



REPORT ON FORMULATING A STRATEGY FOR PRODUCTION, VALUE ADDITION AND MARKETING OF PRODUCTS FROM ARID AND SEMI ARID (IGAD) IN ETHIOPIA

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As the winds die down and silence settles in after a storm a brighter future beckons the pastoral and agro-pastoral communities in the IGAD region due to your contribution to the conservation and sustainable utilization of non-wood forest products including gums, resins, spices and honey

**PRODUCTION, VALUE ADDITION AND MARKETING OF NON-WOOD FOREST PRODUCTS
(NWFPs) FROM ARID AND SEMI ARID LANDS (ASALS) OF ETHIOPIA**



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LIST OF ACRONYMS

| | |
|---------------|--|
| AAU | Addis Ababa University |
| ASALs | Arid and Semi-Arid lands |
| CBO | Community Based Organization |
| CIFOR | Centre for International Forestry Research |
| CRV | Central Rift Valley |
| CSE | Conservation Strategy of Ethiopia |
| EHNRI | Ethiopian Health and Nutritional Research Institute |
| EIAR | Ethiopian Institute of Agricultural Research |
| EPA | Environmental Protection Authority |
| ETB | Ethiopian Birr |
| EU | European union |
| FRC | Forest Research Centre |
| GDP | Gross Domestic Products |
| GO | Governmental Organization |
| IBC | Institute of Biodiversity Conservation |
| IGAD | Inter-Governmental Authority for Development |
| ILRI | International Livestock Research Institute |
| ITC | International Trade Centre |
| IUCN | International Union for Conservation of nature |
| MoA | Ministry of Agriculture |
| MoH | Ministry of Health |
| MoT | Ministry of Trade |
| NGOs | Non-Governmental Organization |
| NGPME | Natural Gum producing and marketing enterprise |
| NWFPs | Non-Wood Forest products |
| USD | United States Dollar |
| WBISPP | Woody Biomass Inventory and Strategic Planning Project |

Disclaimer

This report is prepared for the Inter-Governmental Authority on Development's Programme on Production, Value Addition and Marketing of Non Wood Forest Products from Arid and Semi Arid Lands (ASALs) in the IGAD Region. It was the need, to mainstream NWFPs into the national economy that led IGAD to facilitate the development of "a regional strategy for production, value addition and marketing of non wood forest products from Arid and Semi Arid Lands (ASALs) in the IGAD Region". The overall objective of the programme was to contribute to food security, income generation and alternative livelihoods in the ASALs by exploiting and promoting eco-(bio) enterprises from non timber products existing in the ASALs. The consultancy was commissioned by IGAD, as part of the larger study on strategy development, to i) Undertake review literature to identify underexploited and/or new crop species that exist in wild and/or in limited cultivation in the sub region with a view to promoting and increasing cultivation, multiplication and production; ii) Document, where available, the multiplication and release to research institutions of small quantities of seeds of most promising species cultivars and ecotypes; iii) Explore the present and future research on value addition and market chains (processing and packaging of the new foods and products) in IGAD member states; iv) Undertake preliminary studies on marketing systems for these products and foods to ensure a sustainability of production in IGAD and member states; v) Identify rural cottage industries and community groups for the processing and packaging of the respective foods and vi) Review the possibility of local and international exhibition of these products.

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of either the Inter-Governmental Authority on Development (IGAD) or the member state (Djibouti, Ethiopia, Kenya, Somalia, Sudan and/or Uganda) concerning the legal status of any country, territory, city or area or its authorities concerning the delimitations of its frontiers or boundaries. The opinions expressed in this paper are solely those of the author and do not constitute in any way the position of the IGAD nor the institutions in the member states studied.

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1. INTRODUCTION

Ethiopia has a substantial area of Arid and Semi-Arid Lands (ASALs) covering about 615,000 km² or 55 % of the total landmass of Ethiopia. The ASALs support significant proportion of human population, estimated at 12-15 million pastoralists and agro-pastoralists in the lowland ASALs alone, and several million smallholder farmers in the highland ASALs such as in Tigray and Wollo.

The arid lands of Ethiopia are characterized by mean annual rainfall of between 100 - 800 mm, mean annual temperature of 21-27.5 °C and mean annual potential evapotranspiration of between 1700 - 2600 mm. These areas comprise about 40 % of the Ethiopian Somali and 30 % of the Afar regions and a small part of the north-eastern part of Wollo and 5% of Oromiya Region towards the southern tip which borders with the Ethiopian Somali Region (EPA, 1998). The semi-arid zones experience mean annual rainfall of between 300 – 800 mm, a mean annual evapotranspiration of 1600 - 2100 mm and a mean annual temperature of between 16-27 °C. The semi-arid areas cover almost 90 % of Tigray Region, 20 % of the southern, eastern and north-eastern parts of Oromiya, over 60 % of Benishangul, some parts of the Southern Nations and Nationalities and People's Regional State (SNNPRS) as well as the extreme north-eastern part of the Ethiopian Somalia Region (including Jijiga) (EPA, 1998).

In poverty terms the ASALs of Ethiopia are the poorest of the poor with increasing vulnerability to a growing process of impoverishment. Increasing frequency of climatic extremes, rapid human population growth and natural resources degradation are exacerbating vulnerability of pastoralists and agro-pastoralists in the ASALs of Ethiopia. These areas are also characterized by low social indicators such as literacy/education level and health status. The ASALs continue to suffer from lack of diversification of their economy, which is one of the principal causes for increasing vulnerability. Concerted efforts are therefore required to improve human welfare, reduce vulnerability and enhance sustainable livelihoods.

ASALs are often assumed to be resource poor areas and challenges for development, however this is not necessarily the case. The ASALs of Ethiopia are home to forests and woodlands that can offer good opportunities for improving livelihoods and mitigating poverty, though this great potential is largely overlooked in most policy and strategy development processes. The vegetation is rich in biodiversity, with a wealth of unique and mostly endemic species (Groombridge and Jenkins 2002; Abiyu et al. 2010). Peculiar about these biomes is their richness in the species of the family Fabaceae and Burseraceae. For instance, about half of the 150 to 200 species of the genus *Commiphora* are endemic to the small areas of south-east Ethiopia, north-east Kenya and Somalia (Kuchar, 1988,1995; Volssen, 1989). The genera *Acacia*, *Boswellia*, *Commiphora* are known for their contributions to the world of some of the oldest and most acknowledged forest products such as gum arabic, frankincense and myrrh. These products used today in some of the multi-billion dollar industries. The vegetation resources also provide a number of other products of commercial interest and have subsistence roles. Indeed, the livelihood buffering potential of vegetation of ASALs against extreme poverty and risk is considerable in Ethiopia (Lemenih, 2009). In this report compilation is made of the wealth of non-wood forest products (NWFPs) of the ASALs of Ethiopia through extensive desk study.

2. OBJECTIVES OF THE STUDY

The overall objective of this report is to explore and document the resource richness of ASALs of Ethiopia with respect to NWFPs, and examine their potential and actual contributions to improved livelihoods in these areas. The specific objectives of this documentation are to:

- a. make extensive review of literature and document the resource basis of NWFPs in the ASALs of Ethiopia, and the status and trend of their current productions;
- b. identify over and underexploited and new crop species that exist in wild and/or in limited cultivation in the country with a view to promoting and increasing cultivation, multiplication, production, value addition including branding and packaging where applicable;
- c. indicate whether the NWFPs of socio-economic importance are adequately mapped and where the information is currently held;
- d. identify key players in the sub-sector;
- e. identify at each level in the production and marketing chains the actors and indicate how community participation / benefits can be enhanced / increased and what support is required to do so;
- f. identify research and training institutions involved in forestry research and training and indicate the level of effort put into NWFPs. Indicate also available private sector participation;
- g. explore the present and future research needed in the entire sub-sector;
- h. identify potential areas of intervention, potential investors and issues that need to be addressed to encourage public and private sector investment, and
- i. prepare a log frame of future activities to address the identified prioritized constraints.

The documentation of this paper is based on extensive review of literatures scientific (published articles, books, proceedings and field reports), and non-scientific such as national research strategies, research reports, and policy and rural development strategy documents. The authors long years of research and teaching in dryland forestry was an excellent opportunity for easy access and in prioritization of the areas of intervention. Most of the materials included in this document are also extracts of the author's prior works in the NTFPs throughout the country.

3. BACKGROUND TO THE PROGRAM

This report forms parts of IGAD's program of formulating a strategy for production, value addition, and marketing of products from ASALs in the IGAD's region. The objective of this IGAD's program is to contribute to food security, income generation and alternative livelihoods in the ASALs by exploiting and promoting eco-(bio) enterprises from non-timber products existing in the ASALs. In designing the program IGAD recognized the richness of NWFPs in the ASALs of its Member countries. In the ASALs region of IGAD, local livelihoods depend heavily on natural resources in general and NWFPs in particular making conservation and development of these resources closely linked to sustainable development and enhancement of resilience of the ASALs to climate change. The potential of the ASALs in the IGAD region is much greater and underutilised than it is realised. Being one of the Vavilov centres¹, the sub-region is rich in both wild and domestic plant species

1 A Vavilov Center or a Center of Diversity is a region of the world first indicated by Dr. Nikolai Ivanovich Vavilov to be an original center for the domestication of plants

that have been used as a food for millennia. Like in any other region where the majority of the population derives their livelihood from water and land based occupation, food production and consumption patterns have always depended on the compatibility with the ecological situations of the ecosystems, and recently to the levels of outside influence. Consequently, attitudes towards the ASALs are changing, with new understanding about the value of dry lands environment, the way these environments function, and the way the inhabitants of those dry lands have adapted their livelihoods to the constraints and opportunities that the environment presents.

