destroying almost all the fish in the lake.

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3.9.3. Effect on livelihood caused by changes from disaster

Examples of cases where disasters have had an effect on livelihood can be seen in the following:

- Loss of human and animal lives like in Lake Nyos disaster;
- The heavy loss of fish during the Lake Barombi poisoning deprived the population of Kumba from their regular source of protein;

- The floods experienced in some towns and cities causes losses in property and human lives;
- The lava which flowed on the slopes of Mt. Cameroon resulted to the loss of several hectares of oil palm plantations and food crop farms.
- In the savannah areas bush fires are regularly reported to cause crop losses and natural forests. Habitat destruction has often resulted to loss of wildlife and micro-organisms. It is reported that at least 487000 hectares of forests are destroyed by bush fires annually in Cameroon, (FAO, 2011).

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3.9.4. Biodiversity contribution to improve livelihood regarding natural disasters

In addition to professional measures designed to fight the effect of disasters, biodiversity has also been used to improve the living conditions of disaster victims. Examples can be seen in the following actions:

- The planting of trees on steep slopes has been used to check soil erosion. Also flood areas in some cities in Cameroon have been recovered by growing Eucalyptus species;
- In some industrial plantations, the planting of tall trees has been used as wind-brakes – a protective measure against the effect of violent wind on the fragile crop.
- Indian Bamboo (*Bamboosa vulgaris*) is regularly used by farmers as a support for banana and plantain plants against the effect of violent wind.

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3.10. Invasive alien species and biodiversity for food and agriculture

Invasive species have been seen to have negatively influenced biodiversity in Cameroon. The biosecurity Project now in Cameroon has however not restricted consideration only on exotics. The various biodiversity species groups that are known to be invasive are summarised in Table 19. A total of 164 taxa have so far been listed as invasive species in Cameroon.

Table 19: Invasive Alien Species with significant effect on biodiversity for food and agriculture for the past 10 years

Invasive Alien Species	Production System Affected (code/name)	Effect on Biodiversity component (2,1,0,-1,-2,NK)	Effect on Ecosystem Services (2,1,0,-1,-2,NK)
Crop pests and diseases 109 taxa	F5, C1,C5	NK	NK
Plants 36 taxa	F1,F5	NK	NK
Animal & Human diseases 26 taxa	L1	NK	NK
Aquatic life & animals 11 taxa	A1, M1	NK	NK

Further details can be got from: *List of Invasive Species in Cameroon* – MINEPDED/UNEP(2004)

After the enactment of the Bio-safety Law in 2003, Cameroon has since 2010, been working on a national programme on Bio-security. The invasive species programme is of concern and is now

examined under a UNEP/GEF funded project under implementation since 2011. The project has come up with the following:

- The list of invasive species in Cameroon;
- Pathways of invasive species into Cameroon;
- The origin of invasives that affect Cameroon's biodiversity;
- Risks and risk assessments with regard to invasives
- The social, cultural, cultural economic, environmental, and
- Biological impact on invasives in Cameroon.
- A list of major invasive species in Cameroon;
- A list of White and Black Species in Cameroon.

The ultimate goal is to develop a national monitoring and control system for LMOs and Invasive Alien Species in Cameroon and drafting of a law on Biosecurity.

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Information on Invasives

Recent studies carried out in Cameroon considered pests, diseases, weeds as invasives. Some biological invaders are introduced or "alien"¹⁴ while others are native¹⁵. The study considers all biological invaders of agricultural and non-agricultural landscapes in Cameroon regardless of whether they are native or non-native to the ecosystem under consideration.

The surveys from the on-going project have so far identified 164 invasive species country-wide. Up to November 2014, the main groups identified and which constitute the list of the major invasive species in the country are crop pests and diseases (92), plants (35), animal and human diseases (26), aquatic life and animals (11). The Black and the Black List which has been established contains 46 species while the Black List contains 112 species, (MINEPDED, 2014). Observations made so far showed:-

- That 32% of the species considered as invasives had uncertain origins;
- There is need to adopt good bio-security practices which can be customized and practiced all over the country;
- The lack of key baseline data on invasives;
- Insufficient capacity to identify biological invaders in Cameroon;
- That there is need to systematically conserve genetic resources in Cameroon;
- That considering their level of involvement, the Cameroon public is not fully sensitized on the dangers and risks involved in the lack of knowledge on invasives.

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Managing the spread of established invasives

A number of invasives have been seen to occupy large expanse of abandoned farmlands as demonstrated by species like *Chromonella odorata*, *Bambusa vulgaris*, *Eichhornia crassipes* among plants; *Sigatoka* in

¹⁴A species introduced outside its normal past or present distribution as a result of an accident or deliberate introduction into that ecosystem by humans. (Synonym: Alien, non indigenous, exotic) Adapted from CBD COP 6 Decision VI/23 and the USA legal definitions outlined in Executive Order 13112 of February 3, 1999.

¹⁵A native species is one that occurs naturally with respect to a particular ecosystem rather than as a result of an accidental or deliberate introduction into that ecosystem by humans. Adapted from CBD COP 6 Decision VI/23 and the USA legal definitions outlined in Executive Order 13112 of February 3, 1999

plantains/banana; *Phaeoramularia* in Citrus (Kuate, 1998; Kuate et al. 2006) among the fungal diseases. Management of already established invasives is not a priority as long as the site occupied by the invasive is not used. This accounts for huge populations of the species mentioned above in abandoned forest areas. In like manner, cocoa pods in abandoned cocoa farms are seen infested with the black pod disease (*Phytophthora megakaya*) or poorly preserved maize attacked by *Aspergillus flavus*.

Managing the spread of invasive species in Cameroon has depended on the following:

- The biodiversity sector – each sector has its particularities and preferences. Sectors with heavy agro-pastoral investments will lay great emphasis in managing all forms of invasives that may affect their production.
- The nature and intensity of activity will determine whether it is worthwhile spending the time and resources on managing the invasives.
- Availability of means. Are the management tools readily available and affordable and is there sufficient capacity and technique to cope with the preferred management style?
- Is there sufficient knowledge on the behaviour of the invasive species?

The table below shows how management of invaders varies between individuals and agro-industrial organizations.

MANAGEMENT OF INVASIVES

CLASS OF INVASIVES	MANAGEMENT METHODS		
	Individuals	Agro/Pastoral Industries	Examples
Plants	Weeding	Spraying, ecological	Tadu Diary
Insects	Spray	Spraying	CDC, PALMOL, HEVECAM
Plant Diseases	Spray	Spraying	SODECOTTON
Livestock Diseases	Anti-biotics	Regular vaccination	TADU DAIRY
Vert. Diseases	Traps		

Management limitations

Management limitations reported by most stake holders showed the following:

- Individuals lack the means to apply techniques which proved effective;
- Individuals do not master the application techniques;
- In some cases, there was no early detection.

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3.11. Similarities, differences and interactions

Biodiversity sectors in Cameroon are agriculture, livestock, forestry, fisheries, handicraft and cultural (carving weaving). They all bear similarities and significant differences.

Similarities

- All the sectors contribute to providing food and livelihood leading to the economic improvement of the rural economy. They contributed to more than 40% of the GDP in 2007.
- They revolve on renewable biological resources which need sound management and which can be depleted if poorly managed. Thus their uses all revolve in the “Principle of Sustainable Use”

- Apart from marketing, the economic activities of all the sectors is mostly carried out by the rural population; it is estimated that 70% of the Cameroonian population is engaged in Agriculture and other biodiversity-related activities and engages 82% of the country's working population.
- To improve the marketing of products, most sectors are grouped into produce marketing cooperatives under a recent policy in the Ministry of Agriculture. Today, there are farmers' cooperatives, fishermen cooperatives, livestock cooperatives, vegetable cooperatives, etc.
- For research programmes, the Ministry of Scientific Research and Innovation attaches the same importance to each sector as well as handling cross-cutting issues and has initiated research in various biodiversity sectors – the mission of IRAD;
- The youths and the adult population are engaged in farming, fishing, and in the collection of wild foods.
- All the sectors demonstrate gross absence of infrastructure to ease the transportation and marketing of their products and contact for technical expertise.
- Before the re-institution of cooperatives, product conservation, marketing has not been properly organized and so there have been post-harvest losses in almost all the sectors.

Differences

Main differences within the sectors are:-

- The differences in the ecosystems – agriculture, livestock, fisheries and forestry are practiced on land while fisheries is based on aquatic biodiversity;
- Agricultural practices diminish natural habitats and deplete ecosystems and ecosystem services;
- The nature of investment and the quality of the inputs is different in all the sectors;
- Land use priorities and preferences differ in each sector. There are well known land conflicts between cattle grazers and crop farmers;
- While peasant farming and livestock are undertaken by nationals, much of the artisanal fishing is in the hands of non-Cameroonians who do not usually bother about the principle of Sustainable use.
- Amount of post-harvest losses will vary according to the sector and level of expertise.

Synergies between sectors

- The various sectors collaborate through information sharing especially during sensitization meetings and workshops;
- In all the external services, the administrative officers and mayors treat the various services and attend to any problems that may occur;
- The phytosanitary officials of the Ministry of Agriculture and Rural Development the forestry officers in border posts (ports of entry) collaborate in controlling products following their service regulations.
- Irrespective of the sector, the beneficiary communities endeavour to apply the laws and regulations and consider the management of the resource base as their responsibility.

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3.12. Gaps and priorities on conservation of associated biodiversity

The state, trends, threats and conservation measures on biodiversity in Cameroon have been reviewed in Section 20. The gaps and priorities shown in the table below shall be examined with respect to the management challenges experienced in the country's rich biological resources.

Gaps and Priorities on Ecosystem Services

SITUATION	GAPS TO BE FILLED	PRIORITIES
Information and Knowledge	<ul style="list-style-type: none">- Knowledge of all biological components in each ecosystem;- Mastery of species environmental requirements;- Knowledge of the ecosystem services provided	<ul style="list-style-type: none">- Inventories of all species with their growth rates ;- Reduce post- harvest losses;- Know the product market(s) within and without the country;- Introduce new conservations and processing (product specific) measures- Study new markets;- Increase knowledge of pathology of species
Main Capacities/Resource Limitations	<ul style="list-style-type: none">- Specialists are required in every biological field;- Limited financial allocations;- Control personnel should be re-enforced in materials and personnel.	<ul style="list-style-type: none">- Train local youths;- Allocate adequate funds to encourage personnel to manage the resources appropriately;- Council should assists to re-enforce control personnel ;
Policy & Institutional Constraint	<ul style="list-style-type: none">- Intensify conservation regulations;- Laws need to be understood by all biodiversity stakeholders;- Local communities to collaborate with control personnel.	<ul style="list-style-type: none">- Use of the "Participatory Approach";- Population to assist in exploitation control;- There should be effective Access and Benefit sharing mechanisms to motivate the rural population to encourage conservation of resources.

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3.13. Gaps and priorities on conservation of wild resources used for food and agriculture

Wild resources used for food continue to remain important in the livelihood of rural dwellers especially those of the Dense Tropical Forest Ecosystem. There is need to improve on forest management techniques and sensitize the population to use the resources following the principle of "Sustainable Use". The increases in the population will influence increased demand for wild foods. The gaps and priorities on conservation are outlined in Table below.

Gaps and priorities on conservation of wild foods

SITUATION	GAPS TO BE FILLED	PRIORITIES
Information & Knowledge	<ul style="list-style-type: none"> ▪ Inventory of all food species in each ecosystem; ▪ Keep record of their growth and yield characteristics; ▪ Time and rate of harvesting; ▪ Possibilities of domesticating those in high demand 	<ul style="list-style-type: none"> ▪ Restore habitats for wild foods and apply conservation measures for their maintenance; ▪ Ensure that stakeholders understand and can apply the principle of “Sustainable Use”. ▪ Adopt <i>ex-situ</i> conservation principles.
Resource Limitation	<ul style="list-style-type: none"> ▪ Provision of appropriate personnel is usually a major handicap; ▪ Finance and appropriate materials/equipment seem to retard progress; 	<ul style="list-style-type: none"> ▪ Adopt resource processing and good conservation principles; ▪ Identify markets for the products; ▪ Spend more on processing and conservation.
Policy & Institutional Constraints	<ul style="list-style-type: none"> ▪ There must be sufficient and appropriate rules and regulations; ▪ Set up committee to look into problems of land in the community; ▪ There is need for cooperation between resource providers and users. 	<ul style="list-style-type: none"> ▪ Population to assist in control activities; ▪ Commercial exploiters be given quotas, permits and should pay taxes accordingly; ▪ Set up product cooperatives for all marketable products; ▪ Collaboration among biodiversity stake-holders; ▪ Identify all problems related to each biodiversity sector.

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3.14.Gaps and priorities on impact and response on disasters

The Cameroon Government knows that natural disasters are unavoidable but man-made disasters could be avoided and controlled. It is also aware of the dangers and impact of disasters on the country’s biological resources, the environment on human life and on the economy. The precautions to be taken in the event of any disaster are contained in the sectoral policies and laws related to biodiversity-linked activity. The gaps so far identified and the priorities to be considered will depend on the nature, scale and the means available to address the disaster. Some of the gaps so far identified and the priorities to be considered are summarized in Table below.

Gaps and priorities on impact and response on disasters

SITUATION	GAPS TO BE FILLED	PRIORITES
Information & Knowledge	<ul style="list-style-type: none"> ▪ Know the type of disaster, period and the damage caused; ▪ For man-made disasters, know the root cause and identify the author; ▪ Master the environmental factors that associated with the disaster 	<ul style="list-style-type: none"> ▪ Know how to manage the disaster; ▪ Keep good records of the disasters; ▪ Disaster information should be available to specialists who may want to intervene.
Resource Limitation	<ul style="list-style-type: none"> ▪ Train community dwellers to manage the disaster; ▪ Recruit specialist and local dwellers who can act promptly when disaster strikes; ▪ Create several sources of assistance. 	<ul style="list-style-type: none"> ▪ Allocate an emergency fund for the disaster management; ▪ Provide reliable communication and transport facilities; ▪ Specialists who master the kind of disaster should be on the alert.
Policy & Institutional Constraint	<ul style="list-style-type: none"> ▪ Put down a clear policy on disaster management; ▪ See what coverage the national environmental law says on disaster management; ▪ Fill in all gaps to strengthen disaster management. 	<ul style="list-style-type: none"> ▪ Provide early warning systems; ▪ Educate dwellers of disaster-prone areas; ▪ Relocate human settlements into disaster free zones.

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3.15.Gaps and priorities of invasive species on biodiversity

Since the impact on invasive alien species can have serious environmental, economic, social and biological consequences, information and knowledge about them has become a priority in Cameroon.

Biological invasions have been recognized as a problem in Cameroon and their management has been prioritized. It is for this awareness that Cameroon is currently embarking on bio-security measures that will lead to identifying and listing all forms of invasives. The objective is to list and manage invasive species under a proposed bio-security law. The gaps and priorities identified are found in the table below.

Gaps and Priorities on invasive species on biodiversity

IN WHAT STATE?	GAPS TO BE FILLED	PRIORITIES
Information & Knowledge	<ul style="list-style-type: none"> ▪ Identify all IAS in all ecosystems; ▪ Know the impact of IAS on species and ecosystems; ▪ Effect on the economy 	<ul style="list-style-type: none"> ▪ Record all information on IAS; ▪ Note the most dangerous; ▪ Know best management methods; ▪ Watch for new introductions
Resource Limitation	<ul style="list-style-type: none"> ▪ Need for specialists to identify/record IAS; ▪ Make long term observations of main IAS ▪ Means to copy from proven case studies 	<ul style="list-style-type: none"> ▪ Provide adequate means for valid surveys and characterization of IAS; ▪ Set practicable management principles; ▪ Means to train personnel and sensitize stakeholders; ▪ Adequate resources to cope with eventual introductions.
Policy & Institutional Constraints	<ul style="list-style-type: none"> ▪ Lack of an information centre on IAS ▪ Non mastery/application of laws on managing IAS ▪ Efficient control mechanism to check on pathways of IAS in the country. 	<ul style="list-style-type: none"> ▪ Have a central institution handling matters of IAS; ▪ Inform the public on all laws and regulations on IAS; ▪ Ensure that laws and regulations are well respected; ▪ Have serious and efficient controllers; ▪ Phytosanitary stations should be well equipped and personnel well disciplined.

CHAPTER 4: THE STATE OF USE OF BIODIVERSITY FOR FOOD AND AGRICULTURE

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4.1. Use of management practice/actions that favour maintenance & use of biodiversity for food and agriculture

Management practices that favour maintenance and use of biodiversity for food and agriculture include:

- **Pollination Management:** This is done by bee farmers in the North-west Region where honey is produced industrially and in the artisanal scale;
- **Sustainable Soil Management Practices:** Here farmers are taught to farm along the contours on slopes to avoid the loss of surface soil through erosion.
- **Agro-forestry:** Wild food producing species actively introduced along with traditionally cultivated crops; Bush mango (*Irvingia gabonensis* and *cola nut* (*Cola* spp) trees are examples in some farmlands.
- **Organic agriculture in which agricultural extension workers** teach farmers how to plough and bury weeds in the soil to recycle organic manure. Felled logs are also left to rot instead of burning them.
- **Home Gardens are common in rural areas** where crops, livestock and medicinal plants are grown/ reared near the farmers' home.
- **Reduced impact Logging:** This practice is emphasized on loggers by the forestry regulations and controlled by the forestry control staff. Only marked trees are felled and skidding tracks are constructed to reduce destroying of vegetation to the barest minimum.