Ethiopia is one of the IGAD member states and this program is of interest to Ethiopians. Like most IGAD members states the ASALs of Ethiopia has rich NWFP resources that offer potential for bio-prospecting and bio-enterprising. Despite this available potential, the ASALS of Ethiopia like the ASALs of other IGAD member states, suffer from extreme poverty, high level of conflict and insecurity. Furthermore, changing ecological situation due to climate change, periodic and persistent drought and/or desertification, has made land incapable of supporting traditional food crops and livestock. The problem is further exacerbated by the introduction of new consumption habits both in urban and rural areas where people are increasingly dependent on food that is not grown in their surroundings or in the country. In this respect, urbanization and the food aid programmes have a profound impact in the observed changing consumption patterns of the people of the sub region. Even in the ASALs where there is limited agro-pastoral subsistence, people grow what they do not eat, and eat what they do not grow. Faced with this contradiction, any normal drought episode quickly escalates into famine, making the sub region one of the most food insecure and vulnerable sub regions in the world. Consequently, the population in the ASALs of Ethiopia are subjected to both seasonal food insecurity and perpetual famines while options and potential to develop and utilize other available food crops and products exist. Although pastoralism and livestock remains the principle source of livelihood in the ASALs, the future lies with a combination of livestock and exploitation of products from ASALs. It is time to shift livelihoods beyond livestock.

Promoting sustainable land use in the ASALs of Ethiopia and IGAD region requires a regional perspective on the challenges that pastoralists face with greater attention on transboundary ecosystem management, markets and service provision. Consequently, it was recommended that for long-time sustainability, IGAD should identify and support a pastoralist development institute/dry land training institution to promote eco- and bio-enterprises in the arid and semi-arid lands. In addition, the 2nd IGAD/IUCN conference of Directors of Finance and Planning and Directors of Conservation Ministries held on 9 -13 March 2010 in Entebbe, Uganda recommended a proposal that IGAD formulates a strategy to look into the potential and products of arid and semi-arid areas, looking at marketing chains and value addition. This report, which identifies useful plants and their NWFPs in the ASALs of Ethiopia, will, therefore, contribute to the general aim of formulating a regional conservation and development strategies that will help to diversify the livelihood systems in the ASALs by creating new opportunities for trade and availability of foods and products from ASALs.

4. OVERVIEW OF NWFPs FROM THE ASALs OF ETHIOPIA

A. Ecology and diversity of NWFPs

Ethiopia's ASALs are endowed with diverse vegetation formation (Fig. 1). Wide range of altitude

in the ASALs give rise to a range of environmental conditions (rainfall, temperature, soil) and habitats, and thus vegetation formations of varying structure and composition. Ethiopia's vegetation has been categorized into 14 broad and sub-types (Demissew and Nordan, 2010; Fig. 1), and nearly six of these are typical of ASALs and its immediate surroundings. These are: (i) *Combretum - Terminalia* (broadleaved) deciduous woodlands; (ii) *Acacia – Commiphora* (small-leaved) woodland and bushland proper; (iii) Acacia wooded grassland of the Rift Valley; (iv) desert and semi-desert scrublands, (iv) the wooded grassland of the western Gambella region, and (v) dry evergreen Afromontane forests. For our case in this report the focus is on the first five types that are typically vegetation of ASALs of Ethiopia. The vegetation of the ASALs provide diverse goods and services, the most commercially important products being the NWFPs. Quite a number of NWFPs are also supplied by the vegetation of ASALs. This report focuses on NWFPs of high subsistence, economic and commercial values, and these comprises gum and incense, honey and beeswax, edible forest products, herbal medicine, aloe and essential oil (Table 1).

TABLE 1. MAJOR CATEGORIES OF NWFPs FROM THE VEGETATION OF ASALS IN ETHIOPIA

| NWFP type | Concentration areas within ASALs of Ethiopia | Commercial potential | Remark |
|-----------------------------|--|----------------------|--|
| Gum Arabic | NW, W, S, SE | High | Different types of gum arabic resource can be found due to diversity of source species and variety |
| Frankincense | NW, W, S, SE | High | Different types of frankincense due to diversity of source species |
| Myrrh and myrrh like resins | S, SE | medium | Different types. Commerce is going down |
| Honey and beeswax | Central Rift Valley (CRV), W, NW, N | High | Commerce of these product is growing due to expanded private sector involvement |
| Aloe | All over ASALs | High | No commercialization so far in Ethiopia |
| Essential oil | All over ASALs | High | Little exploited so far. But research has been going on |
| Edible plant products | All over ASALs | Low | Little developed and commercialized |

(NW = northwest; N = north; W = west, S = south, SE= Southeast lowlands)

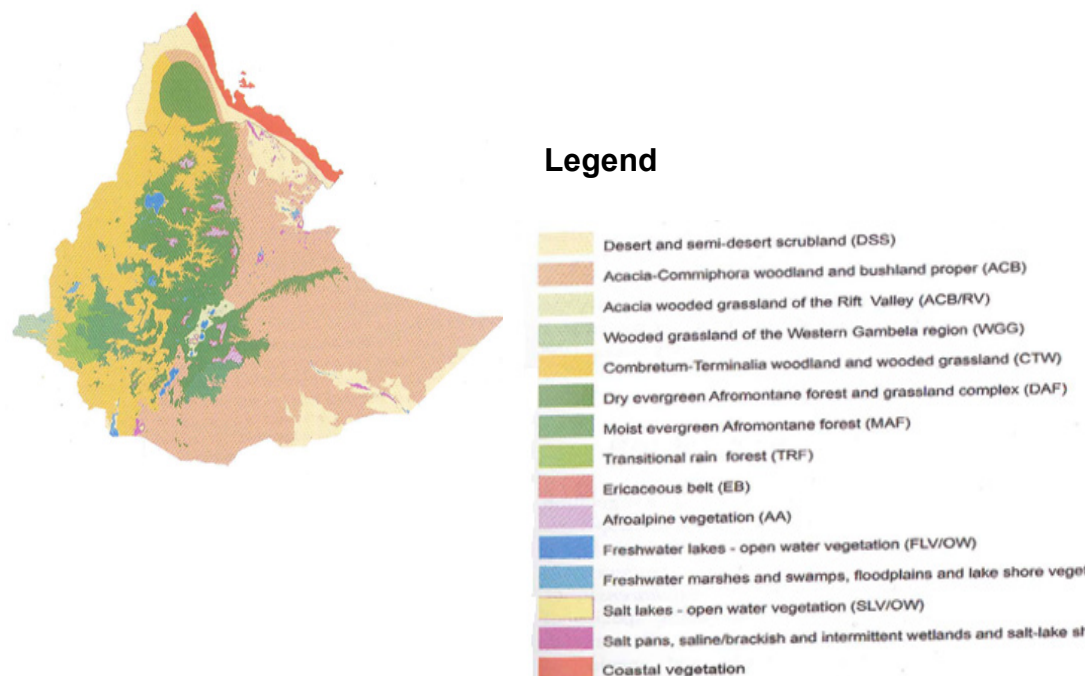


Fig.1. Vegetation types of Ethiopia including the vegetation in the ASALs (note specially the vast Acacia-Commiphora woodlands in the east, southeast as well as the vast stramong othersh of Combretum-Terminalia woodland along the western part of the country stramong othershing all the way from north to south; Source Demissew and Nordal, 2010).

B. NWFP Resource mapping

Gums and resins: Ethiopia's ASALs have substantial gum and incense production potential. Over 60 gum and resin bearing species have been identified with potential for commercial production (Tadesse et al. 2007). The total area of woodlands with good stock of gum and incense bearing woodlands is estimated to reach 3.5 million ha. However, current production is limited to few species and few products. Two major groups are distinguished in the gum sector: (i) the non-aromatic mainly gum arabic, and (ii) the aromatic gum-resins (Table 2). From the aromatic groups frankincense or gum olibanum is the most economically important products today. Frankincense resinous aromatic tear is obtained from various species of the genus *Boswellia*. Based on their origin, three types of frankincense are distinguished in Ethiopia: Tigray, Ogaden and Borana types (Table 2). The Tigray type olibanum (Plate 1) constitute the bulk of frankincense produced and traded both in the local and exported markets. This is the gum resin obtained from the species *Boswellia papyrifera* (Del.) Hochst. *B. papyrifera* is found in the northern, northwestern and northeastern lowlands of Ethiopia as well as in the river gorges of Abay and Tekeze. The Ogaden and Borana types (Plate 2) are frankincense obtained from the various *Boswellia* species namely *B. neglecta*, *B. rivae* and *B. microphylla* found in the woodlands of the eastern and south eastern lowlands.

Table 2. Currently marketed gums and resins, their botanical sources and local designations in Ethiopia

| Category | Common name | | Botanical source | Local designation |
|--------------------------|-------------------------------|------------|---|-------------------|
| Aromatic gums/resins | Frankincense/ Gum olibanum | | <i>B. PAPYRIFERA</i> | Tigray type |
| | | | <i>B. neglecta</i> | |
| | | | <i>B. rivae</i> | Borana type/ |
| | | | <i>B. microphylla</i> | Ogaden type* |
| | Gum myrrh | | <i>C. MYRRHA</i> | Myrrh |
| | | | <i>C. GUIDOTTII</i> | Opoponax |
| | | | <i>C. erythraea/</i> <i>C. africana/others</i> | Hagar |
| Non-aromatic gums/resins | | Arabic gum | | |
| | ☞ True gum | arabic | <i>A. senegal</i> <i>A. seyal</i> | |
| | ☞ Gum talha | | | |



Plate 1. Frankincense of Tigray type with its various grades obtained from *B. papyrifera* species.



Plate 2. Black Borana incense obtained from *B. neglecta*, respectively (Photo: NGPME home page).

Diverse *Commiphora* species are found in the lowlands of Ethiopia and some of these species produce commercial gum resins. The major *Commiphora* gum resins of economic importance currently are myrrh, opoponax and hagar. Myrrh is a typical name for the gum obtained from *Commiphora myrrha* (Nees) Engl. (FAO, 1995; Plate 3). This myrrh is used mainly for medicinal purposes (Lemenih and Teketay, 2003). Opoponax or scented myrrh (Plate 2b) is the name given to the myrrh obtained from *Commiphora guidottii* Chior (Thulin and Claeson, 1991; Farah, 1994). The resin from *C. africana* (A. Rich.) and *C. erythraea* (Ehrenb.) Engl. locally called ‘hagar’ is traded but locally and across border with Kenya (Lemenih et al., 2003), mainly for medicinal purposes. Hagar serves as laxative, insecticide and as anti-parasites like ticks and fleas on livestock. There are many more *Commiphora* species that produce gums that are also collected (Table 2) and sold under the name myrrh or Opoponax (Tucker, 1986; Lemenih et al., 2003).



Plate 3. True myrrh (a) from *C. myrrha* and Opoponax (b) from *C. guidottii* species.

Gum arabic is a dried exudate collected from the stems and branches of *A. senegal* (L) Willdenow or *A. seyal*, but the two are clearly collected and delivered separately. Gum arabic is collected from two varieties of *A. senegal* in Ethiopia namely *A. senegal* var. *kerensis*, and *A. senegal* var. *senegal*. Based on their source variety and location two different types are locally identified: the Humera type and the Borana type. The former is for gum arabic from Humera area (northern Ethiopia) collected mainly from *A. senegal* var. *senegal*, the latter from Borana area (southern and southeastern) collected chiefly from *A. senegal* var. *kerensis*. Areas in Ethiopia with good stocks of *A. senegal* and *A. seyal* are found in western, central (Rift Valley), southern and southeastern lowlands. Despite the wider distribution of the species, gum talha of *A. seyal* origin is collected mainly from Borana area. Good grade gum Arabic from *A. senegal* is in the form of whole, round tears and pale to orange in colour with a matt surface texture. Gum Arabic from *A. seyal* is more friable and is rarely found in whole lumps.

Table 3. Over and underutilized gum and incense products in the ASALs of Ethiopia

| No. | Species | | Main concentration locations | Product type | Status of current use |
|-----|---------------------------------------|--|------------------------------|--------------------------|-------------------------------------|
| 1 | <i>Acacia senegal</i> var Senegal | | NW, N, Central Rift valley | Gum arabic | Utilized well |
| 2 | <i>A. senegal</i> var <i>kerensis</i> | | S, SE | Gum arabic | Underutilized relative to potential |
| 3 | <i>A. seyal</i> var <i>fitula</i> | | S, SE | Gum arabic | Underutilized relative to potential |
| 4 | <i>A. seyal</i> var <i>seyal</i> | | S, SE | Gum arabic | Underutilized relative to potential |
| 5 | <i>A. mellifera</i> | | S | Gum acacia | Underutilized |
| 6 | <i>A. drepanolobium</i> | | S | Gum acacia | Underutilized |
| 7 | <i>A. polyacantha</i> | | NW | Gum acacia (gumero type) | Underutilized |
| 8 | <i>Boswellia neglecta</i> | | S, SE | Frankincense | Underutilized |
| 9 | <i>B. papyrifera</i> | | N, NW, Northern Rivers gorge | Frankincense | Over utilized |
| 10 | <i>B. rivae</i> | | S, SE | Frankincense | Underutilized |
| 11 | <i>B. microphylla</i> | | S, SE | Frankincense | Underutilized |
| 12 | <i>B. pirrotae</i> | | N, NW | Frankincense | Underutilized |
| 13 | <i>B. ogadensis</i> | | S | Frankincense | Nd |
| 14 | <i>B. carteri</i> | | SE | Frankincense | Nd |
| 15 | <i>Commiphora myrrha</i> | | S, SE | Myrrh like resin | Underutilized |
| 16 | <i>C. Corrugata</i> | | S, SE | Myrrh like resin | Underutilized |
| 17 | <i>C. Crenulata</i> | | S, SE | Myrrh like resin | Underutilized |
| 18 | <i>C. paolii</i> | | S, SE | Myrrh like resin | Underutilized |
| 19. | <i>C. africana</i> | | S, SE | Myrrh like resin | Underutilized |
| 20. | <i>C. habessinica</i> | | S, SE | Myrrh like resin | Underutilized |
| 21. | <i>C. guidotti</i> | | S, SE | Myrrh like resin | Underutilized |
| 22. | <i>C. schimperi</i> | | S, SE, NE | Myrrh like resin | Underutilized |
| 23 | <i>C. erythraea</i> | | S, SE, NE | Myrrh like resin | Underutilized |
| 24. | <i>C. kua</i> | | S, SE | Myrrh like resin | Underutilized |
| 25. | <i>C. truncata</i> | | S, SE | Myrrh like resin | Underutilized |
| 26. | <i>C. serrulata</i> | | S, SE, NE | Myrrh like resin | Underutilized |
| 27. | <i>Sterculia setigera</i> | | N, NW | Gum karaya | Underutilized |

Nd denotes no data or information about the species

Ethiopia also has a number of plant species whose gums have not been developed though they have potential for commercial production and utilization (Table 3). One of the species is *Sterculia setigera* produces a gum called gum karaya. There are trials of production and utilization of *karaya* but it is yet to be fully developed. Other acacia species such as *Acacia polyacantha* are also producers of tradable gum but are not yet promoted. These are obviously under exploited and underutilized despite their great potential. The list of species known to have commercial gum and resin production potential, including the major ones that are currently exploited, their major concentration areas and current utilization status are presented in table 3. All the commercial gum arabic, frankincense and myrrh are produced from natural stands and by natural exudation except for Tigray type olibanum where organized tapping has been developed.

Honey and Beeswax: Honey and beeswax are other promising NWFPs from ASALs of Ethiopia. There is high potential to create tangible livelihoods impact through apiculture related intervention in the ASALs. Honey consumption for the renowned traditional beer called 'tej' is high and this demand has persisted for generations. It is culturally favored and is always a "core ingredient" of several cultural ceremonies such as wedding, feasts and many more. Therefore market is not only available but promising. Furthermore, recently Ethiopian honey was awarded the EU Third Country Listing of Animal-Based Products' accreditation. Consequently, the honey produced in the country can get additional market niche in the EU. Beeswax export is an established trade in Ethiopia, the fifth largest producer in the world market.

Beekeeping is an important traditional activity in rural Ethiopia. Ethiopia is known to hold Africa's largest apicultural resources (Table 4). The diverse flora and fauna of the vegetation of the country is providing excellent bee forage making it highly suitable for sustaining a large number of bees colonies. Ethiopia has over 10 million bee colonies (Kassaye 2001), out of which about 7.5 million are confined in hives and the remaining feral exist in the country. According to Hartmann (2004) of all countries in the world probably no country has a longer tradition of beekeeping than Ethiopia.

Although bee keeping has been central to the Ethiopian culture from ancient times, it is limited in extent in the ASALs principally in those areas with scarce surface water availability. But in areas where water is not limiting, beekeeping is a normal traditional farm practice. Among the ASALs, Tigray (90% of which is semi-arid), western, north western lowlands, and Central Rift Valley have quite high potential. The ASALs of Tigray are known for its white honey which is the most popular and in highest demanded honey in Ethiopia. In just one district in Tigray there are 18,567 bee colonies (Atsbi Wemberta ARDO, 2008). Possession of 5 to 7 beehives is not uncommon here (Abebe, 2009). As one travels through country sides in Ethiopia, it is not uncommon to see big trees inside and outside forests holding several hives.

The apiculture sub-sector in Ethiopia is dominated by smallholder producers who practice traditional production system using traditional hives. This traditional production system is less productive with the average of 5-6 kg of honey yield per hive per year, while from the improved one, on average of 15-20 kg is possible. The current honey production in the country is estimated at 24,600 tons per year. The estimate is based on 65% and 75% occupational efficiency of 7.5 million traditional, and 20 thousand framed improved hives respectively. Honey is harvested once or twice a year depending on the rainfall pattern. In mono-modal rainfall condition harvest is one time a year but in bimodal conditions like the southern Rift Valley the harvest is often twice a year.

Table 4. Ethiopia's honey and beeswax production (tons) compared to several African countries (Source: FAO, 2005).

| No. | Country | Honey production | Beeswax production |
|-----|---------------|------------------|--------------------|
| 1 | Guinea-Bissau | 65 | 100 |
| 2 | Burundi | 240 | 45 |
| 3 | Guinea | 600 | 0 |
| 4 | Chad | 960 | 0 |
| 5 | Cameroon | 3000 | 287 |
| 6 | Central A.R. | 13,000 | 690 |
| 7 | Kenya | 21000 | 2400 |
| 8 | Angola | 23,000 | 2000 |
| 9 | Ethiopia | 39000 | 4300 |

Honey is almost exclusively used (80% of the annual production) to satisfy local demand, for the preparation of "Tej", a mild alcoholic beverage popular throughout Ethiopia. The honey produced is so crude that it will not compete in the international market. With adoption of appropriate harvesting technology and post harvest handling, however, the quality and thus marketability can be improved. Ethiopia is the 5th biggest wax exporter to the world market.

Beeswax is a valuable hive product obtained from honeybees as a by-product of honey production. Beeswax is largely collected from traditional hives. It is estimated that the annual production of wax stands at 3200 tones, without taking into account the beeswax wasted or lost in the rural areas. Wax yield from traditional hives is 8-10% of the honey yield, compared to 0.5-2 % from modern hives. The bulk of the supply of beeswax is obtained as residual from "Tej" brewing. According to ITC, report, export of beeswax have had difficult times in the last 5 years, showing an average growth rate of 1 % and even negative in period of 1999-2002. However, exports of beeswax from Ethiopia have increased spectacularly and reached 402 tons of beeswax (1.2% share in world market), destined to different countries (ITC, 2003, CBI, Nov, 2004).

Edible wild plants: The vegetation of Ethiopia including those in the ASALs, are some of the major sources of rich wild-edible plants species. Edible plant species in Ethiopia are estimated to be between 480 and 560 plants. About 25% of these are cultivated as food crops, and the remaining (75%) could be categorized as wild, semi-wild, or naturalized (Asfaw and Tadesse, 2001). Earlier work by Asfaw and Tadesse (2001) described about 203 of these plants, while a recent work by Teketay et al. (2010) described about 378 of them. The records also showed about 287 edible wild species are found in the drylands (Wondimu, 2007). Some of these edible-wild plant species collated from different sources are presented in Table 8. Wild edible plants are found in all geographical areas and ecological sites such as forests, grasslands, wastelands and cultivated landscapes. Lowland woodlands and the forest ecosystems are their concentration habitats.