Table 20: Management Practices considered favourable to maintenance to biodiversity

Production System: F1			
Management Practice	Percent of production area or quantity under the practice	Changes in production area or quantity under the practice	Effect on biodiversity for food and agriculture
Pollination management	Area for honey production % land occupied	NK	NA
Sustainable soil management practices	In peasant and industrial agriculture	NK	NA
Agro-forestry	Peasant farmers land on ago-forestry, % land not known	NK	NA
Organic agriculture	Land on organic agriculture % not known	NK	NA
Home gardening	Restricted to households % un estimated	NK	NA
Reduced impact logging	Unestimated		NA

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4.2. Diversity based practices

Diversity based practices include:

- **Diversification:**
The planting/rearing of new species of plants and animals in the forestry sectors, improvement is centred along the introduction of new species to improve the growth performance of traditional species. Fruit trees from the tropical rainforest ecosystem of the South-west and Littoral Regions are introduced in the Savannah and the Sahel ecosystems of the Northern Regions of Garoua and Maroua.
Production of new genotypes through controlled crossbreeding.
- **Domestication:**
Domestication of wild food species of plants and animals (already mentioned in previous sections) notably, cane rats, rabbits, frogs, quails, snails. Among the plant species domesticated are *Gnetum spp*, *afrostylax lepidophyllus*, *Piper guineensis*, *Talinum triangulare* *dacryodes edulis*, *Canarium schweinfurthii*, *Dacryodes macrophylla*.
- **Management of micro-organisms:**
This is seen in the soil conservation practices adopted in the farming techniques used: no soil burning (and slash and burn) for new pasture. The planting of cover-crop as nitrogen-fixing is constantly practiced in industrial plantations.
- **Enriched forests:**
Tree planting programmes are undertaken in almost all the agro-eco-regions. Operation “Green Sahel” for instance repetitively carries out a planting program in the Sahelian part of the north as well as the management of private and public forests nationwide.
Community forests and communal forest are encouraged using forest management guidelines and control of exploitation of the resources.

In spite of the effort made in diversification as elaborated in Section 3.18, estimates are not available for lack of appropriate records. Table 21 provides information on some diversity based practices in the country.

Table 21: Diversity based practices that involve enhanced use of biodiversity

Production system:			
Diversity based practices	Percent of production area or quantity under the practice (%)	Change in production area or quantity under the practices (2,1,0,-1,-2,NK,NA)	Effect on biodiversity for food and agriculture (2,1,0,-1,-2,NK,NA)
Diversification	NK	NA	2
Base broadening		NA	NK
Domestication (plant and animal species)	NK	NA	2
Maintenance of landscape complexity	NA	NA	1
Restoration practices	NA	NA	1
Management of micro-organisms	NA	NA	2
Polyculture/aquaponics	NA	NA	1
Enriched forests	NA	NA	2

4.3. Major practices that impact associated biodiversity & wild foods

In an economy in which the actors are rural farmers, herdsmen, fishermen and local crafts men, most of whom still use traditional methods for their production, there are situations where their actions impact negatively on biodiversity. Some of their methods even negatively affect their productivity and the continuous availability of their products and services. Table 22 summarizes some of the negative impacts experienced in the main biodiversity sectors of the Cameroon economy.

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Specific Programmes/projects to support practices in Table 20 and Table 21

Cameroon has made considerable progress in undertaking projects and programmes to support biodiversity management and diversity-related activities. Some of the activities receive financial and technical assistance from donor agencies and countries which collaborate with Cameroon towards biological resource management. The projects listed below fall under the following three categories:

- a) Biodiversity Projects supported by the Global Environment Facility (GEF)
- b) Biodiversity Sector Projects/ Programmes – Animal, Fishery, Forestry, soil and environment;
- c) Multi-sectorial projects.

a) GEF- Supported Projects

GEF ID	Project Name	Focal Area	Agency	Status
85	Biodiversity conservation and management	Biodiversity	IBRD	Project closure
153	Preparation of NBSAP and First National Report	Biodiversity	UNEP	Project closure
427	Clearing House Mechanism enabling Activity	Biodiversity	UNEP	Project closure
180	Enabling Activity in the preparation of initial communication related to UNFCCC	Climate chang	UNEP	Project closure
772	Community-based conservation in Bamenda Highlands	Biodiversity	UNEP	Project closure
1063	Forest and Environment Development Policy Grant	Biodiversity	UNEP	Under Execution
1367	Support to implementation of National Bio safety Framework	Biodiversity	UNEP	Project closure
1976	National Capacity Self Assessment for Global Environment Management	Biodiversity	UNEP	Project closure
2023	Persistent organic	POPs	UNEP	Project closure
3821	CBSP Sustainable Community Based Management and conservation of mangrove ecosystem in Cameroon	Biodiversity	FAO	I.A. Approved
4084	CPSP conservation and sustainable use of Ngoyla Mintom forest	Biodiversity	IBRD	I.A. Approved
4641	Disposal of POPs and obsolete pesticides and strengthening sound pesticide management	POPs	FAO	PPG Approved
4800	Sustainable forest management under authority of Cameroon Councils	Multi Focal Area	FAO	PIF Approved

5060	Developing core capacity of MEA implementation in Cameroon	Multi Focal Area	UNEP	PIF Approved
4785	Promoting investment in the fight against Climate Change and ecosystem protection through intergrated renewable energy and biomas solution	Climate chang	UNIDO	Council Approved
5210	Sustainable farming and critical habitat conservation	Biodiversity	UNEP	PIF Approved
5263	Enhancing the resilience of poor communitie to urban flooding in Yaoundé	Climate chang	AfDB	Council Approved
4674	Support to Cameroon for the revision of the NBSAP and development of the 5 th National Report of the CBD	Biodiversity	IBRD	Project closure
2649	Sustainable agro-pastoral and land management promotion undercommunity development support programme	Land degradation	UNEP	Under Implement.
	Development and institution of a national monitoring and control system (framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS).	Biodiversity	UNEP	Under Implement

Source: <http://www.gefonline.org/projectlistSOL.cfm>.

b) Biodiverity Sector Projects

ANIMAL AND FISH PRODUCTION

- Characterisation and conservation of genetic resources;
- Alternative in the breeding of cane rats and other non conventional species;
- Long term increase of production of marine and fresh water fish;
- Increase in the production of aquacole in coastal marine waters

FOREST SOIL AND ENVIRONMENT

- Management of natural forets,
- Strategies for the increase of plantation forest to augment requirement for wood product;
- Master the strategy for the production of NTFPs;
- Study the promotion of some tree species for enriching the natural forest and promoting forest plantation programmes;
- Manage water and soil resource to render them more productive;
- Evaluate risks and vulnerability and adaptations related to climate change;
- Improve knowledge in order to conserve and valorize biodiversity.

Development projects that directly or indirectly affects biodiversity

The following projects/programmes (some of which are on-going and other projected to start) have direct or indirect impact on biodiversity:

	Project Title	Relation to Biodiversity
i	The Kribi Deep sea port	Will also assist conservation of marine biodiversity
ii	The Limbe Deep sea port	Will assist conservation of marine biodiversity
iii	Rail road infrastructure	Ease transportation of products from biodiversity
iv	Equipping the Cameroonian Nigerian boarder	Facilitate movement of products from biodiversity
v	Development of Agro-silvo-pastoral infrastructure	Result to better management and availability of products from biodiversity
vi	Construction of hydro-electric dam Memve'ele	Will assist conservation of marine biodiversity
Vii	Construction of hydro electric dam Lom Pangar	Will assist conservation of marine biodiversity
viii	Construction of hydro electric dam hemo centre Kribi	Will assist conservation of marine biodiversity
ix	Introducing use the hydro-electric centre of Colomine	Energy Source for processing food products
x	Studie in ue of hydro-electricity Song Mbenge:Songdong	Energy Source for processing food products
xi	Contruction of hydro electric dams in Cholle on the Dja, Ndokayo, Noun – Wouri Olamse and Ngambe Tikar	Energy Source for processing food products
xii	Construction of hydro electric centre in nachtingal & Bini	Energy Source for processing food products
xiii	Construction of hydro electric centre	Energy Source for processing food products
xiv	Construction of 425 water points in different parts of the country	Assist in managing and conserving animal biodiversity
xv	Extention fo the Limbe Refinery	Reduce incidents of oil spills harmful againt marine biodiversity.

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Table 22: Major practices that negatively impact biodiversity and/or wild foods

Types of practice	Major practice (Y/N)	Description	Reference
Over-use of artificial fertilizers or external inputs	N	Use is fully controlled by agro-industries and so poses no danger	
Over-use of chemical control mechanisms (e.g. disease control agents, pesticides, herbicides, veterinary drugs, etc.)	N	Extension service workers control the use of pesticides and vert. drugs	
Inappropriate water management	Y	Irrigation schemes lack sufficient funding so yield is affected.	
Practices leading to soil and water degradation	Y	Deforestation for farming especially at water sources cause streams to dry up.	Rumpi Watershed in Southwest Region MINFOF
Over-grazing	Y	Herdsman move with cattle and destroy vegetation	
Uncontrolled forest clearing	Y	<ul style="list-style-type: none">▪ Agricultural expansions use much land. Land which has no land use planning is cleared without control. Very common with peasant farming and industrial agriculture.	
Fishing in protected areas	Y	Use of dangerous chemical to poison fish especially in rivers and streams	
Over-harvesting	Y	<ul style="list-style-type: none">▪ Over logging; felling below the authorized diameter;▪ Fishing and using the unauthorized mesh size;▪ Harvesting above the limit of the authorized quota;▪ Not conducting inventories and appropriate management principles of the product-yielding species;	

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4.4. Actions and countermeasures to limit unsustainable use of associated biodiversity

The Cameroon public is conscious of the products and services derived from the wild. Rural communities have now joined Government in the protection of forest ecosystems and to manage community forests so that they can sustain the products and services that they provide. This is why the following measures are adopted:

- The putting in place of specific policies, legal provision for each sector and the various institutions to administer each sector accordingly;
- Existence of control staff and punishment of offenders in accordance to the provisions of the Wildlife, Forestry, Fishery and land laws.
- There has been considerable increase in the Protected Area surface. Since 2008 PA coverage has increased to 9.124.666 ha (about 19.2% of the national territory) (MINFOF 2013);
- Collection of products from the wild is regulated by the granting of licenses, quota and payment of taxes determined by the amount and quality of product to be harvested.
- There are special control measures to prevent the felling of food yielding species especially during forest exploitation.
- Management of community forests by the community themselves help in sensitizing the rural dwellers on the need to use the products in a sustainable manner.
- International conventions and treaties signed by Cameroon (See Section 84) are simplified and transmitted to the rural communities through seminars and extension services existing in the various sectors (particularly Regional, Divisional delegations of MINADER, MINEPIA, MINFOF and MINRESI).
- There is regular intervention by national and international agencies (WWF,CIFOR, GIZ, SNV, IITA, ITTO, FAO) through the funding of biodiversity-related projects most of which are located in the rural areas;
- Strong ties exist between the staff of the various ministries even at village level for collaborating on policies and regulations in the judicious management and sustainable use of the biodiversity resources within various communities.
- Youths are particularly targeted to help sensitize their population on the need to control the use of the resources.
- Exploitation of forest and wildlife products is regulated by a set of permits and licenses which guide the control staff and the exploiters. Various forms of authorizations are listed in Table 56/1.
- Encouragement of national NGOs engaged in biodiversity-related activities assists in informing the biodiversity stake-holders on the right principles to adopt towards managing biodiversity resource components.
- There is continuous improvement of capacities on biodiversity-related fields. Bokwe and Ngwa, in a survey of biotechnology institutions in Cameroon found that in 2005, there were already 151 PhDs in the various fields biological sciences in 17 establishments with over 30 national and international collaborating institutions, (MINEP/UNEP,2005).
- The ownership of forest by communities accompanied forestry regulations involves all community dwellers to cooperate in applying the rules as well as tracking offenders.

Table 23: Effect of the lack of biodiversity for food and agriculture on production, food security and livelihood

Production System	Biodiversity component for which diversity is lacking	Extent of problem (2,1)	Effect on food and security	Effect on livelihood	Reference
C9, F1, F5	Micro-organisms	2	Poor yield from crops	Affects farmers' income	IRAD
	Invertebrates	1	Results to poor soils	Affects farmers' revenue	IRAD
	Vertebrates	1	Reduction in animal protein	Poor health of the rural dwellers	IRAD, MINEPIA
	Wild & cultivated food species	2	Hunger and mal-nutrition	Population may migrate elsewhere	MINFOF MINADER
A5, A9, A13	Aquatic biodiversity	2	Mal-nutrition; poverty if activity was fishing	Population will migrate	IRAD

4.5. Counter measures to limit unsustainable use of wild foods

Forest and wildlife exploitation titles

FOREST EXPLOITATION

- Authorization to exploit timber;
- Authorization to export timber;
- Authorization as a log exporter;
- Authorization of ownership of timber processing equipment;
- Authorization to export timber-made items;
- Certificate of registration as a wood processor.

WILDLIFE EXPLOITATION

- Hunting licence;
- Licence to capture wild animals for scientific, commercial, breeding or detention purposes;
- Licence to collect game for trophies for commercial purposes;
- License to collect wild game carcass for commercial purposes;
- License to possess crafted ivory;
- Licence of possessing wildlife product;
- License for game ranching/farming;
- License for cinema, synergetic and photographic hunting permits;
- Wildlife exploitation in the capacity of a hunting or a capturer;
- Domestication of targeted species.

FISHERY

- Agreement
Commercial industrial fishery permits for Artisanal (small scale) fishery
Research for scientific purpose and sub-marine fishing;
- License for (i) fish fin fishing/demersal, (ii) shrimp fishing and (iii) tuna and high sea fishing.

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4.6. How increase in amount of biodiversity has improved productivity

The increase in the amount of diversity has definitely improved productivity in many sectors. The productivity, rural livelihood, ecosystem services and sustainability as reflected in the actions, results and the lessons learnt analysed in the table below

Actions/results/lessons on Biodiversity Productivity

F1,C9 C5	ACTION UNDERTAKEN	RESULTS	LESSONS
Productivity	<ul style="list-style-type: none">Encouragement of private forests, like in West and North-west Regions;Increased agroforestry.	<ul style="list-style-type: none">Provision of timber and fuel wood, electricity and building poles;more food from the forest;More income from new sales/commodities.	<ul style="list-style-type: none">Self-reliance improves livelihood and income.
	<ul style="list-style-type: none">Creation of community forests;Creation of agricultural plantations and produce cooperatives based on new crops (agroforestry)	<ul style="list-style-type: none">Community benefit from use of forest products;Increased production and financial benefits from cooperatives.	<ul style="list-style-type: none">Knowledge of resource management and techniques.
	<ul style="list-style-type: none">Control against illegal exploitation	<ul style="list-style-type: none">Collaboration in applying regulations	<ul style="list-style-type: none">Pride in owning and protecting resources
Rural livelihood	<ul style="list-style-type: none">Permits to exploit and collect house-hold products.	<ul style="list-style-type: none">Rural communities content in their settlements for more farm land	<ul style="list-style-type: none">People see importance of protecting forests
	<ul style="list-style-type: none">Information and raising awareness on importance of biodiversity products and ecosystem services	<ul style="list-style-type: none">Rural dwellers become involved in forest resource management	<ul style="list-style-type: none">Users now see the need to manage resources
	<ul style="list-style-type: none">Youth involvement in rural development programmes;Women encouraged into agricultural activities;Creation of financial groups to help finance artisanal activities like livestock, fishing, vegetable growing.	<ul style="list-style-type: none">Youths become development partnersImprovement of the rural economy	<ul style="list-style-type: none">Youths know management principles
	<ul style="list-style-type: none">Use of local materials for community livelihood.		<ul style="list-style-type: none">Competition among rural dwellers for better homes
	<ul style="list-style-type: none">Development of tourist sites.	<ul style="list-style-type: none">aspects of biodiversity valorised	<ul style="list-style-type: none">More income for communities, resources conservation reinforced
	<ul style="list-style-type: none">Recognize/validate and add value to traditional Knowledge.	<ul style="list-style-type: none">Research on TK in communities;Share TK with other communities.	<ul style="list-style-type: none">Credibility needed for productive interaction between researchers and local communities
Ecosystem Services	<ul style="list-style-type: none">Laws and Policies made known to users	<ul style="list-style-type: none">Users conscious of laws and regulations	<ul style="list-style-type: none">Collaborate in protecting biodiversity
	<ul style="list-style-type: none">Population made aware of plant and animal species which provide special ecosystem services	<ul style="list-style-type: none">Valuable species conserved, application of agro-forestry techniques	<ul style="list-style-type: none">Communities act when ecosystem functions of resources are known to them
Sustainability	<ul style="list-style-type: none">information/education of local communities	<ul style="list-style-type: none">Law-abiding community	<ul style="list-style-type: none">Education and community

			participation in decision making are important
	▪ Control through laws and regulations	▪ Number of defaulters reduced	▪ Collaborate with Administration
	▪ Sanctions to defaulters	▪ Users become law-abiding and collaborate to implement control measures.	▪ Participate in principles of sustainable use

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4.7. The proportion of the population that use wild foods on regular basis

Pygmies (*Baka, Bakola/Bagyeli and Bedzang*) are tribal communities in South East, East, Centre and South of Cameroon that live entirely on forest resources for their livelihood. They live in temporary huts built with forest materials and feed from forest plants and animal products. They constitute a small group of the population in Regions where they live in Cameroon.

Most communities living around forest zones depend on the forest using:

- Plants for food, building materials and medicine;
- Plants for wines and traditional/cultural celebrations;
- Wildlife as sources of proteins.

There are other forest community dwellers who depend on the forest for some items for their livelihood. Surveys of forest communities in Cameroon have shown that many rural dwellers of the East, South Regions, partly depend on wild plant and animal species for food and entirely on the forest for their medicinal, building and cultural requirements. These communities have mastered the occurrence and performance of useful plants and animals although they have little knowledge of the biological characteristics of the species. Dwellers in the savannah and Sahel regions also depend on the forest for roofing materials and building poles. *The actual proportion of these communities is not known.*

4.8. Gender-use differences

In most forest communities, responsibilities are gender based. Among some forest dwellers the gender allocation of tasks follows the pattern shown in the table below. Depending on the ecosystem, task activities and gender responsibilities vary. Fishing communities have a gender activity pattern different from a community in a forest or savannah ecosystem. Able boys follow the men on the masculine tasks like game hunting or collecting wild honey while the girls accompany the women on those tasks reserved for the women.¹⁶

In Cameroon food security activities, women have a major impact on resource management. Astolfi (2009), argues that new and specific policies are required to enable women reach their full potential as partners in Protected Areas. This is being achieved in Cameroon by training women as forest agricultural engineers, forest engineers, eco-guards, wildlife technicians and sensitizing them in forest resource management. Participatory workshops on ecological appraisal methodologies and PA conservation enable women in local communities participate and decide how to invest and sustain their local resources.