The use of wild-edible plants as sources of food for humans is common throughout rural Ethiopia despite the cultural taboos in some places. The use is more common and widespread in food insecure areas such as ASALs. Recent studies in various ASALs of the country reported

the contribution of wild-edible plants to the food security of inhabitants. For example, a study in the districts of Derashe and Kucha in the Southern Region of Ethiopia documented 66 wild edible plant species classified among 54 genera and 34 families (Balemie and Kebebew, 2006). Of the 66 wild edible plant species recorded in the two districts, 78.8% were utilized both in normal and food shortage times according to the study. Similarly in Northern Afar, *Balanites rotundifolia* and *Debra glabra* species are highly valued during famine and drought. The former is nearly naturalized as parkland trees or homestead trees in some areas of the region. Its fruits and kernels, which are rich in oil are consumed as supplement to normal diets. Fruits are cooked and the oily water obtained are consumed as soup. The kernels are boiled and used also as food. About 25 kg of the fruit harvestable from an average tree is indicated to sustain a family for a month. Another widely used plant species in ASALs of Ethiopia is *Balanites aegyptiaca*, a small evergreen tree. Its fruits are eaten any time when ripe by children and in food shortage periods also by adults. The new shoots, which grow during the dry season, are commonly used as animal forage. But in periods of food shortage people cut the newly growing succulent shoots and leaves and cook them like cabbage (vegetables).

Medicinal Plants: The Ethiopian flora is believed to contain more than 887 identified medicinal plants of which some are endemic (NBSAP, 2005). Eighty seven per cent of the medicinal plants utilized in Ethiopia are harvested from the wild and only 13% are cultivated (Mender *et al.*, 2006). Over 70 % of the medicinal plant collections involve destructive harvesting because of the use of parts like roots, barks, leaves and the whole plant in case of herbs (NBSAP, 2005). Macro analyses of the distribution of medicinal plants show that they are distributed across diverse ecosystems. The woodlands of ASALs, the montane grasslands including the dry evergreen montane forest and evergreen scrubland areas are reported to contain more medicinal plants with higher diversity (Table 5).

Table 5. Distribution of the Medicinal Plants in different Ecosystems of Ethiopia

| Ecosystem | Number of Species | % |
|--|-------------------|------|
| <i>Acacia-Commiphora</i> woodland | 109 | 12 |
| Montane grassland | 93 | 10.5 |
| Dry evergreen montane forest and evergreen scrubland | 83 | 9.3 |
| <i>Combretum-Terminalia</i> woodland | 69 | 7.8 |
| Moist Montane Forest | 48 | 5.4 |
| Desert and semi-desert scrubland | 45 | 5.1 |
| Afroalpine and sub-afroalpine | 44 | 5.0 |
| Lowland forest | 33 | 3.7 |
| Aquatic | 30 | 3.4 |
| Wetland | 23 | 2.6 |
| Undetermined | 300 | 33.8 |

(Source: NBSAP, 2005)

As indicated in the table above, woodlands particularly the *Acacia-Commiphora*, the *Combretum-Terminalia* and desert and semi-desert scrubs, which are typical of ASALs are richly endowed with medical plants. Well known products such as gum arabic, frankincense and myrrh have

both traditional and modern medicinal applications. Pharmaceutically gum arabic is used as a stabilizer for emulsions, as a binder and coating for tablets, and as an ingredient in cough drops and syrups (FAO, 1995). In modern applications, it is commonly employed as a demulcent in preparations designed to treat diarrhoea, dysentery, coughs, throat irritation, and fevers. It serves as an emulsifying agent and gives viscosity to powdered drug materials; is used as a binding agent in making pills and tablets particularly cough drops and lozenges. In recent years it is prepared as a medicine to treat kidney problems. Powdered, reddish–brown gum exudate mixed with fat or grease is used to anoint the body. The fresh gum exudate is being used as a depilatory. A solution of gum, drunk on an empty stomach, is used to relieve chest pains. The eating of gum is reputed to strengthen the stomach muscles. However, excessive eating of gum can cause flatulence and some discomfort. Gum is highly nutritious, 175 g being sufficient to support an adult for 24 hours (FAO, 1995).

Similarly, Olibanum, myrrh and Opoponax are widely employed in traditional and modern industrial applications principally in perfumery, food industries and pharmaceutical fields. Both myrrh and frankincense are highly valued for their aromatic fragrances and are common ingredients in incense, perfume and potpourris, soaps, detergents, creams and lotions, and are often included in meditation blends, as it strengthens the psyche and aids in deepening the meditative state (FAO, 1995). Frankincense is a favored ingredient in potpourris, as it is known to hold its fragrance for a very long time, some even say indefinitely (Tucker, 1986). Besides adding a special fragrance to any blend, it is also noted to have some value as a fixative in perfumes and potpourris. It is employed by perfumers as an absolute (by alcohol extraction), oil, or resinoid (by hydrocarbon extraction) and is used in the oriental bases, ambers, powder perfumes, floral perfumes, citrus colognes, spice blends, violet perfumes, male fragrances, soaps, lotions, creams, and others (Leung, 1980; Tucker, 1986; FAO, 1995). It is also used in the formulation of many modern perfumes including Replique by Colonia, Me! by Frances Denney, Mennen Millionaire by Mennen, Nino Cerruti Pour Homme by Uniperf, Onna by Gary Farn, Sculptura by Jovan, and others (Tucker, 1986).

Interesting phytomedicine development research activities are currently on-going at the Ethiopian Health and Nutritional Research Institute (EHNRI) where phytochemical and pre-clinical researches are conducted by isolating active component of herbal remedies. Some of the efforts include development of phyto-medicine for human tapeworm, animal tapeworm, skin disorders, hypertension, Bronchodilator and mastitis treatments all based on traditional claims.

Essential oils: There are a number of potential indigenous essential oil bearing plants in the ASALs that can be economically and sustainably harvested in the wild. Many of the species are used as spices and flavoring in foods and drinks throughout Ethiopia. Some of the resin producing species are also renowned for their essential oil production. This essential oil production can be considered as value added processing as it provides an ideal method of utilizing particularly the lower grades resins and those that are underutilized due to color restriction or lack of granulation. The essential oil production potentially enhances returns and is better value than selling the raw product, particularly in the international market.

There are good prospects for the wild harvesting of indigenous essential oil plants such as the Basil (*Ocimum spp.*), *Lippia spp.*, and many others found all over the ASALs. The indigenous

essential oils have potential national and regional buyers for the manufacture of healthcare or bodycare products. Internationally recognized, national and regional certification of the production and processing facilities will be necessary for competing in international markets. Essential oil business are already emerging in Ethiopia, but mostly for humid land species and some cultivated plants.

Aloes and related products: A number of wild aloe species are found growing over vast areas in the ASALs. Demissew and Nordal (2010) indicate that there are 46 species of Aloe in Ethiopia and Eritrea of which 35 are endemic. Demissew and Dioli, (2000) claimed that the ASALs of Ethiopia are floristically the most underexplored areas, with a high potential for the discovery of more species, particularly succulent ones including Aloes. However, there is very little awareness of the commercialization of these ample resources in Ethiopia. A small pilot project initiated by SOS Sahel demonstrated the opportunity for production of several commercial goods such as soap, detergents and bodycare in Borana, South Ethiopia. The project was about “value chain empowerment through women-led initiatives in pastoral communities of Borana” that has been designed to assist the development of community owned bio-enterprise in gums and resins, which includes improving the collection, storage, processing and marketing aspects, and also bio-enterprise development in sustainable wild harvest and domestication of indigenous aloe species. Except for this pilot project, currently, there is no aloe commercialization and product development in the country, and not much is known of the handling and processing of aloes products in the country. To promote commercial utilization of this natural resource, identification and mapping of the species with commercial potential should be the first step. The second step would be to conduct product development study, which would clarify the feasible exploitation and marketing of the resource with special emphasis on the knowledge, technology adoption, financial capability and availability of infrastructure of the area. Value addition and exporting new product may be too complex for pastoralist and pastoralist business institutions while private traders also may not interested to take risk at the start.

C. Production, processing and marketing of NWFPs

Gums and Resins: Production and collection of gum and incense varies depending on the product type and location. Both gum arabic and frankincense from the north are produced by tapping stems and branches (Plate 4). While in the south (frankincense, gum arabic and myrrh) collection is carried out on naturally oozed tears, and there is no tapping involved. Production in the north is very organized and involves hired labour which works about 8 to 10 months (the entire dry season) in rounds of wounding, picking and refreshing wounds. While collection in the south is often carried out by herders and children mostly on casual basis but occasionally systematically. In the north concessionaries or farmers cooperatives produce while in the south mostly individual production is common. Cooperative model of production is also emerging in the south recently (Table 6).

Common to both is that production is made during dry seasons. But due to monomodal rainfall pattern the production in the North extends over the whole dry period from October through June. In the south, the bimodal rainfall breaks the production season into two: mid-December-Mid-March and Mid June – Mid September. Good collections from *A. senegal* are realized in the dry season of December –March, while June – September is the best season for *A. seyal*. For the southern production no special equipment is used rather gums are removed from the tree

by hand, and if hard, an axe or machete is used. Occasionally, the commodity is collected from the ground below the tree where it has dropped and solidified. Consequently, some commodity has a high content of soil or sand. There are also no special or dedicated containers used for collection in the field though some experienced collectors use sacks for gum arabic and plastic containers for frankincense and myrrh. On the contrary, well organized collection and production equipment is used in the north.

Postharvest handling also varies with the product type and region. For gum arabic and *Commiphora* gum resins there is little postharvest processing so far. Tigray type frankincense, however, involves cleaning, sorting and grading. Grading are done by sorting tears into seven classes based on colour and tear sizes (table 7). This work is usually done by women temporarily employed by traders. The processing equipment comprises of mainly different sized mesh trays, with wooden frames and metal gauges the processing was mainly undertaken by women at the National Gum Producing and Marketing Enterprise (NGPME).



Plate 4. Production of frankincense from *B. papyrifera* (left stem tapping using local tool called Mingaf, and right is incense tear that ooze following tapping).

Table 6. Regional comparison of prevailing organisation of gum/resin production system in the north and south of Ethiopia

| No. | Production model and their characteristics | Case study site | |
|-----|---|---|----------------------|
| | | North | South |
| 1. | Gum resin production by individuals (farmer/pastoralist) on casual/part-time base | Not present | Prevalent |
| 2. | Gum resin production by individuals (farmer/pastoralist) on full time base | Prevalent in some and Not present in others | Becoming more common |
| 3. | Gum-resin production by cooperatives from communal woodlands (unrestricted access of members) | Not present at some places and Emerging in others | Prevalent |
| 4. | Gum-resin production by cooperatives (restricted access of members) | Established in some places and not present at some places | Not present |
| 5. | Gum resin production by individual farmers from on-farmland/homestead trees | Common at some places and not present at others | Not present |
| 6. | Gum resin production by concessionaires with local labour force | Common and emerging | Not present |
| 7. | Gum resin production by concessionaires with external labour force | Not present at some and prevalent at other places | Not present |

Table 7. Grades and their descriptions of gum olibanum from *B. papyrifera*

| Grade | Description | Compositional ratio per 100 kg of collection (%) |
|-----------------|---|--|
| 1 st | Size 6 mm and above white colour | 22% |
| 1 ^B | Size 6 mm and above creamy white colour | 9% |
| 2 nd | Size between 4 and 6 mm | 11% |
| 3 rd | Size between 2 and 4 mm | 8% |
| 4 th | Special brown in colour any size | 19% |
| 4 th | Normal black in colour any size | 17% |
| 5 th | Powder and bark no size limit | 14% |

D. Associations along the production and marketing chains

Gum and resin: Several actors are recognized in the gum and incense sub-sector: these are NGOs (local and international) principally, SOS Sahel; GTZ; FARM Africa; AFD; SNV; PCDP; Government and Bi-lateral donors (Federal/regional governments, Ministry of trade, export promotion agency, Ministry of Agriculture, EU, SIDA); Multi-lateral funding agencies/resource mobilization agencies (e.g. GEF); Private companies (see ANNEX 4); and producers (farmers and pastoralists); research and higher educational institutes (principally Forestry Research Centre and Wondo Genet College of Forestry, Mekelle University and Addis Ababa University). Summary of major actors and holders of information including the type of information they hold for most of the

NWFPs of the ASALs including Gum and Resin is presented annex 1.

The market chain for gum and incense involves the flow from producers/collectors to consumers, domestic or export through intermediary enterprises, whole sellers and retailers indicated in the table above. Current marketing chains for the major gum-resin products follows different chains due to different nature of production and marketing. The following are some of the common chains:

- Exporters directly producing and selling to consumers (mono actor) (inland and export);
- Cooperatives producing - selling to gum companies (exporters) - to consumers;
- Individual collectors -cooperatives - gum companies - finally to consumers,
- Pastoralist collectors - rural retailers - whole sellers - exporters - consumers.
- Pastoralist collectors - cooperatives - whole sellers - retailers - consumers

The product market flow (market chain) show considerable variability based on the gum and incense type as well as place of origin. Figure 2 and Table 8 presents chain map and actors for products from Borana area.

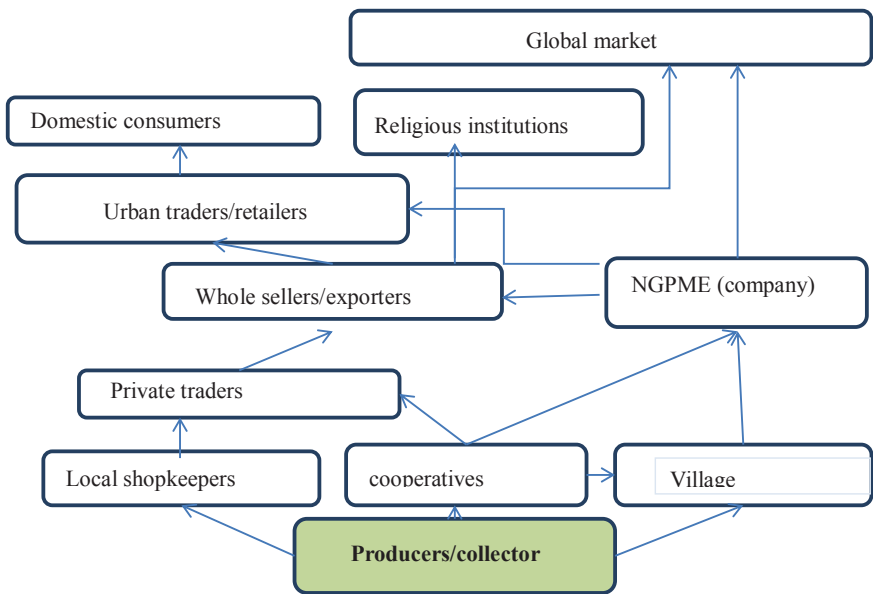


Fig. 2. Value chain map for gum and incense products from southern ASALs of Ethiopia.

Honey and beeswax: Given its established local trade, cultural appeal and livelihood roles, there are numerous actors in the apiculture sub-sector in Ethiopia. These are:

Farmers and their producer associations: nearly millions of farm households throughout rural Ethiopia,

- Retailers: hundreds of thousands of retailers and collectors;
- Private honey processing companies. There are sixteen companies registered as exporters of beeswax in the country. Some of these are: BWAP Export PLC; Tutu and her Family Commercial PLC; APINEC Agriculture Enterprise PLC; HARMONY Agricultural Enterprise PLC; Beza Mar Agro Industry PLC; Century General Trading Pvt. Ltd. Co; Keffa Zone Honey Cooperative Union; East Shoa Beekeepers Association. Four of these are

outstanding in performance: Ghion Industrial and Commercial PLC is the largest followed by Baobed PLC and BWAP Export PLC;

- Ethiopian Honey and Beeswax Producers and Exporters Association” (EHBPEA);
- Line ministries mainly Ministry of Agriculture, Ministry of Trade
- NGOs (e.g. SVA, SOS Sahal, FARMAfrica, JICA, and many more)
- International importer (e.g. Tropical Forest Product Ltd; Walter Lang Honig Import GmbH)
- Bi- and multi-lateral organizations such as EU, GTZ,

Table 8. Major actors in the production and marketing of gum and incense and their functions in the southern Ethiopia

| Actors | | Function | Remark |
|----------------------|---|---|---|
| Category Producers | Specific names | | |
| | Tappers | These are hired labourers that wound the tree, collect tears, season it and pack in the field | This is in the case of the Tigray type frankincense |
| | Farmers | Farmers that wound, collect tears, and pack it for sale to cooperatives from either own parkland trees or from woodland allotted by cooperatives | This is also for Tigray type incense |
| | Pastoralists | Collect gum and incense on natural oozes; temporarily store, and sell to retailers in village towns , cooperatives and/or wholesalers | Typical in the south |
| | Cooperatives | Either produce or hire producers, and sell the harvest to whole sellers; | |
| Intermediary Traders | Shopkeepers in villages | Buy from collectors in cash and mostly in kind; Store; Delivery to wholesalers mostly at their warehouses | Typical of southern production |
| | Cooperatives Intermediary | | |
| Wholesalers | NGPME and several other private gum and incense companies | Organize the production themselves or buy either from cooperatives , retailers and some time from collectors, and transport to their respective warehouses; sorting and grading, packing, pay royalty payment to government, transport to central market Addis and Nazareth), sell to exporters and wholesalers, or export themselves directly. | Specific role depends on the type of gum and incense produced |
| Retailors | Small shops and open marketers | Buy some of the lower grades from the wholesalers and sell it on local market for consumers | |

The honey and beeswax market is less formalized and the trade are complex. Farmers sell their products to anybody and prices are usually fixed by bargaining. Depending on the location of the honey production, the following possible channels and chains can be recognized in Ethiopia:

- Farmers to consumers
- Farmers to honey collectors then to retailer: consumer
- Farmers to honey collectors to processors then to consumers
- Farmers to retailers to consumers
- Farmer to honey collectors to consumers
- Farmer to processor to consumers

In fact, honey and beeswax marketing channel vary considerably across sites and depending on proximity to market. Although it is not possible to map complete picture of the market chain all over the ASALs of the country, the figure below (Fig. 8) can give an example of what the chain looks like and who are the main actors. Until recently, individual farmers are the main supply, and the main receivers from the farmers are consumers, and local honey collectors. This indicates that the trades is not modernized and farmers are not organized. However the support from several development actors (NGOs) and the emerging private sector involvement as discussed above is in the process of changing the trade of the sector.

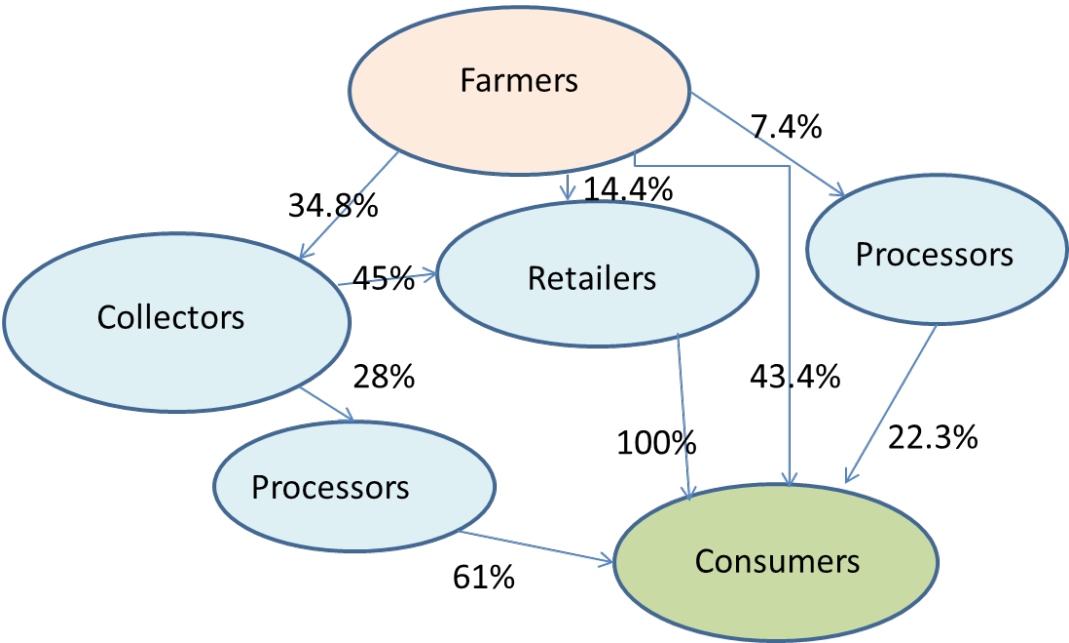


Fig. 3. Honey marketing channel in one of the honey producing district in Tigray as an example of mapping market channel for the sector in Ethiopia (Source: Abebe, 2009).