¹⁶In some villages in the Rumpi Highlands, youths make reasonable income from the sale of frogs. One fresh toment frog (*Conrauna robusta*) is sold at 1000 FCFA (\$US2.00)

Tasks on Gender Basis

MEN	WOMEN
1. Hunting game (Shooting/snares)	1. Fish in streams and brooks
2. Collecting building materials	2. Collecting fuel wood
3. Constructing family homes	3. Preparing family meals
4. Traditional practice	4. Collecting fruits and seeds
5. Weaving, carving, artisanal	5. Tribal girl's education
6. Cultural styles	6. Local midwifery, cooking, entertainment, dressing

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4.9. Adoption of ecosystem approach

Cameroon has applied the "Ecosystem Approach" in managing its biodiversity resources. Table 24 shows the progress in this direction.

Table24: Adoption of and Importance assigned to Ecosystem Approaches to production systems in Cameroon

Production systems	Ecosystem Approach Adopted (Name)	Extent of Adoption (2, 1, 0, NA)	Importance assigned to the ecosystem approach (2,1,0,NA)
F1	Forest Resource Management	2	1
F5	Establish Forest Plantations	2	2
F6	Regional Shrimp fishing management prepared in 2013	2	2
C9	Creation of agro-ecological zones follows the ecosystem approach	2	2
C9	Establishment of Agro-industrial plantations in the Tropical Dense Forest Ecosystem	2	2
M1	Creation of IRAD stations all over the country follows the approach	2	2

4.9.1. Description of the Ecosystem Approach

In adopting the ecosystem approach, the actions, results, plans and the lessons learnt are stated in the table below:

ACTIONS/ RESULTS/PLANS/LESSONS

Code Name	Specific Action	Observed Result	Plans for Adoption	Lessons learnt
F1	Attribution of community forest	Better management of forest for sustainable use	Education & sensitization	Abide by recommendations for sustainable use
	Forest Regulations put in place;	Reduced crimes, income from fines	Greater law enforcement	People know their rights and obligations
	Law enforcement in logging and hunting;	Sanction, seizures, fines, imprisonment	Recruit more eco-guards	More collaboration in identifying offenders
	Apply exploitation quotas, Logging should include more species and limit post logging waste ¹⁷ .	Sustained yield in the country's forest resources	Review and adapt forestry regulations	Improved revenue from forest resources
	Increased capacity and means to apply regulations	Need for more control personnel	Importance attached to training personnel	Better understanding of sustainable use
	Communities own and manage forests Taught forest management practices	community dwellers more knowledgeable in forest management	Facilitate norms for attributing community forests	Communities face challenges of forest management
F2	Creation and management State Plantations	Expansion of forest estate	Create more forest nurseries	More artificial forests
	Creation and management Private Plantations	More private owned forest plantations	Create more forest nurseries	More artificial forests
	Special Regeneration Programmes: SAHEL VERT	Increased desire to improve artificial regeneration	Provide more planting material	Expansion of private plantations facilitated
	Regulate felling trees for fuel and charcoal	Better forest management techniques	Augment control with council/community guards	More forest plantations
	Artificial regeneration programmes by politicians and elites	Increased knowledge on forest regeneration	Politicians/elites to assist with financial aid for tree planting	Fuel wood problem reduced
	Creation of Forest Product Cooperatives	Joint ventures by Eucalyptus planters		More revenue; less pressure on natural

¹⁷ Logging potential economic species in Cameroon is estimated about 600 species but prevailing economic conditions within CEMAC countries are not achieving any value near this potential. Logging intensity in Cameroon is at 7-10m³/ha less than one tree per hectare compared to 50 – 80m³/ha in South East Asia and 10 – 12 m³/ha in Brazil,(Karsenty & Maitre 1994; Jonkers & Foahom,2003).

		of the Western Region		forest
A1,A5	Optimize the exploitation of fresh water and marine resources	Fishing communities set up fishing cooperatives	Low pressure on the capital	Knowledge of the harmful effects on uncontrolled fishing necessary
	Ensure the sustainable exploitation of shrimp resources;	Fishing communities set up fishing cooperatives	Low pressure on the capital	Aware of the harmful effect on uncontrolled fishing necessary
	Minimize the ecological impact	Sensitisation of the actors	Find alternatives	Aware of the positive impact necessary
	Improve governance	Establishment of the rules	Respect of the established rules	Public awareness necessary

(61) Evidence of the adoption of the Ecosystem Approach

(a) Specific Action Taken:

Various actions taken to prove adoption of the Ecosystem Approach have been summarised below.

In the revision of the NBSAP, emphasis has been made to outline 10 Ecosystem Specific Targets for vision 2020: They are:

- **E- Target 1** By 2020, all sources of coastal and marine pollution should be effectively controlled to reduce pollution and mitigate its impact on the ecosystems;
- **E- Target 2** By 2020 Mangrove forest and associated coastal forest degradation and loss should have been significantly reduced;
- **E- Target 3** By 2020 coastal erosion should be greatly reduced and eroded coastal beaches rehabilitated;
- **E- Target 4** By 2020 develop and /or intensify integrated action framework on activities (mining, industrial logging, small holder agriculture and illegal logging) that impact on forest biodiversity, conservation, Protected Area management in a manner that enhances local governance;
- **E- Target 5** By 2020 bush fire incidence should be reduced by at least 30%;
- **E- Target 6** By 2020 the use of alternative energy should have increased and significantly reduced pressure on fuel wood;
- **E- Target 7** By 2020 at least 20% of grazer population have developed the capacity to reduce over-grazing;
- **E- Target 8** By 2020 increase by 20% and strengthen community-based biodiversity and management initiatives for endangered montane species;
- **E- Target 9** By 2020 at least 20% of the sites degraded by draught or floods are rehabilitated within the Semi-arid Ecosystem;
- **E- Target 10** By 2020 wetland of great significance should be under management plans and at least 10% of degraded fresh water catchment areas and riparian zones restored and protected.

i. In Crop Production Systems (C1, C5, C9)

- Crop species are selected for cultivation according to their suitability in various agro-ecological zones plantain, cassava, cocoa, coffee are encouraged following their performances and adaptations to the humid south while the cereals groundnuts and cotton have been found suitable in the sahelian northern regions;
- Research in agronomy is planned and stations put in accordance to the five agro-ecological zones which correspond to the six ecosystems in the country.

ii. In Aquaculture and Fisheries Production Systems ((A1, A5, A9, A13)

- Marine fishing activities are intensified and encouraged in the Marine Coastal Ecosystem while continental fishing is developed within water courses in the fresh water ecosystems
- The Department of Fisheries in MINEPIA has separate programmes for marine fishing and continental fishing with specific technical and financial provision for each type
- Still in recognition of the Ecosystem Approach that much effort is put in encouraging Aquaculture a source of protein for the communities further away from the sea;

iii. Livestock Production Systems (L1, L5)

- Livestock activities are intensified in the northern sahelian region because of the unsuitability of cattle rearing in the Tropical Ecosystem where cattle is infested by a disease caused by the tse- tse fly;
- Small ruminants can withstand the climatic and environmental conditions of the rainy and humid south and so the rearing of goats, sheep, poultry is encouraged;
- The programme of Unconventional Breeding MINEPIA has recognized the Ecosystem Approach because it began in the regions around the humid south of the country– Littoral, Centre, East, SW, and West Region.

iv. In Forests Production Systems (F1, F5)

- Logging is undertaken in the Tropical Forest Ecosystem and the collection of wild foods from species of that ecosystem.
- The creation of artificial forests has been typical in the Savannah and Montane Ecosystems where rainfall is low. Species used in these plantations are *Eucalyptus sp*, *Pinus spp.*, Species used in the sahel north even for private woodlands and agro-forestry are Neem (*Azadirachta indica*), Shear Butter tree (*Butyrospermum parkii*)
- Collection and trading on NTFP is more intensive within the Tropical Forest Ecosystem which has a greater variety of species. The economic importance is so high that government supports domestication programme of a variety of plants and animal species in this ecosystem.
- Management of forest and wildlife resources recognize the Ecosystem Approach. The emphasis in resource management down south is on forest management and logging as a source of revenue while the emphasis up north is on wildlife management and hunting as a major economic activity.

In Mixed Production Systems (M1)

Mixed systems follow the same approach especially in the choice of species to be managed. This is why in the humid south; cocoa farms are inter-planted with plantations and cocoyams.

(b) Results from the adoption

In Agriculture:

- Quantities and variety of root crops – (cassava, cocoyam, yams), plantains;
- Production and exports of the Tropical Rain Forest provide increase in national economy;
- Several income-generating activities and employment in agro-industries;

In Fisheries:

- Marine fish products used and sold and provide family and national income
- Income is generated from fish farm in the region where aquaculture is undertaken;

In Livestock:

- Meat (beef, pork, chicken) is produced throughout the country;
- Products from non-conventional breeding (snails, frogs, rabbits, cane rabbits) are used and sold for income.

In Forestry:

- Income from the sale of wood products (timber, firewood, charcoal), NTFPs;
- Employment from wood industries and building constructions;
- Use of wild products for foods, building, arts and culture
- **c)Plans for adoption in new or existing production Area**

Since the development of the NBSAP 1 in 1999 and its revision in 2012, the Ecosystem Approach has been applied in all the production systems throughout the country. From the result above, it is seen that this approach is the most appropriate in managing biodiversity resources for sustainable use. Policy makers and managers operating in various systems of production will continue to adopt the Ecosystem Approach in new and existing production systems

Lessons Learnt

Stakeholders in biodiversity particularly managers working the various production systems have drawn the following lessons through the adoption of the Ecosystem Approach:

- That ecosystems are natural ecological entities which are designed to render specific products and services
- If not properly managed, the services and the products expected from them will no longer be there; this why they should not be modified without cause.
- If ecosystems are not used appropriately, they will destroy the habitats of many species on which human and animal life depends;

- In a country like Cameroon whose economy is based on products from biodiversity, the non adoption of the Ecosystem Approach will not maximise the production expected from the various production systems.

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4.9.2. Gaps and Priorities on management Practices involving the use of biodiversity for food

With the adoption of the Ecosystem Approach, management practices guard against the unsustainable use of biodiversity products and services. Biodiversity users are told to avoid ecosystem and habitat degradation which can lead to loss of species. The table below shows the management practices which are in place. However, in some places, large portions of forest lands have been cleared for agriculture.

Gaps & Priorities on Management Practices

Measures	Gaps and Limitations
a. INFORMATION AND KNOWLEDGE	The need to inform the rural population on the laws and regulations and how they should be followed.
b. CAPACITY/RESOURCE LIMITATIONS	Need to train control personnel and educate population on proper use of resources
	Allocation of adequate financial resources Provide amenities /incentives to the population
c. POLICY/INTITUTIONAL	Government policy is not sometimes clear to stakeholders of the rural communities Institutions offering services to communities usually far from the rural masses
d. ACTION AND PRIORITIES	Communicate with rural communities and other stakeholders (professional associations) in a manner and language they would understand.
	Prioritise local youths and women in capacity-building programmes and possibly free education
	Prioritise road infrastructure for produce evacuation
	improve the traditional methods of cultivating, processing and conservation
	Introduce domestication of heavily exploited wild species;
	Train stakeholders how to check and reduce post-harvest losses.

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4.9.3. Gaps and Priorities on Sustainable Use

The need to emphasize on the sustainable use of biodiversity products and services is important since the country's economy is based on agriculture and more than 80% of the population relies on biodiversity-related activities for their livelihood. This is why Government has identified gaps and has set priorities so that users of biodiversity could benefit from the products and services in a sustainable manner. Measures, gaps and limitations have been outlined in the table below:

Gaps and Limitations on Sustainable Use

N°	MEASURES	GAPS AND LIMITATIONS
A	INFORMATION & KNOWLEDGE	Lack of knowledge of the resource base. Resource Inventories hardly undertaken. Local communities ignorant of resource management skills and that habitat destruction will reduce ecosystem services.
B	CAPACITY/RESOURCE LIMITATIONS	Lack of sufficient and appropriate staff, financial resources to cope with ecosystem management prescriptions. Poor infrastructure for effective supervision and prompt intervention
C	POLICY & INSTITUTIONAL CONSTRAINTS	Poor knowledge of policy by biodiversity stakeholders; institutions and services not within reach of users.
D	ACTIONS & PRIORITIES	<ol style="list-style-type: none"> 1. Embark on resource inventories and knowledge of their growth rates 2. Inform stakeholders of risk of ignoring the conservation and principle of sustained use; 3. Apply exploitation quotas and apply regulations; 4. Encouragement of replanting programmes especially in the Savannah, Sahel and mountain areas; 5. Prioritize women's activities – educate, encourage; 6. Apply rural finance initiatives to attract investment at local levels. This is already successful in some village communities. 7. Organize the marketing of products produced locally preferably through cooperatives

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4.10. Gaps and priorities in biodiversity contribution

The gaps identified and the priorities set so far with regards to their contribution to food and agriculture are summarized in Table below.

Gaps and Priorities in Biodiversity Contribution

N°	MEASURES	GAPS AND LIMITATIONS
A	INFORMATION & KNOWLEDGE	<ul style="list-style-type: none"> ▪ Little knowledge of resources for lack of inventories; over 300 exploitable timber species and 1000 species of NTFPs in Trop. Forest ecosystems (MINFOF 2013). ▪ Production forest areas not covered by management plans; ▪ Little information of growth rates of exploitable species; ▪ Non mastery of economic values of resource potential, since commodity prices are controlled by foreign markets; ▪ No knowledge of silviculture of species for plantation forestry. <i>Eucalyptus spp</i> has proved unreliable in the woodland savannah ecosystems where there are water-shortage problems; ▪ Climate change has provoked crop losses due change of planting, tending and harvesting periods.

B	CAPACITY/RESOURCE LIMITATION	<ul style="list-style-type: none"> ▪ There is lack of sufficient and appropriate personnel to cope with modalities of managing domesticated species, wildlife habitats within the various ecosystems ▪ Effort towards domestication of selected wild plants and animals require knowledge of special techniques in managing such species. Cane rats, snails and frogs and <i>Gnetum spp</i> are now being domesticated in Cameroon; ▪ The few and available staff are in-effective due to budgetary limitations.
C	POLICY/INSTITUTIONAL CONSTRAINTS	<ul style="list-style-type: none"> ▪ There is need to revise some of the policies related to biodiversity resource management; the present Wildlife, Forestry and Fishery Regulations need to be revised. ▪ Proper application of some articles of the CBD particularly those related to <i>Access and benefit-sharing</i> of proceeds from genetic resources.
D	ACTIONS & PRIORITIES	<ul style="list-style-type: none"> ▪ Sensitize all biodiversity stake-holders on the effective conservation of biodiversity resources and their sustainable use. ▪ Improve human resources and increase budgetary allocations to meet up with management demands. ▪ Re-enforce regulations on the control of exploitation of biological resources. ▪ Collaborate with the Ministry of Scientific Research and formulate research programmes to produce results to guide resource management. ▪ Improve tourist sites nation-wide to attract ecotourism. <p>Prioritize the following:</p> <ul style="list-style-type: none"> ▪ Road infrastructure to rural communities to improve the present state of the Farm – Market Roads in the country; ▪ Technical and financial assistance to farmers/fishermen and graziers; ▪ Group producers into cooperatives to enhance productivity, competitiveness and produce marketing. ▪ Development of training programmes for the youths and women will ensure participation in development and management with the spirit of sustainable use. ▪ Improvement of land regulations to facilitate women acquisition and ownership of land to enable them undertake wild plant domestication programmes.

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4.11. Gaps and limitations in applying ecosystem approach

Cameroon used the Ecosystem Approach in building up its NBSAP in 1999 and its revision still considered the same approach. There is no doubt that the application of the NBSAP II within six ecosystems and a rich biodiversity should have gaps and limitations. These are in the Table below.