Medicinal plants: There is very limited knowledge available on the value addition for indigenous medicinal plants in Ethiopia. Except for the recent attempt for pharmaceutical development at EHNRI under the Conservation and Sustainable Use of Medicinal Plants Project (CSMPP) hosted at IBC, there is hardly significant work done so far. Value addition is essential for the economic success of medicinal plants related enterprise and also to enhance the medicinal value of the raw

drugs obtained from wild plants. Suggestions for value addition of medicinal plants:

- ♦ Semi-processing of the materials to a value added product through the adoption of different techniques.
- ♦ Guidelines for harvesting; storage, drying and grading and civil structures, required for value addition, and
- ♦ An improved organizational/institutional arrangement for handling the marketing of medicinal plants.

The market chain for medicinal plants is undeveloped and often the traditional healers are the collectors and deliverers of the services/products directly to the users. Indeed, there is no observable chain events in the marketing of medicinal plants.

E. Economic contribution of NWFPs

Gum and resin: One of the benefits rendered by gums and resins is foreign currency earning through export. The data in Table 9 below show that Ethiopia produced 63,656 tons and exported 32,535 tons of natural gums and resins during the period between 1993 and 2008. The export worth 40,857,968 USD (Lemenih and Kassa, 2010). Domestic sales during the same period are estimated at 750 tons per annum. The export volume is also increasing on average by 12% a year over the past 10 years. There are over 40 import destinations (countries) for gum and resin products from Ethiopia. The bulk of the products are destined among others to China (29%), Germany (13%), Persian Gulf (9.5%), Tunisia (8.6%) and United Arab Emirates (7.3%) (Lemenih and Kassa, 2010). Export volume and the value of foreign currency that the country is earning from gums and gum resins have been increasing since the last decade. This is probably due to the increasing participation of private enterprises in the production, processing and exporting of natural gums taking the advantage of policy reforms and export promotion support of the government of Ethiopia in recent years.

Economic contribution to households from gum and incense sub-sector is increasing (Lemenih et al., 2003; Work, 2006; Teshale, 2010). Collection, sale and employment through tapping generates income for thousands of households in the forest, scrubland, arid and semi-arid areas of Ethiopia. Women in particular have been benefiting from the processing and retailing of gums and resins. In particular, the production and processing of Tigray type frankincense is a labour extensive process generating high employment. Along the production and marketing chains, the gum and incense business is estimated to generate about 25,000-35,000 jobs annually at the national level. Of interest concerning the gum-resin sub-sector is the fact that it is a undertaken during dry season when few other options of employment or engagement are available. In some cases, gum and resins provide the only source of household income, while in others it stands as a safety-net (Lemenih et al., 2003; Worku, 2006). A study made in Liban, south-eastern lowland showed that the annual income from collection and sale of oleo-gum resin is on average USD 80.00, the second most important means of household livelihoods (Lemenih et al., 2003). Another study indicated that about 1,300 individuals are hired annually as daily labourers in North Gonder Zone of the Amhara Regional State (Eshete, 2002). Given the large potential, the role of the sub-sector can be enhanced through appropriate policy, resource management and utilization interventions (Tadesse et al., 2002; Lemenih et al., 2003; Eshete et al., 2005). There is already a growing interest and participation in the development of the sector from various actors such as the private sector, GO and NGOs.

Table 9. Natural gums (gum olibanum, gum arabic, myrrh/opoponax) export by different enterprises from Ethiopia during the past 15 years.

| Year | Total production (tons) | Export quantity (tons) | Value of export sale (\$ US) |
|----------------|-------------------------|------------------------|------------------------------|
| 1993 | 2671 | 354 | 313800 |
| 1994 | 3421 | 755 | 741800 |
| 1995 | 5303 | 987 | 767200 |
| 1996 | 4557 | 389 | 373800 |
| 1997 | 2522 | 710 | 566000 |
| 1998 | 3606 | 1925 | 2411263 |
| 1999 | 4934 | 1663 | 1990947 |
| 2000 | 4608 | 1648 | 2264737 |
| 2001 | 4532 | 2183 | 2764737 |
| 2002 | 4427 | 2138 | 2712526 |
| 2003 | 4778 | 1544 | 2014737 |
| 2004 | 7479 | 3109 | 4001053 |
| 2005 | 4906 | 3791 | 4529474 |
| 2006 | 2894 | 3529 | 4911368 |
| 2007 | 1474 | 3976 | 5293158 |
| 2008 | 1544 | 3834 | 5201368 |
| Average | 3978.5 | 2033.4375 | 4107585.5 |

Edible wild plants: The importance of edible wild plants is more of subsistence than commercial or cash generation. Edible wild plants offer vital insurance against malnutrition or famine during times of seasonal food shortage or emergencies such as droughts, floods or wars. It is common in Ethiopia for rural households to depend on wild foods between harvests, when harvested stocks have been depleted and the new crops are yet to mature. Women, in particular count on these resources for supplementary nutrition and as emergency foods to secure the well-being of their families. Whereas the rich indigenous knowledge on the medicinal use of wild plants from the ASALs of Ethiopia is relatively well documented, particularly concerning the socio-economic, cultural values, traditional and nutritional aspects of wild-food plants have received little or no attention. Wild fruits contain vital nutrients (carbohydrates, protein, and minerals) and essential vitamins which are important, especially for growing children, who are prone to malnutrition and related diseases. Reliance on wild edible plant is very high in ASALs due to the widespread food insecurity. Increased consumption of wild-edibles enables people to cope better with erratic, untimely rains and drought for several consecutive years without facing severe food shortages, famine and general asset depletion (Mathys, 2000). Indeed, wild-food plants are praised for their role to fill a variety of food gaps. Their availability during different times of the years qualifies them for such a role.

Particularly southern Ethiopia, who are culturally distinct from the more conservative north, the consumption of wild-food plants seems to be one of the important local survival strategies and appears to have intensified due to the repeated climatic shocks hampering agricultural production and leading to food shortages (Guinand and Lemessa 2001). But in most cases the biomass production from the wild-food plants is not bulky enough to cover the required needs. This is where intervention is required to enhance productivity and improve availability. Wild-food plants are mostly used for home consumption and if traded on the market, they also provide the opportunity to supplement household income (Addis et al. 2005). For instance, *Moringa stenopetala* and *Solanum macrocarpon*, *Balanites aegyptiaca*, *Opuntia ficus-indica*, *Leptadenia hastata*, *Ximenia americana* and *Sclerocarya birrea* are regularly and/or occasionally marketed in southern Ethiopia (Balemie and Kebebew, 2006).

Similarly, in Western Ethiopia (Jimma and Illubabor) as well as in remote areas in the Tekeze River lowlands and in the Semien Mountains area of North Gonder and Wag Hamra, a considerable variety of wild-food plants are offered on local markets (Addis et al., 2005). These marketed wild-food plants include a couple of teff-like grassy plants and seeds. An example of a traded and exchanged wild-food plant is *Opuntia (ficus indica)*, a cactus plant. Its fruits are traded for cash on markets in Tigray Region during the rainy season. Also, the fruits of *Borassus aethiopum*, the African Fan Palm, are marketed in Afar Region (Lemessa, 1999; MacLachlan, 1999). The leaves, stalks and seeds of *Brassica carinata* are traded on remote markets such as in Jana Mora Woreda in North Gonder (Addis et al., 2005). Fruits of *Cordia africana* and *Ziziphus spina-christi* are also traded, particularly throughout Wollo and in Gonder.

Medicinal plants: These category of NWFPs has both subsistence (use at household) as well as cash income generation roles. Studies show that about 80% of the Ethiopian people and 90% of domestic animals depend on traditional medicine for their health care practices, and 95% of traditional medical preparations in Ethiopia are from plant origin (Who, 1998; Mander et al., (2006). The dependence of medicinal plant is high in the ASALs where health service facilities are very poorly provided, if at all (Lemenih et al., 2003). At national level, a study by Mender et al., (2006), revealed that the medicinal plants industry plays an important role in Ethiopian healthcare system and in terms of government expenditure, it plays a major cost saving role. The study revealed that the traditional medicine trade value in the year 2005 was estimated as ETB 2 billion (some 8% of the total budget), whereas the total federal government budget expenditure in the same year was estimated at ETB 24.7 billion. Furthermore, the trade in raw medicinal plants in the same year is some ETB 423 million (42% of current expenditure on modern medicines) while the government expenditure on medicines is estimated to be just over ETB 1 billion per annum. In addition to the health care advantage which the country benefits, the study showed that the economy as a whole also benefits substantially. It is estimated that the trade contributes an additional ETB 2 billion to the GDP via the informal trade and the industry provides some 346000 income earning opportunities associated with the trade. Both the government and the people of Ethiopia have benefited from having cheap and easy access to medicinal plants. The study further revealed that the consumption of medicinal plants is based on largely wild plant stocks. For example, some 48 million consumers use some 56,000 tons of medicinal plants per annum. Of this, 49, 000 tons (87%) are harvested from wild stocks, with only 7 000 tons (13%) being cultivated. Most of the medicinal plants collected seem to be for home consumption and

domestic use (Desissa, 2001). Local studies on the economic role of medicinal plants in Ethiopia in general and in ASALs in particular are yet to be undertaken. In fact, there is an increase in demand and supply of medicinal plants in local markets and recently established herbal clinics in Addis Ababa and few other regions *Hagenia abyssinica*, *Embelia schimperi*, *Ximenia americana*, *Jatropha curcas*, *Glinus lotoides* and *Tamarindus indica* are among the most commonly sold medicinal plants by vendors in the country.