Gaps and limitations in applying ecosystem approach

SITUATION	GAPS / LIMITATIONS
INFORMATION & KNOWLEDGE	<ul style="list-style-type: none"> ▪ Users and providers of biodiversity services have their priorities and resist change even if the change is to their advantage; ▪ Innovations in various biodiversity domains do not get to the users quickly and follow-up is difficult; ▪ In some areas (particularly in fisheries), resource exploitation is by foreigners who may not bother to respect the principle of sustainable use. ▪ Ignorance of the community's rights and obligations discourages them from collaborating. ▪ In the absence of reliable records there is poor knowledge of the characteristics of the ecosystem, habitat and even the population of the species to be exploited.
CAPACITY RESOURCE LIMITATION	<ul style="list-style-type: none"> ▪ There is lack of man-power to cope with the supervision and the sensitization of stake holders; ▪ Each stake-holder is interested in what interests him economically; ▪ There is need to have specialized personnel, taxonomists, entomologists, to monitor trends in ecosystem functioning. ▪ Studies and research recommendations made by international organizations through projects are hardly implemented on the ground at the end of the projects.
POLICY & INSTITUTIONAL CONSTRAINT	<ul style="list-style-type: none"> ▪ Government policies do not single out the peculiarities of specific ecosystems or species. Care is therefore required to examine situations through case studies; ▪ The lack of means by various intervening authorities prevent the message from reaching the rural masses ▪ Some policies and laws no longer fit in the present-day realities of managing biological resources.
ACTIONS AND PRIORITIES	<p>The following actions require urgent attention:</p> <ul style="list-style-type: none"> ▪ Introduce more training programmes to raise the capacity of field staff and specialists in various domains; ▪ Increase budgetary allocations to those ministries working with biodiversity; ▪ Facilitate effective coordination between all biodiversity stakeholders from the Central Administration alongside the stake-holders in the rural areas. ▪ Facilitates a smooth takeover and continuation of successful projects by donor agencies and the need to adapt them with the realities of that ecosystem; ▪ Increase of the number of rural community radios and effort made in trying to broadcast using local dialects; ▪ Use the "Participatory Approach" to involve all stakeholders in all the eco-regions. ▪ Encourage youth and women groups in resource management and exploitation activities throughout the country. ▪ Sensitise politicians, mayors and parliamentarians to champion the course of proper management of biological resources of their areas. ▪ Finance agro-forestry and species domestication programmes at local levels

CHAPTER 5: THE STATE OF INTERVENTIONS IN THE CONSERVATION AND USE OF BIODIVERSITY FOR FOOD AND AGRICULTURE

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5.1. Policies and Programmes

In Cameroon there are policies and programmes that:

a) **Support Integrated Conservation and Sustainable Use of Biodiversity**

Integrated conservation and sustainable-use principles are achieved through the following:-

- Implementation of the CBD and other biodiversity related conventions; this implies stronger cooperation ties between the MINEPDED and other biodiversity stakeholders nationwide;
- The NBSAP which was developed following the ecosystem approach involved all biodiversity stakeholders. It is recommended that activities planned in it be followed in all the sectors to be able to achieve integrated conservation and sustainable use;

b) **Support the conservation and sustainable use of associated biodiversity**

- This is achieved through the creation and management of protected areas including marine reserves which help to stabilize all form of associated biodiversity;
- Agro-industrial plantations of certain perennial crops: cocoa, rubber, oil palm;
- Application of the forestry, wildlife, fishery and phytosanitary regulations;
- Farmers are being taught effective use of soil and water conservation principles and to abandon the slash and burn farming method destroy humus ingredients, invertebrate and oil micro-organism
- Farmers are advised to heed to the recommendations of the extension worker with regards modern farming techniques and the use of proper planting material.

c) **Address food security and nutrition with explicit reference to biodiversity for food & agriculture, associated biodiversity and /or wild foods**

MINADER has adopted a number of measures to address the food security, among which are the following:

- The national territory has been divided into 5 agro-ecological zones. Every zone has its crop production particularities and policy considerations. Resources for agricultural production: land, personnel, and finances are used with this consideration.
- The service of agricultural statistics keeps records of all production in all the zones to assess production at all level with a view to always improve on the production.
- Programmes and activities to improve food production are undertaken by all agricultural staff of the extension services in all the regions;
- Improved farming method and distribution of free and improved planting material as well as chemicals to combat pests and diseases in crops;
- Research results are available to all kinds of producers so that they can adopt better production techniques;
- There is increased domestication of the commonly used and marketable species of wild foods;

- The policy of “Second Generation Agriculture” entails mechanised farming and therefore greater production;
- The programme of Youth for participation in Development is nationwide and involves youth programmes into agriculture;
- Manufacture of agricultural machinery: tractors and accessories has began encouraging youths into agricultural production
- The recent move to group interested farmers into produce cooperative has taken roots in other sectors: fishery and livestock, forestry and wildlife.

d) Address the maintenance of ecosystem services with explicit reference to biodiversity for food & associated biodiversity and /or wild foods

- It should be noted that both ecosystem services and associated biodiversity can truly be available in an undisturbed forest. This will be possible in the well conserved protected areas; this is why the MINFOF conservation policy aims at conserving 30% of the national territory into Protected Areas. Presently, the area allotted to forest reserves is 4 92.605 ha (15.19%) while parks, faunal reserves and sanctuaries occupy 3.571.496 ha (19.18);
- The Environmental law of 1996 forbids all forms of pollution It is forbidden to use poisonous chemicals for fishing in rivers and stream courses
- The collection of wild foods from the forest should be well organised and plants yielding food products must not be felled.
- Already the commonly used (and even commercialized) products have been involved into agro-forestry research programmes of ICRAF. Their conservation message is also programmed to reach the grass roots.

e) Improve resilience and sustainability of production system with explicit reference to biodiversity for food and agriculture, associated biodiversity and /or wild foods

- All the 12 production systems in Cameroon are covered by government policies as shown below:
- MINADER executes policies related to C1, C5, C9, M1;
- MINFOF executes policies related to F1, F5, and M1;
- MINEPIA executes policies related to L1, L5, A1, A5, A9, A13, and M1
- MINEPDED executes policies related to environmental management and its effect on the components of biodiversity

There are legal provisions that regulate the management of the resources including the conduct of exploiting in all production systems.

- The implementation of the CBD and other related conventions is coordinated by the MINEPDED
- National and international organisations in biodiversity (Appendix 3 collaborate and advise government on the management and sustainable use of genetic resources in each production system..
- The local councils and parliamentarians of respective communities recognize that production system(s) in their communities contribute to improving their livelihood and the economy. This why they inform their communities to strictly abide to the regulations on the exploitation of the resources.

- The “Participatory Approach” is applied to enable the local population feel concerned pay active roles in the management of their resources;
- Within the recent Policy of Decentralisation, regions have begun measuring their economic power from the productivity of their production systems. The challenge now is to well manage the resource at the disposal of every community such that they remain sustainable for the well being of the people.

f) Support farmers pastoralists, forest dwellers and fisher folk to adopt and maintain practices that strengthen the conservation and use of biodiversity for food and agriculture

- Government provides technical and professional extension workers who educate and advise farmers, fishermen and other groups through the creation external services in the regions, divisions and the sub divisions;
- Research results in agriculture, fisheries, forestry and livestock are made available to the local population through research centres located all over the national territory. Moreover, MINRESI has a policy of organising their demonstrations for the public to see the results of their findings so that farmers, pastoralists, etc., can benefit from such knowledge;
- Government has created “The Farmers’ Bank” which grants low interest loans to farmers and other economic groups in biodiversity-related activities;
- The organisation of agro-pastoral shows in the divisions and in the regions and the prizes awarded encourages producers in all biodiversity sectors to improve on their production;
- The granting of hunting licences, permits for collecting NTFPs, provision of farming tools to farming groups, provision of fishing materials, free spraying of cocoa farms, livestock vaccination campaigns and many other incentives are measures aimed encouraging the local producers;
- Great attention is paid by government in providing infrastructure to local communities. Farm-to –market roads, village electrification mobile telephone, radio and television signals have become major considerations for the local population;
- Through the Ministry of Commerce, government ensures the marketing of farm, fish and animal product while protecting the producer, the consumer as well as the quality.
- Government protects the rights of the local population down to village level through the presence of the officers of law and order and the officers of Territorial Administration.
- Through the recent policy of remunerating traditional rulers, discipline has improved and rural communities are more organised.

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5.1.1. Ten Major Policies/Programmes that Enhance application of the Ecosystem Approach

Cameroon as a Party to the CBD has adopted policies and programmes for the effective application of the Ecosystem Approach. The main policies are embodied in the institutional, legal and *Good Governance*, educational practices as well as international cooperation. The following actions /programmes illustrate the application of the Ecosystem Approach:

1. Reasonably advanced in the implementation of the CBD – NBSAP in 1999 followed the Ecosystem Approach, revised in 2012, Five National reports; established the CHM. Signed the Cartagena Protocol on biosafety, Enacted the Law on Bio safety;
2. Political and administrative considerations consider the ecosystem including seasonal and climatic variations. There are different policy considerations for the Savannah north from those of the maritime south.
3. The policy on land is under revision to suit various forms of economic activities in the various ecosystems. There may be consideration for women to start owning land especially for agricultural use.
4. There is regular sensitisation of biodiversity stake holders including local communities towards the sustainable use of biological resources;
5. The MINRESI has established research stations in all the five agro-ecological zones which correspond with the country six ecosystems. Research programmes are designed to the food and agricultural requirements of the population of the zone.
6. Water resource management programmes are designed to provide water through irrigation schemes and water conservation programmes to the population of the savannah/ Sahel zones.
7. International treaties and agreements provide technical assistance which is usually appropriate to the ecological conditions of the zone
8. Common Initiate Groups in the various eco-regions receive assistance for their activities according to ecological conditions of the zone.
9. Government financial and technical assistance to various communities that are engaged biodiversity-related activities recognises ecological variations – fishing, animal husbandry, logging, and fish farming.
10. Government is today financing tree planting programmes in the savannah regions and creating Protected areas in other parts of the country and emphasising

Policies, Programmes and enabling frameworks that meet with objectives in 68 and 69

a) Extent of Implementation

- There is a ministry which executes the policy on management of environmental resources. The Environmental management Plan and Law on the Environment have been in place since 1996.
- Since the ratification of the CBD in 1994 Cameroon has strictly implemented the CBD – developed the NBSAP, created the CHM, Bio safety Clearing House, Signing the Cartagena Protocol on Bio safety and preparation of the five national reports on biodiversity to the CBD.
- Women are appointed are placed in decision-making positions so that they can speak for women – in the Senate, in Parliament, in government and even in the military;
- Environmental Education is now included in the primary and school curricular to enable youths understand the environment around them.
- Every project proceeds with an Environmental Impact Assessment supervised by the Minister of the Environment, Nature Protection and Sustainable Development.

b) Production Systems Involved

The production systems involved in sections 68 and 69 are: L1, L5, F1, F5, A1, A5, A9, A13, C1, C5, C9, and MI

c) Extent of use of biodiversity for food and agriculture

- Plants and animals products are used for food, food wrapping stimulants;
- Manufacture of tool handles, building material, furniture, fencing materials and cultural uses wax, latex;
- Soil humus, nitrogen fixing legumes, micorhzal-plant association
- Animal material for medicinal uses, drums, hides & skins
- Invertebrates, worms, insects, micro-organisms used useful in soil improvement for agriculture.

d) Lessons Learnt

- The following lessons have been learnt:
- Products from biodiversity are very useful for life support and therefore need to be managed to make life continuous;
- There is need to identify and conserve the useful species of plants and animals them , then manage their uses to avoid them from disappearing;
- It is important to have plant and animal specialists who would understand the characteristics of the species which greatly support life so that they can be managed properly;
- Proper management entails suitable government policies, human and financial resources and the willingness of the communities living with the resources to abide to recommendations and rules towards proper resource management.
- The younger generation should be encouraged to study and undertake economic activities based on biodiversity;
- Women have a great part to play in the use of biodiversity and its products and therefore should be encouraged towards:
 - i. Involving them in decision making in biological resource matters;
 - ii. Authorising them to control and own land especially for agricultural uses;
 - iii. Considering the education of the girl child in those communities which do not attach importance to female education;
- Biodiversity in Cameroon has been seen as an endowment for the promotion of ecotourism
- Biodiversity project managers are conscious of the need to properly manage components and relay the message to communities around the project sites.

e) Evidence of indicators of vulnerability that have decreased as a result of the efforts

Agricultural production is reducing in some village communities due to:

- Youth exodus to city and towns;
- Absence of farm-to- market roads does not encourage increased production;
- Lack of means to apply research recommendations;

In maritime fishing, the local communities do not improve on their catch due to lack of modern fishing equipment;

- Industrial fishermen still use nets with forbidden mesh sizes and so help to reduce the fish population by catching immature fish;
- There is a marked destruction of the mangrove forests of the Littoral and SW Regions through the multiple use of the mangrove wood - fish smoking, building ,cooking;
- There has been poor land use due to the absence of land use planning policies;

- The farmer/grazer conflict has continued to account for social unrest among people of the same communities in some regions;
- Many wildlife species are threatened with extinction due to the removal of the forest cover;

f) Value added of mainstreaming gender in programmes/policies

- There is greater interest among male/female youths towards agricultural production;
- Women have taken up smoking and trading on fish products;
- Organisation of women into CIGs and cooperatives financing income-generating activities;
- Helping to identify markets and attractive prices for commodities from rural dwellers;
- Training of youths as technicians and professionals in biodiversity-related activities within their communities will help in improving capacities needed for extension services for the fisher-folk, livestock farmer and the food crop farmer;
- The authority for rural women to harvest wild foods increases trade possibilities in the wild food substances
- The processing of food products from farm commodities like cassava (*Manihot utilisima*, groundnuts, oil palm, Irvingia, etc creates chains of supply and demand and eventually create job opportunities;
- Following the release of research results, there is greater encouragement for producers to improve on their production qualitatively and quantitatively

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5.1.2.Ten Major Policies /Programmes that embed the use of biodiversity for food including different components into disaster management

1. Institutional provisions and policies made on the with regards to the management of environment and its components through the creation of the Ministry of the Environment, Nature Protection and Sustainable Development.
2. Preparation of the National Environmental Plan, the National Tropical Forestry Plan
3. The Environmental Policy and Environmental Law of 1996 were meant to sensitize Cameroonians on the need to keep a safe and healthy environment. This included the expectations from environmental disasters and sanctions that accompany negligence of the law.
4. The signing of the Cartagena Protocol and the enactment of the Law on Bio safety made Cameroon conscious of the need to safeguard its biodiversity from harmful introductions including GMOs.
5. Involvement of the indigenous Cameroon people in the “REDD +” is a measure principally aimed at combating the degradation within the forest ecosystems;
6. Creation of the Observatory by the Head of State is another means of monitoring disasters within the Cameroon environment.
7. Cameroon is preparing towards the having a Bio security Act and a law on biosecurity for the control of the movement of living modified organisms and invasive alien species;
8. The MINEPED makes it mandatory to conduct an Impact Environmental Assessment before activities of any project begin;

9. In the schools curricular, Environmental Education has long been included to equip the younger generation the knowledge of the environment including disasters and what they should do in the event of any disaster;
10. Cameroon's adherence to the Convention on Climate Change enables the Cameroon public (especially decision makers) share experiences and obtain assistance in combating the negative consequences on climate change.

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5.1.3. Ten major policies/programmes that embed the use of biodiversity into climate change for food & agriculture

Among the measures undertaken by Cameroon to the use of biodiversity into climate change adaptations are:

1. The planting of tree crops in flood prone fields;
2. In recent land use practices, steep slopes are not used for agriculture;
3. Improvement of drainage ways and construction of dykes in regularly flooded areas;
4. Following research findings, the use of short rotation crops and disease resistance varieties is being adopted. This seen in cassava, maize, mangoes, cattle,
5. The MINFOF is presently embarking on financing forest regeneration programmes in the savannah and Sahel regions.
6. The population is being sensitised on the effects of climate change and advised through extension services of the MINADER and MINRESI on the appropriate agricultural and livestock practices;
7. As a party to the Convention on Climate Change Cameroon implements all major decisions of the Convention and ensures that the Cameroonian population is updated to the principles and practices to be adopted.
8. The introduction of an Observatory in Cameroon will enable:
 - Collection and storage of information on climate change;
 - Upgrade Cameroon's capacity to address effects on disasters caused especially by climate change;
 - Educate the population in the safeguard through the provision of *Early Warning Systems*.
9. Cameroon's bio security Project has obtained a list of major invasive species of plant and animal species including plants and animal diseases in Cameroon. This strategy is meant to develop a national monitoring central system of LMOs and IAS in Cameroon.
10. Fragile habitats and ecosystems have been identified and special management principles have been adopted as is the case with:
 - Habitats with frequent temperature fluctuations – arid and semi-arid zones
 - Ecosystem degradation by landslides especially in steep slopes;
 - Habitat and species destruction by high sea levels;
 - Crop losses through tornadoes and heavy rainfall

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5.2. Conservation of biodiversity for food and agriculture

The conservation of biodiversity for food and agriculture has been government's concern for a very long time through the following actions:

- The NBSAP was developed in 1989 and was revised in 2012 as act of implementing the CBD which involved all biodiversity stake holders in the country.
- Cameroon implements other biodiversity-related conventions and multi-lateral agreements – Convention on Climate Change, Convention to Combat Desertification, CITES, etc...
- The fishery, forestry, wildlife and agricultural and environmental policies all emphasise on sound resource management and sustainable use;
- There is more emphasis towards the education of the younger generation on the importance of conserving the country's biological resource potential and to use them sustainably;
- Consideration is made on ploughing the revenue got from exploited biological resources towards the development of the local communities;
- Institutionally, special ministries have been created to address the problems in specific biodiversity components. The MINADER examines issues related to crops and agriculture, MINEPIA examines the problems of fisheries and animal husbandry, MINFOF examines the problems of forestry and Wildlife, MINEPDED looks at the problems related to the stability of the environment and protection of the environmental components while MINRESI is engaged in the research towards the state, improvement and availability of products from biodiversity;
- The provisions in the fishery, forestry and wildlife laws are all aimed at the conservation, and sustainable availability of the products from various forms of biodiversity.
- Research conducted by MINRESI and universities provide biodiversity managers the information needed for management decisions.
- Existing international cooperation on biological resource management is seen by the presence of international institutions related to biodiversity among which are: WWF, IUCN, FAO, SNV, COMIFAC, WCS, ICRAF, IITA, ITTO and other national non-governmental organisations –(Appendix 2);
- Over the years, biodiversity projects have been financed by both the state and foreign donors with the common objective of conservation and sustainable use.
- Sensitisation and encouragement of the local communities has been through:
 - i. Seminars with village communities;
 - ii. Decentralisation which enables the local councils spread the message of “Sustainable Use”
 - iii. Conservation messages are sometimes delivered in the local through programmes designed by the extension workers.
 - iv. Community radio is being used among some communities to teach about the use of resources
- The domestication of heavily demanded plant and animal species has been encouraged through technical and financial assistance of the CIGs and food cooperatives.
- The management of forest resources by local communities conveys the message of managing the resources such that the products from the forests could be available for future generation;

- Encouragement of fish farming contributes in providing protein and income from such resources;
- There is additional effort to provide local communities with farm to market roads, village electrification to enable food storage and primary processing.

5.2.1. Plans and strategies

The following strategies and plans were concluded between 1995 and 2013

- Preparation of the Tropical Forestry Action Plan (MINEF/FAO) 1995;
- Preparation of the National Environmental Plan 1996;
- The Environmental Law was enacted in 1996;
- The National Biodiversity Strategy and Action Plan in 1999 and 2013
- Le plan national de développement des produits forestiers non ligneux in 2012
- The Master Plan for the Cameroon Estuarine Mangroves Forests in 2013.

5.2.2. Legal provisions

- The following laws were all related to the common objective of implementing the CBD in order to have the country's biodiversity resources well conserved and used in a sustainable manner:
- The former Forestry, Wildlife and Fishery Laws were revised in 1994;
- The Environmental law of 1996
- The Bio-safety Law of 2003.

5.2.3. Institutional setting

In order to follow the national plans and implement the legal provisions, suitable institutions had to be created to implement and comply with the provisions of the CBD. This is why Government saw the need of the following changes:

- The creation of a Ministry of Forestry and Wildlife and a Ministry of Environment, Nature Protection and Sustainable Development.
- Provision of external services of that ministry so that the CBD's message of "Conservation and Sustainable Use" can get to the rural population who live and work with biodiversity.
- The Ministry further centralized the activities of CBD-related UN conventions of Climate Change and Desertification and named focal points to coordinate with other administrations and the private sectors.