F. Commercialization of NWFPs

Given the natural potential and global demands, the NWFPs of the ASALs of Ethiopia offer high commercial potential and viable investment. Unfortunately, commercial extraction so far is restricted and far below the potential available. Few NWFPs of the ASALs of Ethiopia are being promoted for commercial scale production and trade. Prominent of these are the gum-incense and honey and beeswax. List of important companies engaged in commercialization of the gum-incense and other commercial NWFPs are presented in tables 10 and 11. In fact, use of modern bee hives to boost honey production is emerging but expansion very slow. Processing, grading and packing the products are done mostly manually and thus labour intensive and a potential source of rural job creation. There is little industrial technology involved, except for the extraction of essential oils, in the processing of the NWFPs. On the other hand the dependence on wild and natural product is an advantage by itself since it makes the products not only organic but also natural. Product certification in the country is generally not developed. However, organic certification has recently been started on some products like wild and organic coffee. It is important to study the international market potential for certified natural gums and resins.

Table 10. List of some large private gum and incense companies in Ethiopia.

| No | Enterprise name | Telephone | Fax | P.O. box | Address |
|----|--|------------------------|---------------------|----------|-------------|
| 1 | Abbebaye C.C. PLC | 251 11 5530775 | 25111 513965/ 73 | 5304 | Addis Ababa |
| 2 | Genale Migs Trading P.L.C. | 251 11 1560352 | 251 11 513965 | 2259 | Nazareth |
| 3 | Darulea Nesredin | 251 11 2752572 | 251 11 756261 | 12672 | Addis Ababa |
| 4 | Guna Trading Houses P.L.C. | 251 11 4652288 | 251 11 654633 | 80316 | Addis Ababa |
| 5 | Ambassel Trading house | 25111 5533502/ 5525695 | 25111 533502/525695 | 12617 | Addis Ababa |
| 6 | NGPME | 251527081-83 | 65111 51811 | 62322 | Addis Ababa |
| 7 | BWAP Export P.L.C. | - | - | 5304 | Addis Ababa |
| 8 | Yahiya Seid Omer | 251 11 2751296 | 25111 75 12 96 | 4202 | Addis Ababa |
| 9 | Aguguba Natural Gum Exporters | - | - | 8722 | Addis Ababa |
| 10 | Kesete Tesfaye General Export and Import | 251911210114 | - | 26648 | Addis Ababa |

Increases in global demand for natural products of the types indicated in this report means there is high commercialization potential provided that support to promote trade, quality production and resource development are properly provided. There are signs of increasing commercialization over the last two decades following trade liberalization and involvement of private sector. Most of the NWFPs such as gum-incense, honey and wax, herbal medicines and essential oils sub-sector have strong tradition and a large potential in the country. The challenges to commercialization are, however, several. These include: poor infrastructure, lack of marketing information, poor capacity in business plan development, low level of investment in training collectors and exporters, limited credit and finance resources to run successful NWFPs based enterprises, lack of capacity and technology in adding value to the products to compete with other products, poor quality control due to limited physical facilities. Low business management skills, institutional supports for collaboration among producers to form national and local associations, low quality branding and packaging, poor access to financial services.

Table 11. Some examples of Bio-enterprises in NWFPs of ASALs of Ethiopia (In fact these are not restricted to products of SALs origin only)

| No. | Enterprise name | Product speciality | Status |
|-----|---------------------------------|--|---|
| 1 | Beza Mar | Honey | Part of the supply is now certified organic. The company is expanding its processing centre and areas of collection across Ethiopia, focusing on organic and fairtrade supply, and working in hand with relevant private and development sector partners. |
| 2 | Ariti Herbal Company | Range of herbal medicines and essential oils | The company formulates and retails a range of herbal medicines, massage oils, herbal extracts and cosmetics. |
| 3 | Agri-CEFT Plc | Herbal medicine | Produces herbal medicines, such as “Endod” (<i>Phytolacca dodecandra</i>), claimed to be effective against Bilharzia and Mosquito. Research trials are conducted with the European pharmaceutical company |
| 4 | Teppo Agriculture and Trade Plc | Herbal medicine | Recently started to produce, process and promote the moringa tree for medicinal use in the Ethiopia nutraceutical market. |
| 5 | TERRA Plc | Essential oil | It produces medical plants and essential oils – Rosa Damascus. |
| 6 | Aromabyssinia Plc | Essential oil | extracts and exports essential oils to the international markets |

G. Policy aspects related to NWFPs in Ethiopia

1) Forest sector policy related to management and conservation

The forest sector in Ethiopia has shown improvement with respect to policies and legislations over the years. For a long time policies related to forest resources management in Ethiopia were vague, and could only be inferred from various related legal instruments such as institutional mandates or other bodies of legislation. Since 1994 a new forest law was installed with the Proclamation

No. 94/1994, and a further forest policy was issued in 2007 with the accompanying proclamation number 542/2007, which was the first, ever, refined forestry policy in Ethiopia. In fact, there are a number of other policy instruments that apparently support forest development and conservation in Ethiopia. Among these policy instruments the Conservation Strategy of Ethiopia (CSE, 1997), the Environmental Policy of Ethiopia (1997), and the Rural Land Administration and Land Use Plan, Policy and Strategy (2004) clearly stand out. All of these policies and strategies support not only the conservation and management of the existing forests but also restoration of degraded forests and development of new forests through active participation of communities and private sector. Unfortunately, most of these policies and strategies have remained statements of intents, suffering poor implementation (Bekele, 2008). There is no clarity on who is, organizationally responsible for operationalization of most of these policies and who is responsible for implementing various aspects of the policy.

However, serious weakness remained in the institutional and organizational aspects of the forest sector. Organizationally the sector has been the most unstable with low to very low budgetary and poor logistical support (Bekele, 2008; Mengesha, 2008; Yemishaw *et al.*, 2008). The existing policies have remained on paper in the absence of strong and enabled implementing bodies or organizations. Those organizations supposed to do so (such as the Ministry of Agriculture -MoA) are not only unstable but also overburdened by a number of competing institutional mandates. Furthermore, within the MoA, the forestry section is always the most understaffed with marginal budget and logistic allocations (Yemishaw, 2002; Mengesah, 2008).

The decentralization of forestry administration and management to region level has further complicated the institutional setup in the sector with different regions pursuing different strategies. An issue that is compounded by the differences in human resource capacities between regions. The two factors have resulted in significant regional differentiation in on-the-ground actions and achievements. The weakness in institutional arrangement is clearly reflected in the continued loss of forests/vegetation ecosystems to croplands and other land uses as evidenced by several local-scale studies. Particularly, in most regional states with large remnant forest areas, forests and woodlands are subject to continuous degradation as a result of weak or absence of forestry supporting institutions.

2) Policy specifically related to pastoral areas or drylands (ASALs)

In Ethiopia awareness of the importance of pastoralism and pastoral areas have gradually increased. The major policy steps implemented recently is the securing of the constitutional right of pastoralists not to be displaced from their own land and devolution of power to regions and districts. In addition there has been formation of pastoral institutions, including a Pastoral Affairs Standing Committee in the Parliament, and a Pastoralist Area Development Department (PADD) and Inter-Ministerial Board under the Ministry of Federal Affairs.

The Pastoral Areas Extension Team and Pastoral Development Coordination Team, within Ministry of Agriculture and Rural Development, are responsible for providing institutional support for the pastoral regions as well. In addition, the pastoral regional states have redesigned many of their institutions to incorporate pastoralism in their planning process.

The main elements of the pastoralist program in Ethiopia includes improving Pastoral Livelihoods and Asset Bases through improving Livestock Marketing, Veterinary, and Livestock Feed; Water Development and Environment Protection and Management: reversing natural resource degradation and improving NRM. The strategies to deal with these issues are discussed in more detail in the strategy documents of the various sectors, but include, among others:-

- a) Developing participatory drought management mechanisms: including community-based drought early warning systems, and mitigation measures;
- b) Encouraging livelihoods/asset diversification (fishery, agro-pastoralism, herd, diversification, mining, among others.);
- c) Encouraging preservation of hay, and dry season range reserves, and focusing on timely restocking and de-stocking activities;
- d) Controlling drought-induced and flood related livestock diseases;
- e) Facilitating local and cross-border livestock trading, with better market information, credit provision, and certification for quarantine; restoring the stocker/feeder program through private or livestock cooperatives; and promotion of 'commercialization' of livestock production objectives;
- f) Strengthened veterinary services, in both the public and private sectors, to enhance the possibility of controlling livestock diseases; and training of community-based animal health workers from the pastoralists;
- g) Expanding strategically-placed dry season water points, including traditional deep-wells, boreholes, and environmentally friendly water harvesting technologies;
- h) Strengthen participatory watershed development program and traditional and community-based water management schemes;
- i) Strongly controlling mechanism on factories/state farms polluting rivers, and encouraging traditional environmental protection and natural resource management mechanisms;
- j) Construction of new/rehabilitation of health posts/health centers strategically situated, and improving their efficiency through staffing with incentives, supplies of drug and equipment;
- k) Strengthening of extension networks and outreach services in pastoral and agro-pastoral areas; and,
- l) Strengthened internal and external market support for various rangeland products, e.g. livestock, meat, milk, salt, honey, resin, wood, among others. and improve the business environment of pastoral economic activities.

These strategies do not make mention of vegetation assets utilization to improve pastoral livelihoods. However, the sustainable exploitation of the vegetation resources can fall in strategy of enhancing livelihood diversification (b). The mention of livelihood diversification together with

the forest policy can be considered as a favourable policy ground for intervening in the area of NWFPs.