Activities to Implement the Convention on Biological Diversity

The activities of the CBD were prioritized to ensure its strict implementation notably:

- Preparing the National Tropical Forestry Plan with assistance from the FAO;
- Preparation of the National Environment Plan ;
- Law on the environment 1996
- Preparing the National Biodiversity Status, Strategy & Action Plan; 1999;
- Preparation of the 1st, 2nd, 3rd and 4th National Reports on Biodiversity;
- Representing Cameroon in all the CoP CBD conferences, SBSSTA meetings and related panels;
- Inclusion of Environmental studies in School curricula.

5.2.4. Infrastructure development

Development of infrastructure has been government's priorities. Emphasis since the past years has been:

- Construction of rural roads: through the decentralization process, the rural councils are being financed to construct and improve farm to market roads.
- Intensification of rural electrification to enable rural producer's process and preserve their products.
- Health facilities are another priority. Construction of district hospitals to serve the rural communities is on-going and is supervised by the Ministry of Health.
- The Ministry of Sports has services represented in the rural areas and sports infrastructure is provided through educational institutions located in rural areas.

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5.3. Obstacles in implementing legislation

The Cameroon Government has identified measures for the strict application of the laws and regulations on the management of biodiversity components. Some of these measures listed in Table 25 include:

Table 25: Obstacles which hinder application of biodiversity management

Component of associated biodiversity	Obstacles to legislation for protection of associated biodiversity
Foods from the wild	<ul style="list-style-type: none"> ▪ Ignorance of biodiversity regulations – most rural dwellers have little knowledge of the laws related to resource exploitation. ▪ Language – Regulations are not translated in languages known by local biodiversity users so users and legislators hardly communicate. ▪ Poor Infrastructure – Bad roads especially during the rainy seasons prevent law enforcement staff to meet rural biodiversity stakeholders. Poor knowledge – Traditional biodiversity users like the Baka forest dwellers (who depend entirely on the forest for their livelihood cannot understand when they are arrested for killing a chimpanzee (a protected animal species) which has been their food for generations. ▪ Poor knowledge of the biodiversity components by users who erroneously feel that the resource will continue to be there even if they are not managed. ▪ There are measures to the protect areas of biodiversity hot spots especially Protected Areas seeing that some of the PAs are constantly being encroached upon by farming populations.

Course of action to remedy the anomaly in table 25

Government is addressing the problem by adopting the following measures:

Education:

- **Sensitization:** Traditional forest dwellers are gradually being taught on the need to manage the forest in order to render it productive for future generations.
- **The Participatory Approach:** This concept reminds dwellers that they are part of the resource conservation process and that they should play their roles as expected. In the

Savannah and Sahel regions, citizens are expected to plant their own trees and told to intensify in agro-forestry activities

- **Environmental Stability:** There is nation-wide campaign on the need to have a stable environment. This awareness is already being taught in all educational institutions and the subject of seminars in women communities and youth movements.
- **Effects of Climate Change:** Climate Change which was previously a meaningless Government slogan is now a reality and almost all biodiversity users have noticed and are sharing the concern. Farmers, graziers and fishermen have been experiencing seasonal surprises coupled with temperature irregularities and un-expected floods.

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5.4. Policies, programmes on framework governing exchange, access and benefits

Cameroon has taken measures to ensure that access to resources is accompanied by special conditions beneficial to people living with the resources. The situation is as follows:-

- The PIC principle is hardly taken seriously and biodiversity users in rural areas do not master their rights and benefits regarding the use of genetic resources.
- In the absence of records by rural dwellers, indigenous knowledge is not recorded anywhere and hence individuals cannot be talking of property rights. Knowledge is kept by families and can be released only when the need arises within the community.
- Benefit-sharing occurs when government authorizes the use of resource through licences or permits. Provisions in the Finance Law enable communities receive benefits through the exploitation of the resources. This has been the case with forest and wildlife exploitation.
- Benefits are paid in the form of:
 - Tax and incentive to local communities;
 - The provision of social amenities;
 - Employment of youths by resource exploiting companies.

Table26: Policies and programmes governing access to its genetic resources of associated biodiversity

Component of associated biodiversity	Intended use (e.g. any use, research and development, commercial use)	PIC and benefit-sharing required (Y/N)
Plants – timber	Commercial use	Y
Collection of wild foods	Food and commercial use	N
Safari/commercial hunting	Commercial use	Y

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The Prior Informed Concept and Involvement of Local Communities in Resource Benefits

The issue of PIC, involvement of the local communities and the equitable distribution of benefits derived from genetic resources has depended on a number of situations

Movement of Genetic Material:

- Initially movement of genetic material out of the country was undertaken by foreign organisations with no definite conditions beneficial to local communities. Some of the foreign missions which undertook movement of genetic resources from Cameroon were: ORSTOM (wild coffee), IRCC (cocoa), IRHO (Oil palm), ICRAF (*Irvingia sp*), CTFT (various forest species), IRFA (Fruit trees), Cote d'ivoire (Sofoutier)

Absence of Information on Genetic Resources:

- The absence of basic information had contributed to the movement of genetic materials out of the country unlike today that the country has equipped laboratories for screening get basic information from genetic material.

Absence of Qualified Specialists on Genetic Resource Analysis

- Genetic materials for analysis was carried out of the country for lack of competent analysts – molecular biologists, biotechnologists, etc

Present Situation

Today the situation has improved because the composition genetic material can be determined within the country. There are both qualified professionals and laboratory equipment to provide basic information on species requiring analysis. The following examples illustrate what now operates in relation to PIC and Access to benefit sharing:

- The co-management of ZICs (1-4) in the North West Region;
- Existence of management committees and local consultative bodies in the management of eight Protected Areas;
- Deliverance of a hunting zone to a local community
- Attribution of 22 hunting to be managed by local communities, 10 of which are already operating;
- Exploitation of *Echinops giganteus* in Bamboutos in the Western Region by a pharmaceutical firm is undertaken with the collaboration of a local NGO (ERUDEF)
- Government approved in the labelling of pepper produced from Penja, (Littoral Region) and the honey produced from Oku (North Wet Region);
- From forest exploitation, Government determines (using the finance law) a portion of the taxes that has to be paid to the local communities as some form of compensation to the local dwellers around the exploited resources;.
- Although a temporal measure, consideration for employment is given to the youths of a community around where a genetic resource project is located. This was the case with the

Korup Project, the Buea Mountain Project in the SW Region, the Mangrove Restoration Project in the Littoral Region and several others.

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5.5. Sector linkage Information systems on biodiversity

Information systems and programmes exist in which the farmers/graziers, livestock keepers fisher folks and the entire public are sensitized about food security issues and related issues. The Cameroon National Radio and Television and other private media designed to inform the public and particularly biodiversity-related establishments on policies, progress made and announcements concerning agriculture and food security. In addition, there are community radios in some rural communities which serve some rural masses and help to improve performances in their techniques and practices.

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Table 27: National Information Systems on Associated Biodiversity

National System Information	Components of Associated Biodiversity	Concise description of Information System
Written	Forestry & Wildlife 1. Foret et Faune du Cameroun (MINFOF)	Forest Estate, regulation, production figures, forest and wildlife, Protected Areas Information.
	2. Cameroon Forests (MINFOF)	Discusses potentials with the Cameroon forest economy, including forest production.
	3. MINFOF's News Letter	Inform the public on activities of MINFOF
	4. Cameroon Hidden Harvest	CIFOR's publication on illegal exploitation in Cameroon.
	5. La Voix du Paysan	National monthly Newspaper discusses serious biodiversity stakeholders issues
	6 Matanda News	Six monthly magazine on mangrove
Radio & TV	Special agricultural and environment education programmes (MINADER, MINEPIA)	- Our changing rural world; - Animal proteins
	Environment Watch (MINEPDED)	
	Point sur l'Environnement (MINEPDED)	
Internet	CHM (MINEPDED)	- Centre d'Echange sur la Biodiversité - Biosafety

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5.5.1. Information Systems to Support Traditional Knowledge

Cameroon as a Party to the CBD, seeks to implement the provisions of Article 8(j) of the Convention related to Traditional Knowledge through:

- The recognition of the custodians of indigenous communities who are seen as holders of such knowledge and traditions. Traditional Rulers are expected to identify and record all forms of traditional knowledge within their communities.
- Ethno-botanical surveys have been conducted in some parts of the country to record various plant uses. Many plants were seen as having the potential to cure specific diseases. African

Union Pharmacopeia (Adjanohou et al 1996) is a comprehensive contribution to the ethno botanical and floristic studies in Cameroon. These are other:

1. Studies undertaken in the Korup Nat. Park area (2510km²) on about 550 plants by Duncan Thomas, Jane Mc Macauley, Thomas Wendy, Ann Bromley, Fonki Tobias Mbenkum in 1989;
 2. Studies undertaken in Kupe Manengouba covering an area of 2390km² involving 125 plants by Benedict John Pollard.
 3. Another survey was conducted in the Takamanda Forest Reserve (67599) by Terry Sunderland and collaborators in 2003;
 4. A survey conducted by Augustine Bokwe in Southern Bakundu Forest Reserve on wild food products in 1998;
 5. A survey undertaken by Bokwe Augustine and Ngatoum Donalt on the exploitation and commercialization of *Gnetum spp* in Cameroon
 6. The survey in the Buea Mountain in area of 30000km² by Nkwantoh and Anthanasius and Ferdinand Weh on NTFPs in 1998;
 7. A nationwide survey was undertaken by 22 Cameroonians and some Nigerians on Medicinal plants in 1996;
 8. Another survey was undertaken by Benedict John Pollard in the Bali-Ngomba Reserve;
 9. A survey was done by van Dijik in the Bipindi Akom II Region (200.000 ha) involving 500 plants species in 1999.
- The Ministry of Culture and the Natural Museum promotes and recognizes information on traditional knowledge within Cameroon ethnic grouping They organize concerts, seminars cultural displays to sensitize the public on the need to preserve and hand down traditional cultural values to future generations.
 - Today there are local pharmacies stocked with indigenous local products in strategic places all over the country.
 - The local markets and road sides contain adverts of local products depicting different forms of indigenous knowledge. In towns and cities, vendors using loud speakers move around advertising local medicinal and food products. The Radio, TV and newspaper adverts are common with Dr. Dewa's medicinal products. In 2010, the products of Dr. Ambeno's Motra Clinic were readily sold in Jos Nigeria during a Multi-Stakeholder Biodiversity Conference as the products were discovered to be effective cures for Malaria and other diseases.
 - The IMPM in MINRESI collaborates with tradi-practitioners on research information in medicinal plants while the Ministry of Arts and Culture seeks looks at the possibility of preserving cultural values of some tribes in Cameroon. The Ministry of Tourism has identified cultural sites which qualify and are used as tourist sites.
 - Some tradi-practitioners have reported having partners abroad and resort to the use of internet to ease communication for the sale of products.
 - Government has liberalized traditional medicine and the sale of products related with traditional knowledge.
 - In 2008, Government hosted a Conference on traditional healing financed by the Commonwealth Science Council; attended by Ghana, Sierra Leone, Nigeria and Cameroon, the forum led to the formation of The West African Commonwealth Traditional Healers Association. This was an encouragement to those who have traditional knowledge.

- The Faculty of Science, University of Yaoundé I (Nutritional Biochemistry) works on a number of plant species from the wild.

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5.6. Stakeholder participation and ongoing activities that support maintenance of biodiversity for food and agriculture

The important stake-holder groups, including groups of associations of farmers, forest dwellers fisher folk and pastoralists, NGOs or other civil society organisations active in the conservation of biodiversity for food and agriculture are listed below:

N°	Name of stakeholder group	Biodiversity conservation objectives
1	Better World Cameroon	Provide capacity for environmental education among youths in Cameroon
2	Vigilance Committee Kupe, SWR, Kilum/Ijim, NWR	Village committee groups for control of exploitation of Prunus sp. And wildlife resources
3	Fako Women Fishing Association	Control of fish resources in Fako Division SWR
4	Enviro-Protect	Intervention in environmental management
5	TADU DAIRY	Animal husbandry & Dairy Products
6	Musée Ecologique du Cameroun	Preservation and education of biodiversity
7	Centre for Biodiversity & Sustainable Development	Biodiversity and environmental education
8	Bioresources Development and Conservation Programme - Cameroon	Biodiversity conservation Health and food contributions of biodiversity particularly from the wild
9	Projet d'Appui aux Elevages Non Conventionels	Unconventional breeding programmes
10	Sugar cane Farmers' Group - Fako	Sugar cane cultivation
11	Apiculture National organisation	Conservation of special bee habitats for honey production
12	North West Potato Union	Potato cultivation
13	North West Farmers Platform	Cultivation of Divers crop
14	Heifer Project	Livestock Management

		Exploitation of diversity of species
15	MAISCAM	Maize Cultivation
16	Agriculture Biodiversity Cameroon	Micro-flora biodiversity
17	TOP LADIES Common Interest Group	Snail Breeding
18	AMBITIOUS WOMEN Interest Group	Snail Breeding

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5.7. Incentives or benefits to support activities for the conservation and sustainable use of biodiversity for food and agriculture

Incentives and benefits to support biodiversity activities for the conservation and sustainable use of biodiversity can be seen from what operates in all biodiversity sectors of the country. General to all sectors:

- a. In all the sectors on biodiversity, Government encourages the creation of common initiative groups to promote activities on income-generation. There are farmers' fishermen associations, livestock groups and forest exploiters' unions;
- b. There are laws and regulations to govern the use of biodiversity related resources all with a view to their being used in a sustainable manner;
- c. Within the Cameroon biosecurity project, pilot sites (2-3) are included for invasive species control/management;
- d. All the ministries which have biodiversity-related activities have endeavoured to operate with their extension services in the rural areas of the national territory. Thus at village level, the sub-delegates satisfy the service requirements of the sector.
- e. Within the process of Decentralisation, the council administration will be capable of lessening the burden of the rural population referring to the Central Administration as it had always been;
- f. In all the sectors, women and youths are being encouraged to:
 - Learn the management and use of biological resources in a sustainable manner
 - Create markets for the products from biodiversity-related activities;
 - Improve infrastructure/road, social, in the rural areas to enable the transport and marketing of product from the rural areas.

5.7.1 Sector incentives

➤ Agriculture

Cameroon produces a large variety of food products (Section 2) and incentives in this sector are based on the improvement of food production.

- a. Farming is liberal and owning a farm is not taxable. This encourages Cameroonians to own farms even for commercial purposes;
- b. Government encourages some farmers are with agricultural inputs and improved planting material.

- c. In the bid to implement the Second Generation Agriculture, there is greater encouragement in the processing of food products to improve revenue;
- d. Research results are regularly available to the farmer so that he can improve on his farming methods for better yields;
- e. There are schools of agriculture for youths to train on better farming methods and techniques.

➤ **Fisheries**

There are maritime, continental and fish farming activities involved in the fishery sector. Incentives and benefits are therefore linked with activities in these areas. There are industrial and artisanal fishing activities within the country inland and territorial waters.

- a. Government has fishery laws and regulations to protect fishery resources and promote sustainable use. The laws also protect the local and artisanal fisherman against the industrial fishing operators;
- b. Fishermen are encouraged regarding the formation of fish cooperatives to enable them be recognised especially when they have to address their problems;
- c. In some fishing communities, fishermen are supplied with fishing equipment to encourage them into their activities;
- d. The opening of an institute related to sciences of marine resources in Yabassi, Littoral Region, is further encouragement of the youths into the fishing profession;
- e. Licenses for fish/shrimp fishing and high sea fishing allow all levels of fishermen to practice fishing according to their level of competence.

➤ **Wildlife**

The exploitation of wildlife resources is of both nutritional and commercial value to nationals and international stakeholders. Government has therefore adopted control and incentive measures to ensure the sustainable use of wildlife products.

- a. Government provides for the granting of different kinds of licences to suit all levels of wildlife exploiters, game ranching, hunting for trophies, etc. (see Section 4.5)
- b. In Protected Areas rural dwellers are allowed to collect NTFPs for food;
- c. There is regular dialogue between government and communities around Pas for their requirements for land and wild life products;
- d. For forest and wildlife project activities around state owned forests, employment considerations are prioritised for youths around those areas.
- e. The messages on the sustainable use of wildlife resources are available to councils and Parliamentarians of each community and rural communities are progressively becoming conscious about the dangers of ignoring the laws and regulations related to wildlife.

➤ **Forestry**

This is a very sensitive sector especially among the rural dwellers that have for so many years largely depended on the forest for their livelihood. In order to promote sustainable use of forest products, Government has been very careful in providing the kind of incentives which will encourage the communities to participate in sustainable management of the resources.

- a. Dwellers in forest zones are permitted to collect NTFP without any harassment;

- b. Traditional Knowledge of rural communities is being progressively valorised by ethnobotanist. The Ministry of Scientific Research and Innovations through its institute of Medicinal and Medical Plants has been working with many rural dwellers to identify and valorise medicinal plants.
- c. Forest exploitation taxes are ploughed into benefits for road and social infrastructure for the benefit of communities living around forest areas;
- d. Government grants Community Forests to those communities who show competence of proper forest management and can benefit from the *Sustained Use Principle*
- e. Through Agro-forestry practices forest exploiters are prevented from exploiting trees that produce wild foods particularly in the farms of community dwellers
- f. Through forest control staff, messages and regulations on the better forest management techniques now reach the rural communities.

➤ **Livestock**

Livestock activities are encouraged in all ecological zones and government has provided incentives for actor in this sector:

- a. The Ministry of livestock, Fisheries and Animal Industries has made its service available in all the rural areas where its services are required;
- b. Techniques have increased such that since 2007, Unconventional Breeding (Cane rates, snails, frogs) has attracted men and women;
- c. Research results are available to encourage the domestication of wild animal species cane rats and frogs;
- d. Animal improvement programmes are now available through demonstrations in TADU DAIRY Cooperative Society)
- e. Veterinary services are available to animal breeders especially those with high populations of animals.

(79)

5.8. Ten (10) major projects (either in progress or completed in the last five years) that support the conservation or the sustainable use of biodiversity for agriculture, associated biodiversity and/or wild foods

N°	PROJECT TITLE	INFORMATION ON PROJECT ACTIVITIES	COMPLETED/NOT COMPLETED
1	Projet Flore du Cameroun	Document endemic plant species in Cameroon	2007 - 2013
2	Red List Project/Cameroon	Evaluate seed plants using IUCN Criteria for conservation of ecosystems in Cameroon	2007 -2010
3	IRAD/C2D Horticulture		2014-2018
4	Programme d'Appui à la Promotion de La Culture de l'Okok (PAPCO)	promoting the cultivation of Gnetum spp.	2009-2015
5	The Obala Mushroom's Project	Encouraging the cultivation and the conservation of mushrooms	Not Completed
6	MANGROVE RESTORATION PROGRAMME	Management of Mangrove Ecosystems in NK Cameroon for sustainable use	
7	Le Projet d'Appui à la Promotion	Unconventional Breeding of snails, rabbits,	Sinc 2007

	de l'Elevage Non Conventionnel (PAPENOC)	cane rats, frogs
8	Mount Cameroon Project	Promoting biodiversity conservation around Mt Cameroon village communities
9	Korup Project	biodiversity conservation and rural completed development
10	Development & institution of a national monitoring and control system for LMOs & IAS	Promote and intensify cooperative biosecurity measures in Cameroon 2011 - 2016

5.9. Country initiatives for Conserving and managing biodiversity for food and agriculture

These are outlined below:

- major landscape initiatives;
 - linkages and collaboration between sectors;
 - how ministries are working together with the Aichi Targets;
 - Cameroon's effect in addressing the Aichi Targets;
 - involvement in the implementation of regional and international initiatives targeting for conservation and sustainable use;
 - Training and extension programmes.
- (80)

➤ Ten Major Landscape initiatives

The following important landscapes/seascapes are aimed at protecting biodiversity

Table 28: Landscape based initiatives to protect/ recognize areas of land and water...

Landscape based initiative	Description of sites & their characteristic of relevance to biodiversity for food & agriculture	Extent (hectares)
1. Takamanda Forest Reserve	Production forest: provides wild foods to village population around the reserve	67,599 ha
2. Edea-Ngambe Forest Reserve	Production forest: provides wild foods to villages around the reserve	60,000ha
3. Duala-Edea Wildlife Reserve	Faunal reserve: Protects fresh water species of fish and aquatic mammals	160,000 ha
4. Korup National Park	Protection of floral and faunal biodiversity	125,900 ha
5. Benoue Game Reserve	Protection of floral and faunal biodiversity	180,000 ha
6. Waza National Park	Protection of faunal biodiversity and promotion of touristic activities	170,000 ha

7. Trypanotolepant Cattle Ranch	Conservation of range lands; management of pasture for cattle feed.	NK
8. Community Forests	Production of timber and NTFP for the community	1200,000 ha
9. Mengine Gorrilla Sanctuary	Protection for conservation of primates	26,711 ha
10. Safari hunting Zones	Production of wildlife resources –meat and trophies.	8,138,000 ha

(81)

➤ **Linkages and Collaboration between Sectors Information Systems on Biodiversity**

In Cameroon there is close linkage and collaboration in the management effort directed in many areas of biodiversity components. In addition to special management in the various sectors – Agriculture, Fisheries, Livestock Forestry, there are cross-cutting issues where collaboration is further required to attain the goals for the country’s food security. Such collaboration is achieved through the following:

- The National Strategy and Action Plan (NBSAP) elaborated in 1999 was cross-sectorial and was achieved with the collaboration of 14 Government ministries, 6 national NGOs, 10 international organizations, the main agro-pastoral establishments, and other biodiversity stakeholder in the county, (MINEP 1999).
- NBSAP II strengthens cooperative actions of ministries concerned with biodiversity for food and agriculture.

➤ **Existing Information Systems on Associated Biodiversity**

- The Ministry of Scientific Research and Innovation has centres located all over the country and collaborates with all biodiversity related ministries and biodiversity stake holders. It has centres in all the agro-eco-zones and serves farmers/animal breeders, fishermen and fish farmers through IRAD.

The Ministry has a policy of publishing research results annually and publicly and in the form of annual displays for the attention of crop and livestock farmers.

- Collaboration is achieved through the services of special laboratories like LANAVET, for vaccine production research, and then the Soil Micro-biology attached to Yaounde 1 University for farmers who have problems on soils for agriculture.
- It has become MINADER’s tradition to organize agro-pastoral shows at divisional, regional and national level in which biodiversity stakeholders collaborate and interact to address matters on quality, production and productivity.
- The higher institutions (most of which have biodiversity-related programmes, collaborate among themselves, with the public and with Government to discuss and share important findings on food security.
- The National Chamber of Agriculture, Forestry and Livestock have centres in all regional headquarters and cater for the interest of stakeholders in every biodiversity sector.

- The major Agro-industrial organizations (about 10 in the country) collaborate among themselves especially on matters relating to productivity and yields. They together endeavour to discuss with government and Parliament on the fate of their products and services. Thus:
 - The CDC collaborates with HEVECAM on matters of Rubber;
 - The CDC collaborates with PAMOL, SOCAPALM on matters of the oil palm;
 - The CDC collaborates with PHP, SPM and Boh Limited Plantations on matters of Banana endeavour;
 - SEMRY collaborates with UNVDA on matters related to rice;
 - All these agro-industries in turn collaborate with their small holders;
 - The national and international organizations on biodiversity collaborate among themselves.
- The country's research bodies have strong collaboration with the universities as well as with other ministries¹⁸.

(82)

How ministries are working together to Aichi targets as they apply to the conservation and sustainable use of biodiversity for food and agriculture

The Aichi Targets have relevance with the objectives of the CBD. The ministries are collaborating in order to meet with the objectives of the Aichi Target:

- The NBSAP which was developed in 1999 and revised in 2012 was achieved under a participatory approach and all biodiversity stakeholders in all the ecosystems were involved.
- The involvement of biodiversity-related ministries included their front line and field representatives who work with the rural communities on a day to day basis.
- There is regular collaboration and the sharing of information through meetings and seminars on biodiversity issues.
- All biodiversity-related ministries have been sensitized on the Aichi Targets and each ministry is programming the application of the Aichi Target according to its area of intervention.
- As a matter of principle, every ministry informs other biodiversity-related ministries before enacting any policy or regulation on the management of any sector on biodiversity.
- Contributions from relevant sectors are expected in the exercise of land use activities;
- The Ministry of Scientific Research and Innovations has been playing the central role in providing research findings in all sectors of biodiversity.
- The Ministry of Higher Education collaborates in the building of capacities to fit in the management of biological resources.

(83)

➤ Cameroon's effort in addressing Aichi targets

Cameroon' future actions in addressing the Aichi Target have been provided for in:

- In the National Biodiversity Strategy and Action Plan (NBSAP II, 2012) which has 20 National Biodiversity Targets and 10 Ecosystem Specific Targets. Some of the general and specific targets have relevance to the Aichi Targets. Some of the country's targets are:

Biodiversity Targets:

¹⁸Some ministerial staff serves as lecturers in some of the country's universities. This is an opportunity to share with un-informed colleagues and teach the younger generation government's policies on biodiversity conservation and sustainable use.

- By 2010, at least 80% of the population is aware of the knowledge of human activity on major ecosystems;
- By 2020, Pollution from land-based activities will become less detrimental;
- By 2020, the laws and regulations will be strong enough for better biological resource conservation;
- By 2020, the impact on Climate Change will be reasonably negative;
- By 2020, genetic diversity of cultivated plants, domesticated and threatened wild relatives should be maintained and valorised

Some Ecosystem Specific Targets:

- By 2020, there should be reduction of coastal marine pollution;
 - By 2020, mangrove and associated forest degradation should be reduced;
 - By 2020, Bush fire incidence reduced by 30%;
 - By 2020 at least 50% of the grazier population will develop capacity to reduce over-grazing.
 - By 2020, increase by 20% and strengthen community-based biodiversity conservation management initiative for endangered mountain species.
- (84) ▪ By 2020, wetlands of great significance should be under management plans.

➤ **Involvement in the implementation of regional and international initiatives targeting conservation and sustainable use**

Cameroon is involved in the implementation of the following regional and international initiatives targeting the conservation and sustainable use of biodiversity as outlined in Table 29:

Table 29: Regional/International Initiatives targeting conservation/sustainable use

Initiatives	Scope (Regional International)	Description	Reference
COMIFAC	R	Conservation of forest ecosystems of the Congo Basin	MINFOF
LAKE CHAD COMMISSION	R	Protection of the Lake Chad Basin and the aquatic species	MINEPIA
AFRICAN TIMBER ORGANISATION	R	Regulate the exploitation of the tropical timber in the Central African sub region	MINFOF
<i>Convention on Biological Biodiversity</i>	I	Regulate the conservation and sustainable use of biodiversity	MINEPDED

CCD	I	Organize and adopt measures to fight against desertification	MINEPDED
CLIMATE CHANGE	I	Sensitize the world about the effects of climate change	MINEPDED
IPPC	I	Inform stakeholders on the need to protect agricultural biodiversity	MINADER
Ramsar Convention	I	Importance of conserving wetland biodiversity	MINEPDED
IUCN	I	Conservation of all natural ecosystems and their habitats	MINEPDED
WCS	I	The importance of conserving wildlife species	MINFOE
WWF	I	Conservation and the protection of nature	MINFOF
GIZ	I	The German Technical Assistance	MINEPDED
CITES	I	On the protection of Endangered species	MINFOF

R : Regional, I : International

(85)

Training and Extension Programmes that target Conservation and sustainable use

The following training programmes exist and are targeted for conservation and sustainable use:

For Agricultural Studies

- School of Agriculture, Obala - trains people in agricultural sciences and techniques;
- School of Agriculture, Bambui - trains people in agricultural sciences;
- University of Dschang - trains agricultural engineers and agronomists;
- University of Buea - trains agricultural engineers and agronomists;
- National Cocoa Academy- trains specialist on cocoa processing.

Forestry and Wildlife Studies

- School of Forestry, Mbalmayo trains forestry technicians and higher technicians;
- University of Dschang trains forestry engineers
- University of Bamenda trains forestry engineers
- College of Wildlife, Garoua trains wildlife technicians

Animal Science

- Veterinary School, Jakiri trains veterinary technicians

Fisheries Studies

- College of Marine Studies, Yabassi trains fishery technicians;
- School of fisheries, Limbe trains fishery technicians
- Centre for aquaculture and research, Melap, Foumban

Food Science and Nutrition

University of Ngaoundéré, Train specialists in food science and Nutrition

Tourism – Hotel Management Studies

O.I.C. Buea - trains personnel for hotel management

Cameroon has training and extension programmes at all levels.

There are programmes for training personnel in various domains aimed at the conservation and sustainable use of associated biodiversity.

As indicated in Table 30,

The universities train professionals;

The technical schools train technicians and front line staff

(86)

Higher Education Programme Targeting Biodiversity Conservation and Sustainable Use:

The following institution run programmes outlined in Table 30 run higher education programmes that target the conservation and sustainable use of associated biodiversity genetic resource in Cameroon.

Table30: Higher Education Programme Targeting conservation/sustainable use

Institution	Programme	Level	Enrolment		
			Total	Male	Female
University of Yaoundé 1	Courses on biological sciences <ul style="list-style-type: none"> ▪ Biochemistry ▪ Botany ▪ Soil Science 	A. BSc M Sc, Ph D	NA		NA
University of Dschang	<ul style="list-style-type: none"> ▪ Agronomy ▪ Agricultural Sciences ▪ Forest Engineering ▪ Rural Engineering ▪ Soil science 	B.Sc, M.Sc, Ph D	NA		
University of Buea	<ul style="list-style-type: none"> ▪ Agronomy ▪ Agricultural Sciences ▪ Forest Engineering ▪ Rural Engineering ▪ Soil science 	B. Sc, M.Sc, Ph D	NA		
University of Ngaoundere	<ul style="list-style-type: none"> ▪ Food Sciences – processing & Nutrition 	B. Sc, M S	NA		
National Forestry School of Mbal Mayo	<ul style="list-style-type: none"> ▪ Forestry Sciences ▪ Wood Technology ▪ Forest Exploitation control 	ATAEF TEF TSEF Wood technologist	NA		
Wildlife School of Garoua	<ul style="list-style-type: none"> ▪ Wildlife biology ▪ Habitat conservation and management 	Wildlife specialist	NA		
College of Fisheries of Yabassi	<ul style="list-style-type: none"> ▪ Training of fishermen 	Fisher technicians	NA		
Obala Agricultural Institute	<ul style="list-style-type: none"> ▪ Training of agric technicians 	Agric. Technicians	NA		

(87)**Ten Major institutions directly involved in research on conservation and sustainable use**

The following ten institutions are directly involved in research and conservation in Cameroon:

1. Institute for Agricultural Research for Development;
2. Centre for International Forest Research;
3. The Batoke Fishery Research Station;
4. The University of Dschang research programmes - agronomy;
5. The University of Buea research programmes on Biotechnology and forest ecology;
6. The Lanavet Animal Research Laboratory in Garoua;
7. The TADU Research Programmes in improved cattle breed through artificial insemination;

8. The Congo Basin Forest Food Programme (cbff)
9. International Institute of Tropical Agriculture;
10. The Banana/plantain Research Station in Njombe

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5.10. Gaps and Priorities

The following gaps and priorities need to be carefully examined during resource management and appropriate measures be taken in each case.

5.10.1. Information management, national policies programmes and enabling frameworks

a) Gaps in Information and knowledge

- The absence of resource inventory of the resource base to inform stakeholders
- Lack of taxonomy details for resource managers
- Poor knowledge of the characteristics of the resource being managed;
- National policies may become unsuitable for certain class of resources;

b) Gaps in Capacity Resource Limitation

- Inadequate or insufficient personnel for management activities;
- Insufficient financial means to cope with resource management problems;
- Amount of the resource may be insufficient for the growing population

c) Gaps for Policy and Institutional constraints;

- Policy may be unsuitable or obsolete;
- Unsuitable supervisory institutions;
- Institution or managing organization may have poor or inadequate structures.

d) Actions to be taken

- Undertake regular resource inventories in order to current with your stock;
- Inform all biodiversity stakeholders about their resource potential;
- Find out what they have to contribute for resource management decisions;
- Ensure strict application of regulations linked with the exploitation of the resource;
- See that the control staff are well paid and cannot easily be corrupt.

(89)

5.10.2. Stakeholder participation/collaboration between institutions

a) Gaps on Information and knowledge

- Stakeholders are not informed of the policies and actions;
- Absence of regular meetings to inform stakeholders on current situation of the resource;
- Lack of exchange of information between groups of the same biodiversity sector;

b) Gaps on Capacity Resource Limitation

- Stakeholders may not have same managerial competence;
- Message may not be understood by all involved;

- Level of personnel and financial capacities may be lacking;

c) Gaps on Policy and Institutional constraint

- Policy may no longer be appropriate
- Institution may be incapable in personnel and material to cope with management exigencies;
- Some institutions are incapable to handle species/ecosystem specific issues:

d) Actions to be taken:

- National NGOs and farmer/fishermen/grazer groups to be involved and be informed about resource problems;
- Records of activities to be kept by all stakeholders
- Develop techniques for processing wild food products
- Collaborate with partner institutions for exchange of knowledge to improve performance.

(90)

5.10.3.Capacity development

a) Gaps on Information and Knowledge

- Ignoring the inadequacy and poor performance of equipment;
- Failing to learn and not using success stories;
- Delaying or refusing to train personnel for better performance

b) Gaps in resource limitations

- Lack of adequate funds for training;
- Lacking trainees to train personnel for specialized duties;
- Poor performance in production;

c) Gaps in policy and institutional constraints

- Policies may be inadequate to safeguard the requirements of the activity;
- Poor regulations and no suitable personnel to enforce them

d) Action to be taken

- Regular activity report on the equipment and personnel performance;
- Thinking of producing to improve quality and quantity;
- Training of appropriate personnel for all level of resource management
- Ensure strict application of regulations related to your activity.

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5.10.4. Knowledge generation, science for management

a) Gaps on Information and Knowledge

- Information on management principles could be old and no longer applicable;
- Refusing to use innovations and research findings

b) Gaps in Policy and resource limitations

- Non evolution of activity for lack of scientific approach;
- Need to test methods and products scientifically;
- Need to recruit specialists to handle delicate issues in resource management;
- Afford means to test performance scientifically.

c) On policy and institutional constraints

- Planning did not consider the scientific approach
- There could be testing phase or the lack of testing establishment
- There could be the need for a suitable specialist.

d) Action to be taken:

- Be interested in research activities and use scientific methods;
- Share your problems and finding with other international bodies engaged on the same activity
- Keep a record of all the stages of the activity

CHAPTER 6: FUTURE AGENDA FOR CONSERVATION AND SUSTAINABLE USE OF BIODIVERSITY FOR FOOD AND AGRICULTURE

(92)

6.1. Enhancing the contribution of biodiversity for food and agriculture

Planned Actions and future Priorities to improve conservation and sustainable use of biodiversity with respect to:

a) Improving Food Security and Nutrition

- The use of new and improved breeds to improve yields qualitatively and quantitatively;
- Domestication of wild plant and animal species for food trade and medicine;
- Agro-forestry practices using heavily demanded species;
- Intensified research on plants and animals proved to have high economic value.

b) Improving Rural livelihoods

- Improved infrastructure in rural communities – roads, electricity, health, sports;
- Communication facilities for rural communities now operational as some communities have rural radios, mobile telephone network and national TV signals now reach many rural areas;
- There are youth and adult education programmes existing in some rural communities.

c) Improving Productivity

- The grouping of farmers, pastoralists, fisher folk into interest groups and cooperatives gives them recognised for financial and technical assistance;
- The creation of a “Farmers’ Bank” encourages low interest loans and enhances production and productivity;
- Distribution of improved and free planting material encourages people to invest in agriculture
- Recent moves by the MINADER to embark on mechanised agriculture with the manufacture of tractors and other agricultural machinery will certainly improve the production of food commodities;
- Provision of extension workers and demonstration plots as success stories to farming groups.

d) Supporting Ecosystem Functioning and Supporting of Ecosystem Services

- Knowledge through resource inventories of available biological resources in any given area and to recognize the values of each resource;
- Conservation of species and their habitat and implement protective measures on the identified habitat/ or species;
- Sensitisation of the values and risks involved losing those recognised values
- Strict application of the laws governing the protection, exploitation of wild food resources especially within Protected areas

e) **Improving the sustainability and resilience of production systems**

- Proper education on the proper use of biological resources;
- Encouraging mixed farming practices;
- Use of buffer zone around Protected areas which are heavily encroached by the surrounding population for want of land for multiple uses;
- Raising of capacities to enable better understanding of characteristics of the products and their sustainable use;
- Today, management and Environmental Impact Assessment are done prior to any form of resource exploitation as is the case with logging concessions.

f) **Supporting Sustainable Intensification**

- Establish cooperation links between biodiversity institutions – government ministries and stakeholders of the biodiversity domain including donor agencies;
- There are attempts at sharing information particularly on major management decisions taken with regards to biodiversity components;

Ways and means of improving the capacity and operations of the institutions concerned by the use of biodiversity:

Improvement of capacity and operations of institutions are demonstrated through:

- Creating and running institutions engaged with the teaching of biological sciences with specialisation in relevant domains of biodiversity;
- Universities now conduct teaching and research programmes on agronomy, forestry fisheries, food sciences, biotechnology;
- Adapting research programmes to the economic requirements of the country. IRAD conducts research on plant and animal species which are prioritised for food and for the export market –cassava (*Manihot sp.*) Banana/Plantain (*Musa spp*), Okok (*Gnetum spp*), Bush Mango (*Irvingia gabonensis*) Safou (*Dacryodes edulis*);
- Increased collaboration between various biodiversity related stakeholders in the country and the Central African Sub Region.
- There is regular involvement in the innovations of the Cameroon Academy of Sciences which has been cooperating with other world science bodies on recent discoveries and publications on biodiversity related issues.

Ways and means of supporting and developing new policies initiatives or implementation of current ones

Support and development of new policies has depended on how effective the application of the current policies has been and the total effect of the application on the resources being managed. The forms of support have been examined in each biodiversity related sector.

In the agricultural domain, new policy involves

- Encouraging youths into agriculture, food processing small size business
- Youths Participation in Development is a national programme aimed at encouraging youths into agricultural activities mostly within rural communities.
- The New Generation Agriculture is a recent policy which innovates into mechanised farming

In the Livestock Sector:

- Efforts are made to encourage the use of selected and improved animal breeds
- Artificial Insemination has been introduced in cattle rearing areas like the TADU DAIRY in the North West Region which also demonstrates ability to produce dairy products – milk, butter cheese, yoghurt.
- More organised and systematic allocation of pastoral lands to pastoralists and improvement of animal feed through careful choice of appropriate species for fodder.
- Expansion of non conventional breeding for selected species and which is not capital intensive – snails (*Achatina achatina*), frogs (*Conruana spp*) cane rats (*Tryonomys swinderianus*)
- Increased veterinary attention to avoid loss of existing stock of domestic animals.

In the Fishery Sector

- The enforcement of Fishery Regulations towards management for sustainable use;
- Encouragement of nationals to undertake fishery activities through provision of fishing equipment to rural coastal population;
- Creation of the Institute for Fisheries and Maritime Sciences in Yabassi in the Littoral Region
- Fish farming is expanding among the populations far from the marine and coastal areas through technical assistance from MINEPIA;
- The Fishery Research Institute in Batoke in the SW Region is providing fishery information required for marine fishing.

In the Forestry and Wildlife domain

- Through the National Forest Action Plan (FAO, 2005) the Cameroon forest estate was classified and recommended for utilisation using sound management principles;
- Strict application of Forestry Regulations particularly in respect to resource exploitation
- Levying of sanctions on defaulters who fail to comply with the regulations put in place.
- The Granting of Community forests to those communities which show proof of managing the forests for sustainable use and for the benefit of their communities
- The granting of various forms of hunting licences;
- Application of the UFA for logging concessions and strictly assigned quotas for exploitation of wildlife species
- The training of forestry technicians in the Forestry School of Mbalmayo and wildlife experts in the Wildlife College of Garoua.

In the Tourism Sector

- Tourists in Cameroon are attracted by biodiversity formations and variability – plants, animals, parks reserves, sanctuaries, and special habitats like mangroves, endemic forest and fresh water species. The nine endemic *Tilapia* species in Lake Beme in SW Region has attracted aquatic biologists to this part of Cameroon. An added attraction is the food and medicinal potentials inherent in some species. It is with this perspective that the Ministry of Tourism and Leisure adopts a tourism policy which:
- Develops tourist sites to attract tourists towards the provision of ecosystem services

- This development includes the provision of tourist guides;
- In collaboration with the MINFOF conduct species inventories and habitat restoration of particularly threatened species;
- Provide baseline information for studies and advanced research on species habitats and ecosystems;
- The MINTOUR has been emphasising on a policy of maintaining acceptable hotel standards, respectable treatment of visitors at the country entry ports – air ports, sea ports, etc.;
- There is a design to encourage the training of hotel staff to cope with international hotel management standards;
- Collaboration exists between MINFOF and MINTOUR to have information on biodiversity, plans, programmes and strategies available to tourists,

Product Processing

Emphasis is being placed on the processing of materials from biodiversity to finished and semi-finished products with the objective of creating more jobs and improving the economy. This plan is being achieved by:

- Creation of a Ministry of Small and Medium -sized Enterprises which provides directives on the financing of small business activities including the processing of products from crops and livestock;
- Already products from food crops have been in the Cameroon and CEMAC country markets – cassava products, tomato, coffee guava, mango, orange;
- MINFOF has for long adopted the policy of processing at least 70% of logs from timber concessions while 30% could be exported in the form of logs
- L'Union Cooperative de Cafe de l' Ouest has been processing coffee since 1985 and the coffee has a renowned reputation worldwide.
- The CDC, SOCAPALM, PAMOL have been processing palm nuts industrially to produce palm oil, and other derivatives like soap (produced by PAMOL)

Major Information and Knowledge Gaps that remain to be addressed and options that exist to address them

- There has insufficient knowledge of the actual resource potential due to the lack of resource inventories.
- More attention is needed in forest conservation strategies with regards to micorhyzal association with many high tropical forest tree species, (Ongene et al 2004)
- The complex nature of tropical ecosystems and wide variety of species require the intervention of specialists in the domain of agriculture, fisheries, forestry and animal science
- Research findings are still awaited on studies of some commonly used species for food and agriculture with a view to producing them on industrial quantities;
- Knowledge of the major invasive species has just been made available but more knowledge on their management and risk assessment principles is required.
- The formalities to provide land to women are still being studied especially because allocations will relate with cultural norms;
- It will be necessary to undertake market studies and master the trade partners for the commodities which show market demands;

- There is need to standardize products since some are already facing competition with other manufacturers

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6.1.1. Planned Actions and Future Priorities to Support Conservation of Biodiversity Components

Some important steps have been taken by Government to support biodiversity conservation include:

Strategies and Programs

The development of strategic national plans relating to biodiversity components notably:

- The National Environmental Management Plan in 1996;
- The elaboration of the National Biodiversity and Action Plan in 1999 then revised in 2013;
- Le Rapport National sur l'état des Ressources Génétiques pour l'alimentation et l'agriculture, 2008
- Adoption of the Rural Sector Development Strategy (SDSR) (UA,2010) which focuses on:
 - a. Food security, economy, growth of revenue of farmers, livestock breeders, and fish farmers;
 - b. Improve population's micro-economy;
 - c. Sustainable use of capital
 - d. Adoption in 2009 of the Aquaculture Development Plan.

Institutional Arrangements

The creation of separate ministries to take care of the various components of biodiversity should be strengthened consequently to reinforce the current composition made of:

- Ministry of Environment in charge of centralizing treaties and conventions related to the environment;
- Ministry of Forestry and Wildlife in charge of forestry/wildlife activities and protected areas.
- Ministry of Agriculture and Rural Development for the management of farmers and food security.
- Ministry of Livestock and Fisheries and Animal Industries for the availability of animal and fish products to the population.
- Ministry of Scientific Research and Innovations for the research in various fields related to biodiversity.

Policy and Legal Arrangements

Policy and laws have been enacted to ensure the proper management of all biodiversity components.

- the Environmental Law N° 96/12 of 1996;
- the Forestry, Wildlife and Fisheries law N° 94/01 of 1994;
- the Law on Bio safety (law N° 2003/006) of 2003;
- the law N° 2001/014 of 2001 related to seed activities in Cameroon;
- the phytosanitary protection law of 2003 (law N°2003/003 of 2003).

Cameroon is a signatory to the CBD and other biodiversity-related conventions.

Institutions of higher learning have been functioning in order to provide appropriate and sufficient personnel for the management of all forms of biological resources.

The Government prepared a framework document on management of fisheries in 2011.

In order to fill gaps and prioritize issues regarding the conservation of wild foods and maintain ecosystem services, the following measures need to be adopted:

- There should be synergy between government ministries (policy makers), commodity producers and the product consumers in order to keep up with acceptable standards and withstand market competition.
- There is need to involve the Ministry of Scientific Research and Innovations throughout the production period in order that required controls can be made at various stages of production.
- All stakeholders who may be interested in a given product should join hands and make the product(s) have an economic impact to the community handling it. Individual efforts hardly yield huge economic benefits to their communities. The tendency with MINADER today is to deal more with farm groups and food cooperatives.

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6.1.2. Planned Actions and Future Priorities to Implement Ecosystem Approach

In all the sectors of the country's biodiversity, the various ecosystems are known by their product variety and efforts are being through proper resource management for continuous availability of products and services. This objective is achieved through the following actions:

- Each agricultural eco-region has its products identity with programmes to encourage improved and increased productivity. In the savannah regions, research is based on improving the main crops – cotton, sorghum, groundnuts. In the dense forest regions, emphasis is on the improvement yields of oil palm, rubber banana/plantains while the coastal marine regions have programmes on fish production and modern fishing techniques.
- Agricultural research IRAD Centers have been created in each agro-region to cater for the research needs of each region and even for crop and animal species. Thus the following centres can be cited:
 1. Nkolbisson in Yaounde is the IRAD Headquarters. It coordinates and directs research policies and administration throughout the country;
 2. Regional IRAD Center Nkolbisson in the bimodal forest zone targets on crops and animals research;
 3. Regional IRAD Centre Ekona in the monomodal forest zone targets on fruit vegetable research;
 4. Regional IRAD Center Bambui is engaged on the research of animals in the high land;
 5. Regional IRAD Center Wakwa in the high savanna zone is engaged in the research on animals and crops.
 6. Regional IRAD Center Maroua Soudano-sahelian zone is engaged in the research on animals and crops.
 7. Specialized IRAD Center Kribi In the coastal zone targets on marine ecosystems research ;
 8. Specialized IRAD Center Sangmelima in the bimodal forest zone targets on forest and environment research ;
 9. Specialized IRAD Center Dibamba in the bimodal forest zone targets on palm tree and oil research
 10. IRAD has fishery and aquaculture research structures in Limbe, Kribi, Foumban and Nkolbisson.

Other priorities on the “Ecosystem Approach:

- There will be need to sensitize farmers, fishermen and livestock breeders on the knowledge of the limits of their ecological zones and to endeavour to use them to their economic advantage.
- Results of studies of characteristics and prevailing conditions of certain ecosystems should be available to the stake holders concerned to assist them operate with some basic information.
- Operators within given ecosystems should master the various factors which contribute to productivity and see how they can use those factors profitably.
- Government should endeavour to provide and equip the extension services particularly for the benefit of producers in rural areas who have rural infrastructural problems.
- Communication meant for producers should be made in the language familiar to stakeholders concerned.
- Traditional methods should be discouraged while carefully introducing modern production methods. There should also be efficient monitoring systems to check on the results of recommendations.
- There is need to maximise the production of those products which can easily be produced in a specific ecosystem.

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6.1.3. Stakeholder Involvement and Awareness

There are cooperation ties between the private sector farmer/grazer/fisherman/forest exploiter and Government with regards to policy/law implementation. Government ensures that administrative services particularly those that concern the peasant farmer are readily available and well understood.

- In 2005, there were 13 state run research centres and located in all agroecological zones, 5 agro-industrial centres, 20 private research centres among which are 8 seed companies, (MINEF/UNEP,2005).
- Higher and specialized institutions train required manpower to cope with the challenges faced by biodiversity stake holders in every sector.
- The challenge which Government has been addressing the arid and savannah regions of the country has been:
 - Sensitizing the population towards better ways of maintaining the forest cover through control of illegal felling of trees for fuel wood, the production of charcoal and the use of economic stoves for cooking.
 - Encourage agro-forestry methods especially where land is scarce.
 - Adoption of the “Green Horizon Education” for all Cameroonians which aims at practically achieving the slogan, “**One pupil, one tree, one school, one forest**”, African Union, (2010).
 - The scarcity of wood products in the Sahel zone makes Government focus more on the establishment of forest plantations

The way forward in the conservation of wild food resources will consist in adopting the following measures:

- There should be strict application of the rules and regulations related to PAs and control staff should be well treated to avoid any forms of trespass into forest reserves and parks.
- Agro-forestry practices should be encouraged to reduce rate of deforestation for agriculture;

- Land-use planning should be adopted even within rural communities particularly in communities with conflicting land uses. Land conflicts are common in communities with agro-pastoral activities.
- All income-generating activities should be carried out with full application of the laws and regulations related to that activity. The Fishery and Wildlife Laws should be applied for fishery and wildlife activities etc. The various treaties and conventions related to the management of biodiversity resources should be explained to biodiversity stake-holders and ensure their full and regular application. Further encouragement to conserve wild food resources will imply:
 - I. Investment in the domestication of selected and marketable wild animal and plant species;
 - II. Creating benefits for people to benefit from financial assistance. There is already a farmers' bank;
 - III. Ensuring that there are reliable markets for products from the wild so that their exploitation can be carried out in a sustainable manner;
 - IV. There should be proper knowledge of the species being domesticated in particular its growth characteristics and conservation requirements of its products.
 - V. There should be regular training of man-power in all biodiversity domain with greater emphasis on taxonomists and pathologists;
 - VI. Policy makers in various biodiversity sectors and researchers need to exchange information with producers in order to understand the problems of all parties.
 - VII. A major challenge is the processing, packaging, and conservation of wild food products most of which are perishable and do not preserve for long under tropical conditions. There is need for a joint policy and appropriate regulations between the Ministries of Agriculture, Small and Medium-sized Industries and the Ministry of Commerce each intervening in his own way to ensure the production, processing, conservation and the marketing of food products.

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6.1.4. Planned actions/priorities to support role of farmers /pastoralists /fisher folk etc.

- Ministries administering biodiversity activities have endeavoured to register all biodiversity stake holders in the country;
- List out the problems and grievances of the community dwellers;
- Establish a medium of collaboration between various stake holders and to tell them the need to manage the resources in keeping with national policies and regulations.
- All stake holders should regularly be informed of Government action with respect to biodiversity activities.
- Government has been using the "Participatory Approach" in which stake holders particularly the rural communities are given the opportunities to contribute towards decisions related to biodiversity matters.
- Regular sensitization exercises to improve on the mentality of biodiversity users most of who think that the products will always be there. They are told that ecosystem services can diminish and eventually disappear if the resources are poorly managed.
- Since PAs are considered as reservoirs of enormous plant and animals of enormous genetic significance, Dr. Olayiwola (2009) calls for new partnership between institutions , Ministry of

Health, indigenous people, universities, botanic gardens research institutions, on biodiversity conservation.

- With the acquisition of Community and Private Forests, owners are being taught management principles for sustainable use.
- Problems of land use and land ownership by women especially within local communities are now being discussed in high government circles through the revision of land laws.

6.1.5. Challenges to be overcome

The main challenges to be addressed include:

- The spread of government policies to all biodiversity stake holders and seeing that they apply the laws and regulations related to the specific forms of biodiversity.
- Language difference is a communication barrier which if not addressed can be a major handicap in sharing important messages with biodiversity stake holders particularly those of the rural areas¹⁹..
- The problems of every sector must be emphasized according to the particularities of the biodiversity sector. Thus the problems of fishermen, herdsman, crop farmers must be handled in their context.
- There is need to put an end to the farmer/grazer conflict which has for years reduced production capacities in cattle rearing regions.
- Road infrastructure is a major challenge which presents:
 - Low income levels of the rural community dwellers since their products do not reach the markets in good condition or do not reach the market at all;
 - It is estimated that about 50.000 tons of annual fish production from the Nnian creeks are sent to Nigeria due to poor roads between Nnian and the rest of the Cameroon territory,(Quote).
 - Poor roads have caused post-harvest losses to be as high as 20 – 25% for crops, (Nami, 1997)

Other forms of social infrastructures – health, education, and portable water should encourage rural community dwellers toward healthy living. Growing communities cannot all depend on traditional medicines; their children need to be educated.

6.2. Other measures being taken

The following actions are being followed to support particularly the rural population in biodiversity conservation practices:

- I. Careful studies on the income-generating activities of all local communities. The studies are based on:
 - The ecosystem characteristics and available resources;
 - Gender-based such that women's activities are recognized different from men's activities;
 - The interest of the youths in resource-based activities and programmes;

¹⁹ Cameroon has over 250 local and 2 official languages (English and French). The medium of communication should be effective so that users of biodiversity can receive biodiversity policy messages and truly benefit from them.

- Complementarities of activities within the same community. In a fishing community, fishermen coordinate with canoe carvers, net weavers, fish smokers and traders. Tomato farmers will link with basket weavers and carriers to loading sites.
 - Creation of farmers' cooperative to finance farming activities
 - Access to micro-finance institutions
- II. Recent moves from MINADER is to group all rural producers into cooperatives so that :
- They can be provided with technical expertise and benefit from financial assistance and good planting material;
 - Standardize their products for competitiveness, and gain good markets in and out of Cameroon;
 - They will be able to speak and negotiate with one voice to Government and aid organizations. There is the Potato Cooperative in the North West Region, the Eucalyptus Cooperative in the Western Region, fishermen cooperatives in Limbe and Kribi and many others.
 - "The New Generation Agriculture" is the current strategy in the Ministry of Agriculture which seeks to mechanize and improve farming techniques in order to increase production and improve product quality.
- III. Following Art.8 (j) of the CBD, indigenous knowledge of the local people should be prioritized and recognized and recorded to avoid it from being lost. Their planting, tending, processing and conservation methods are being noted and extension services are gradually improving. Other forms of knowledge should be recorded.
- IV. Exchange of visits between rural communities is another tool to improve cooperation in order to share techniques and methods, gain experiences and learn lessons.
- V. Rural communities are now being organized with traditional rulers and administrative representatives. Organization is at village level and involves:-
- Creating committees for sound administration;
 - Holding regular meetings to communicate government policies and decisions, deliberating through examination of the report of activities of the village and examining recommendations on the way forward.

6.2.1. Major Challenges

The following challenges are worth noting and have been prioritized in government action:

- I. Provision of all forms of infrastructures - roads, health, schools to the rural communalities to facilitate transportation of goods and services as well as enabling settlers dwell in healthy conditions and reduce youth exodus.
- II. Equally is the problem of communication with the introduction of mobile telephones and the internet. Every effort is made to ensure net-work coverage and national television images to be received in all rural areas.
- III. Government is trying to address the problem of middle-men produce buyers which usually leaves the farmer at a loss. Subsidies and provision of free improved material and essential agricultural inputs is being considered as the solution.

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6.3. Planned Priorities to Recognize Women's Contribution to Conservation

The Cameroon Government recognizes that women's are primary users of biodiversity and greatly benefit from its products. This is why their role towards biodiversity cannot be neglected. As main producers of food products in almost all the five agro eco regions, government sees them as a force to be reckoned with in almost all planning on biodiversity management and biodiversity conservation programmes. They are the cultivators and collectors (from the wild) of main household food items. This is why the following considerations have been reserved for the Cameroonian woman:

- The creation of a Ministry of Women's Empowerment provides the possibility of women's matters to be properly handled and for women to be heard at national and international levels;
- There is a reasonable representation of women in the country's policy and legal bodies (30% in Parliament and? % in the Senate.
- The setting up Women's programmes and clubs particularly for the rural women implies that messages on conservation and sustainable use can be effectively delivered. The following women organizations exist and there are plans to create others in many other rural communities.
- The problem of land ownership by women is an issue that government is trying to address within the current land reforms initiatives;
- The marketing of farm products was an issue which worried the women but now being handled at policy level through the creation of produce cooperatives and women organizations.
- Women are permitted and seen playing key roles in masculine trades like the sale of sawn timber and building poles for in addition to their regular sales of fuel wood, (CIFOR 2010)²⁰
- OTHER MEASURES
- Recognize the work of the United Nations Organisation for Women (ONUFEMMES) as an invisible force producing visible goods.
- Mobilize resources for women's economic activities and to give voice and visibility to the enormous contribution of women.
- The recognition the work of the Global Assembly on Women and the Environment containing 200 success stories of women from all over the world which reveal that women succeed in protecting ecosystems against all odds with little means.

6.3.1. The Major Challenges

Women's challenges can be seen through their contribution in biological resource conservation activities that are aimed at income generation. It will be important to continue encouraging their activities in those domains where their interest is felt.

In a survey conducted during an ITTO Project on the conservation of Mangrove ecosystems in Doula-Edea Reserve, women were seen to participate in the 19 of the 21 common interest groups identified in the project activities. In three of the GICs, with 99 members, 100% were women. These were the

²⁰ 1. Women were seen selling in most of the 260 sawn timber depots in Montee Park in Yaonde. Timber depots in Montee Park rose from 7 in 2003 to 260 in 2010 and in Mimboman Market increased from 10 in 1997 to 60 in 2010.

Ndokohi Community Forest “Le progrès des femmes” 60 members, “Femmes Actives de Mbengue” 22 members and “Femmes Rurales de Ndoktock”, 17 members. Their main activities are based on the use and sale of timber products, the cultivation of food crops, small scale breeding (broilers, cockerel). It is encouraging to note that in the CiG for the protection and regeneration of Londji mangroves, 52% of whose principal role is the reforestation of degraded mangroves forest area, Ndjebetet *al* (2014)²¹.

The major challenges that women face include:

- Problems of scarcity and ownership of land by women;
- Cultural practices in some tribal communities in which the widows are deprived from inheriting property from the late husband;
- The need to intensify the education of the girl child, a practice rampant within the Moslem communities of the Northern regions
- Women feel that they are regularly excluded in decision- making and therefore think that their interest is not considered.
- Elites and politicians in various communities are fighting to eradicate cultural and traditional practices which disadvantage women.
- Women are seen participating and collaborating with men in resource conservation activities in which women choose gender sensitive activities like the cultivation and sale of food crops, fish smoking, and cash crops. Men concentrate on fishing, hunting bee-keeping, cocoa/coffee farming and canoe carving.

The Way forward for Gender Consideration

Having seen the important role that women play in contributing to the conservation and sustainable use of products used for food and agriculture, the following considerations should be seen as the way forward:

- a) Women should be fully educated in the area of resource management with regards to the following:
 - Resource availability and the principle of “Sustained Use”
 - Various uses of biodiversity. Biodiversity users can generate income in many ways using different biodiversity resources;
 - The need to manage resources otherwise they get depleted;
 - Some wild food resources should be cultivated because their natural habitat can get destroyed. Cultivating new species require directives from research organisations
 - In order to have good financial returns, it is necessary to use proper harvesting methods, simple processing and conservation techniques.
 - There is need to produce good quality products whose standards can compete with the same products even outside the country;
 - All bulk producers should be linked to producer cooperative for better market strategies.

²¹ Cécil Ndebet and Patrick Ndokoy directed an ITTO Project N°PD 492/07 Rev.3(F) on a collaborative process involving nearly 1600 people of various social groups – traditional chieftains, women, local officials, administrators experts and researchers in order to contribute to the management of mangrove ecosystem in the Duala – Edea Wildlife Reserve and related watersheds.

- b) Community women who want to generate income should engage into activities which will be complementary with one another. Women growing potatoes must not be the same women supplying planting material; those growing beans should be different from those growing groundnuts.
- c) The need for women to own land should be considered very carefully. They are the main producers of food crops for the city and even export markets. In order to sustain productivity it is necessary that land which is a key factor of production be owned by the producer. Such ownership also guarantees planning and market satisfaction including trade balance for export market commodities.
- d) Women should be allowed to control income from their activities or at least participate in planning in the use of income that they generate as this provides satisfaction and encouragement to produce more.²²
- e) The extension worker has a lot to share with the rural farmer or herdsman and therefore his recommendations should be taken seriously;
- f) Special sensitisation programmes and appropriate techniques should be designed for the group of women who specialize on the collection and sale of wild foods;
- g) Policy makers, legislators and resource managers should give room for the woman to express her concern especially in biodiversity management programmes; woman.

The Way Forward on Invasive Species

Management of invasive species has been mentioned in Section 3.10 (Paragraph 44). The way forward is summarized below:

- All biodiversity stakeholders are advised to give careful thought to the effect of invasive species in their sector of activity and to respond according to the most efficient methods of mitigating their effect. The effect of biological invasions is sometimes not taken seriously by some managers of biological resources.
- An inventory of priority invasive species is underway in Cameroon by MINEPDED within the framework of the Cameroon Biosecurity Project (2011 -2015). More information (depending on the sector of interest) can be got from the Ministry.
- Information on invasive species related to all sectors of biodiversity should be communicated to interested parties to enable them react accordingly.
- Another major challenge regarding invasives is the ability to manage them. In some cases, their management can be difficult or expensive;
- Cooperation between stakeholders and researchers to enable resource users improve their knowledge on invasives
- It is interesting to note that the Biosecurity Act and the Law on Biosecurity are expected as the ultimate products of the CBP. These will be legal provisions designed to regulate the occurrence and introduction of invasive species within the various sectors of activities.

²²Some traditions in Cameroon require that the husband or the family head controls family income no matter the source. However some families have began to see the need to plan together and see how the jncome has to be used particularly ensuring that the children are not neglected.

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APPENDICES

Appendix 1

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Appendix 2

Members of the National Committee designed for writing the Report:

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Mrs. Ekobo ColleteEdith	Focal Point	MINADER
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Dr. CHEPANDA Vitalis	Member	MINEPIA
Mrs.ESSONO Daniel	Member	MINFOF
Dr. IROUME Roger Noel	Member	MINRESI
Mr. LIBAM Christian	Member	MINEPAT
Miss EMASSI TCHAGO Armelle	Member	MINREX
Mrs. WADOU nee ZIEKINE Angele	Member	MINEPDED
Dr. KUATE Jean	Member	IRAD
Dr. ONANA Jean Michel	Member	National Herbarium (IRAD)
Mr. NJILAH Isaac KONFOR	Member	University of Yaoundé 1
Pr. FONTEM Dominic Jung	Member	University of Dschang
Dr. Tom AGBOR EGBE	Member	IMPM
Dr. David A. MBAH	Member	CAS
Mr. NJAMNSHI Augustine	Member	BDCP-C
Chief BOKWE Augustine	Member	CBSD
Mrs. FOSI Mary	Member	MYFF
Mr. SHANG Lawrence	Member	TDC
TECHNICAL UNIT		
Mr. NJOME ETAME Noel		MINADER
Mr. ATANGANA Flavien Nicaise T		MINADER
Miss SAMEKOMBA NANG Amandine		MINADER
Mr. BAKELAK Didier Jefferson		MINEPAT
SUPPORT STAFF		
Mrs. BANDOLO OLINGA Agnes		MINADER
Mrs. NKUETE Sara Leone		MINADER

Appendix 3

ORGANISATIONS ASSOCIATED WITH BIODIVERSITY IN CAMEROON

INSTITUTION	FIELD OF BIODIVERSITY
International	
World Wildlife Fund (WWF)	Forest/Wildlife
German International Cooperation Agency (GIZ)	Resource Management
Netherlands Development Organisation (SNV)	Resource Management
Birdlife International	Birds Conservation
International Union of Conservation of Nature (IUCN)	Nature Conservation
United Nations Environment Programme (UNEP)	Environmental Management
CARPE	Environment and flora
Food and Agriculture Organization of the United Nations (FAO)	Food Security
International Centre on Agro-Forestry (ICRAF)	Aro-forestry
Wildlife Conservation Society (WCS)	Wildlife Conservation
Central African Ecosystems (COFAC)	Forestry
Central African Conference of Forestry Ministers (COMIFAC)	Forest Conservation
Institute of Agricultural Research for Development.(IRAD)	Agricultural Research
Centre for International Forestry Research (CIFOR)	Forestry Research
International Institute For Tropical Agriculture (IITO)	Agricultural Research
HEiFER Project	Livestock
African Research Centre on Banana and Plantain (CARPAB)	Banana/Plantain Research
Kew Botanic Gardens (KBG)	Botanic Research
MHN (Museum d'histoire Naturelle	Forest & Wildlife Conservn.
Selbey Gardens	Botanic Research
National	
AGRIBIOCAM	Micro-flora
Bioresources Development and Conservation Programme-Cameroon (BDCP-C)	Conservation
Cameroon Academy of Sciences (CAS)	Scientifique Communication
Centre for Biodiversity and Sustainable Development (CBSD-C)	Agric/Forestry Information
Enviro-Protect	Environmental Care
Earthlife	Conservation
Centre for Environment and Development (CED)	Environmental Care

Programme on Non-conventional Breeding (PAPENOC)	Unconventional Livestock
National Agency for Forestry	Forest Management
Support Service to Local Development Initiatives (SAILD)	Agriculture Livestock
MAISCAM	Maize Cultivation
Musée Ecologique du	In-situ conservation
Cameroon Cotton Company (SODECOTON)	Cotton cultivation
Cameroon Sugar Company (SOSUCAM)	Sugar Industry
Cocoa Development Organization (SODECAO)	Cocoa produce and marketing
Arabica Coffee Cooperatives of the West (UCCAO)	Coffee processing
SOCAPALM	Oil palm cultivation and processing
Cameroon Development Cooperation (CDC)	Rubber, Palms, Bananas
DEL MONTE	Banana Agro-industry
SAFACAM	Rubber Agro-industry
PAMOL	Oil palm Agro-industry
Cameroon Tea Estates (CTE)	Tea Agro-industry
Upper Nun Valley Development Authority (UNVDA)	Rice Agro-industry
Hevéa du Cameroun (HEVECAM)	Rubber Agro-Industry
MUKETE PLANTATIONS Ltd	Rubber and oil palm Agro-Industry

**Appendix 4: Plates of important plants, animals and non
timber forest products used for food and agriculture in
Cameroon**

Plate 1: Some animals species used for food and agriculture in Cameroon



Tryonomys swinderianus, Photo Depierre



Tragelaphus euryceros, Photo Depierre



Python regius, Photo D Heuclin



Chelonia mydas



Apis mellifera



Conruana goliath

Plate 2: Some plants species used in Cameroon Agro-biodiversity



***Coffea montekupensis* (Rubiaceae)**

Photo Martin Cheek photo martin cheek



***Cola* sp (Etugei) (Sterculiaceae)**



***Raphia regalis* (Palmae),**photo Cheek



***Impatiens frithii* (Balsaminaceae),** photo Cheek



Gnetum africana* (Gnetaceae)**Pteridium aquilla* (Pteridofytae)**



Photo Mauremootoo

Plate 3: Some aquatic species in marine ecosystems used for food and agriculture



Mugil cephalus, photo Ndjeng



Seriola dumerilii, photo Ndjeng



Pseudotolithus elongatus, photo Ndjeng



Callinectes sapidus, photo Ndjeng



Parapenaeopsis atlantica, photo Ndjeng



Phalium sp, photo Ndjeng

Plate 4: Selection of some edible non timber forest products used as food



Fruits of *Trichosypha acuminata* (Anacardiaceae)
photo P. Nyemeck



Dry fruits of *Xylopiia parviflora* (Annonaceae)
photo P. Nyemeck



Nuts of *Garcinia kola* (Clusiaceae)
photo Awono



Seeds of *Ricinodendron heudelotii*
(Euphorbiaceae), photo CIFOR



Fruits of *Dacryodes edulis* (Burseraceae)
photo Awono



Nuts of *Cola acuminata* (Sterculiaceae)
photo P. Nyemeck

Plate 5: Selection of some edible animals and mushrooms products



Achatina achatina



Cantharellus sp



Imbrasia oyemensis



Reticulitermes sp



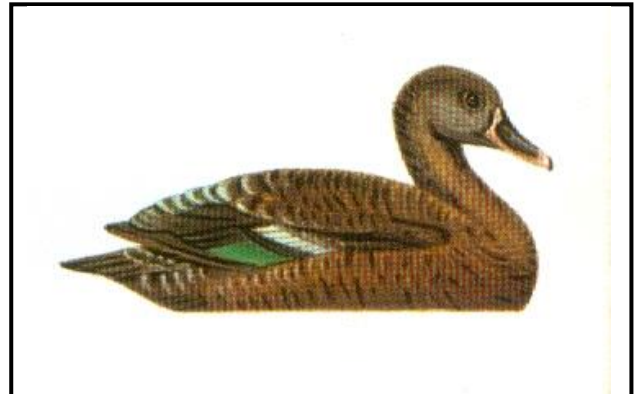
Single *Dorylus gribodoi* Colony of *Dorylus gribodoi*



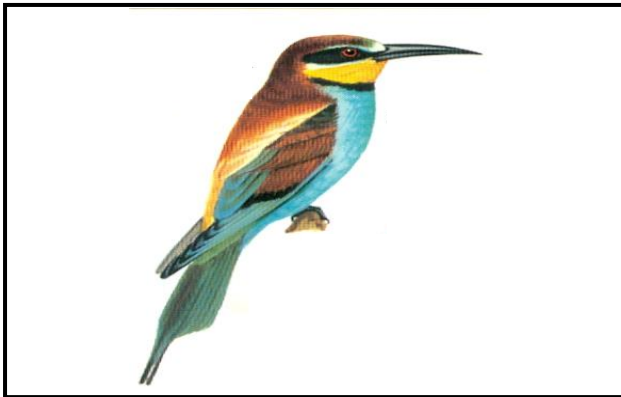
Plate 6: Some important birds species for food and agriculture in Cameroon



Psittacus erithacus (Psittacidae), Photo Hartwig



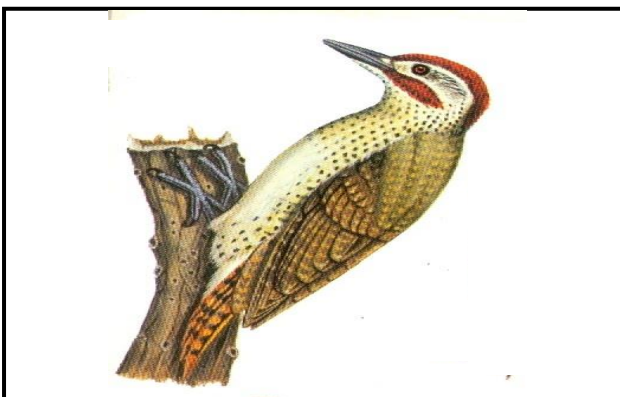
Anas sparsa (Anatidae), photo Hartwig



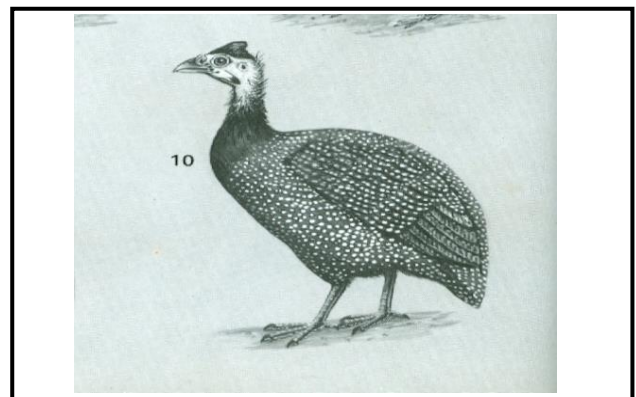
Merops apiaster (Meropidae), photo Hartwig



Nectarina olivacea (Nectarinidae), photo Hartwig



Campethera punctuligera (Picidae), photo Hartwig



Numida meleagris (Phasianidae), photo Hartwig

Plate 7: Fruits and products from *Irvingia gabonensis*



Irvingia gabonensis (photo Oben)



Fruits of Irvingia gabonensis(photo Oben)



Products containing active ingredients from *Irvingia gabonensis*(photo Oben)