3) Policy aspects related to investment and trade

To promote the export of agro based industry products the government has initiated different incentives for companies engaged in export activities. These companies are exempted from import duties on raw materials, equipment and machinery used to produce the export products. The introduction of withholding tax on payment caused delays in activities of many exporters, especially in the purchase of raw materials of domestic origin for products intended for export. The Export Development Bank (EDB) reported that they had developed a more efficient system of providing the loans. Formerly, the procedure to obtain the loan took as many as 90 days, but now it is no more than 30–35 days. The bank provides loans at a reduced interest rate (7.5 instead of normal 8.95 percent) to finance 100% export oriented projects. In addition, as an added incentive the government has allocated 1.5 billion Birr, equivalent to about 0.2 billion USD, for onward lending.

The Development Bank of Ethiopia also provides a three years' grace period for loan repayment while the repayment period is capped at 10 years including the grace period. (Source: Development Bank of Ethiopia, A Short Guide to D.B.E Loans for Export Oriented Projects). However, to be eligible exporters need to meet certain requirements of the bank including the provision of collateral. According to changes instituted recently the collateral should be equivalent to 30 per cent of the loan in cash or redeemable bond holdings.

The Ethiopian Investment Commission is the main contact point for foreign investors. It provides a highly expedited "one-stop shop" service that cuts the bureaucracy, time and cost of acquiring investment and business licenses. A foreign investor intending to buy an existing enterprise to operate or buy shares in an existing enterprise needs only to obtain prior approval from the Ethiopian Investment Commission. The minimum capital requirement of foreign investors amounts to USD 100,000 per project for wholly foreign owned investments and USD 60,000 for joint investments with domestic investors. A foreign investor reinvesting profits, or exporting at least 75 % of the output will not be required to meet minimum capital requirements.

Ethiopia's Investment Proclamation Law allows all foreign investors, whether or not they receive incentives, to freely remit profits and dividends, principal and interest on foreign loans, and fees related to technology transfer. Foreign investors may also remit proceeds from the sale or liquidation of assets, from the transfer of shares or of partial ownership of an enterprise, and funds required for debt service or other international payments. No assets of a domestic investor or a foreign investor, enterprise or expansion may be nationalized wholly or partly, except when required by public interest and in compliance with the laws and payment of adequate compensation. According to the Ethiopian constitution, land is a public property. There is no right to private ownership of land as all land is leased from the state for up to 99 years. Individuals, companies and organizations have only use rights to leased land.

All payments abroad require permits, and all transactions in foreign exchange must be carried out through authorized dealers supervised by the National Bank of Ethiopia (NBE). Importers

and exporters now obtain import/export permits through the commercial banks. In addition, exporters can indefinitely retain 10 percent of their foreign exchange proceeds and sell the remaining 90 percent to commercial banks within four weeks.

4) Regulations and Strategies on Traditional medicines and practices in Ethiopia

The Ethiopian Health and Nutrition Research Institute (EHNRI) under the Ministry of Health (MoH) developed regulation of traditional medicine that would help recognize the practitioners, regulate use of traditional medicine including its practices. The MoH organized a consultation workshop where adequate numbers of THPs were represented including other relevant stakeholders. The regulation has been finalized and in process for approval. The MoH is also in the process of formulating a unit of Traditional Medicine within the Health Service Department to implement the Regulation. Finalizing the regulation will allow formal registration of phytomedicine by the Drug Administration and Control Authority (DACA). This will facilitate commercialization of phytomedicines developed by the Project.

To meet the growing challenges in the area of traditional medicine, the EHNRI also formulated a 5-year (2004-2008) strategic plan. The strategic plan incorporates three strategic objectives that incorporates several components:

- Strategic objective 1. Regulatory frameworks for traditional medicines and practitioners,
- Strategic objective 2. Research on traditional medicines, and
- Strategic objective 3. Documentation of traditional medicines and therapies.

H. Research and Development

Numerous institutions and organizations are actively working on drylands in general and their NWFPs in particular in Ethiopia. NGOs, CGIAR organizations, national and regional research and higher learning institutions are actively working on research and development. The main research and development actors and their areas of focus are summarized in table 12 below.

Table 12. Organizations actively engaged in research and development of NWFPs, their major focus areas and persons responsible in Ethiopia

| Organizations/ Institutions | Their focus area in the context of NWFPs of ASALs | Major activities | Resposnible person |
|--------------------------------|--|--------------------------------|--|
| CIFOR – Ethiopia office | Livelihood and institutional dimension of dryland forests and their products | Research on policy of NWFPs | Dr. Habtemariam Kassa (H.kassa@cgiar.org) |

| | | | |
|--|--|--|--|
| Forestry Research Centre (EIAR) | NWFPs of highland and lowland areas of the country | Research on NWFPs emphasis on Gum-incense, Bamboo, | Dr. Wubalem Tadesse, wubalemtw@yahoo.com ; Abeje Eshete, Zewdu Yilma, among others. |
| Wondo Genet College of Forestry | Forestry | Research on Forest development and utilization | Dr. Melaku Bekele (Bekelemelaku@yahoo.com)/ Dr. Mulugeta Lemenih (Elerohi@yahoo.com) |
| Oromia Agricultural Research Institute (Yebello research center) | Dryland forest development, conservation and utilization | Research and extension on NWFPs | Haileyesus Agonafir (Yabello Research Centre) |
| Amhara Agricultural Research Institute | Dryland forest development, conservation and utilization | Research and extension on NWFPs | Dr. Teshome Tessema teshome_tesema@yahoo.com |
| Tigray Agricultural Research Institute | Dryland forest development, conservation and utilization | Research and extension on NWFPs | Mr. Negussie Agazi (Mekelle; TARI) |
| NGPME | Private sector – production and commercialization | Production and development | TEKLEHAIMANOT NIGAT; Girmay Fitwi Phone: 251-11-5527082 Fax: 251-11-5518110 natgum@ethionet.et ; fitwi_girmay@yahoo.com |
| Save the children USA | Promoting livelihoods for dry land community through NWFPs | Gums and incense | Mr. Biruk Assfaw BASFaw@savechildren.org |
| SoS Sahel | Promoting livelihoods for dry land community through NWFPs | Development of livelihood options | Mr. Feyera Abdi Tel: +251 11 416 03 91 Fax: +251 11 416 02 88 Email: sos.sahel@ethionet.et |
| GTZ | Promoting livelihoods for dry land community through NWFPs | Development of livelihood options | Mr. Sisay Nune |

| | | | |
|---|------------------------------------|---|--|
| Mekelle University | Boswellia papyrifera | Production and development | Dr. Kindeya Gebrehiwot |
| Addis Ababa University | Research | Research on Edible and essential oil plants | Dr. Zemedede Asfaw and his group; Dr. Feyera Senbeta (e-mail: Feyera_s@css.aau.edu.et) |
| Pastoralist Concern Association Ethiopia (PCAE) | Honey and other resources of ASALs | Development of livelihood options | Fax: (+251)-11-554-5823 Email: pcae@ethionet.et |
| CARE Ethiopia | Diverse NWFPs | Development of livelihood options | Abby Maxman, Country Director E-mail: amaxman@care.org Tell: +251(0)116 18 32 94 Fax: +251(0)116 18 32 95 E-mail: care.eth@ethionet.et |

In general, a large number of research and development works are on-going but exhaustive list of these all is beyond the scope of this review. Some of the prominent researchers on going are summarized below:-

- “Evaluation of the Quality of Gum Arabic from Tanzania and Ethiopia” funded by AFORNET. The project is working towards establishing quality characteristics for gum arabic from the southern parts of the country. The research has already evaluated and published quality of gum arabic from one of the potential gum arabic producing area in Ethiopia – central rift valley (Dagnew et al., 2008), and is working on the same for southern lowlands.
- FRAME “Frankincense, Myrrh and gum Arabic: Sustainable use of dry woodland resources in Ethiopia (FRAME)”, which is funded by WOTRO, of The Netherlands. The project’s duration is five years 01-12-2006/30-11-2010. It is a multidisciplinary project that is using several scientific disciplines ranging from landscape level geo-information studies to village-level socio-economic studies, plot level ecological and harvesting technology studies to tree-level eco physiological studies with a strong contribution of local knowledge will be used to answer the central research question. The research program, will determine the ecological and livelihood role of the gum/resin producing species, and the role that people have in either degrading or restoring these ecosystems. The results of the research program will stimulate: (1) sustainable management of tree resources, including a combination of conscious protection of natural woodlands and their controlled transformation (2) cultivation of these tree species on degraded lands, and thereby restoration of degraded sites; this improves the economic benefit from yield and commercialization of tree resources in the future; and (3) management strategies (including appropriate institutional arrangements) at the landscape level, tuned with local environment and socio-economic conditions.

- Community Based Woodland Management for Improved Livelihoods in Dry land Areas near Lake Langano. This is a development oriented participatory research forming part of a research program of Wondo Genet College of Forestry called DOIT-AR an acronym for Development Oriented Interdisciplinary Action Research. The aim of the woodland project is to organize and work with local people in restoration of woodlands and utilize it for wood and non-wood products principally gum arabic so as to achieve sustainable livelihoods and ecosystem conservation.
- Dry forest – Human interaction. This is a CIFOR sponsored research that aims to understand the interaction between human aspect and dry forest status. It specifically attempt to study the impact of resettlement on dry forest and gum and resin long term production opportunities.

I. Constraints to optimal utilization of NWFPs in the IGAD region

Improved production and commercialization of the NWFPs from the ASALs in Ethiopia is facing a number of constraints and challenges. The constraints and challenges are product specific and are summarized by product type as follows:

Gum-resin sub-sector: Given the potential and recent development in the sub-sector, sustainable enterprise in gum and incense is a viable economic activity in the ASALs of Ethiopia. However, there are still a number of constraints holding back the realization of the full potential. Constraints identified are both in the resources base as well as with respect to production and trade. The following summarizes existing constraints:

- The production areas are very remote and lack public utilities such as health post. Lack of infrastructure and services is a barrier to increasing the production, and obtaining sufficient labour force;
- In some of the production systems the woodland is leased just for the period of one or two years. As a result, the gum collectors do not make efforts to develop the area and do not make long-term plans. And despite the fact that the lease may be renewed every year, but it does not give certainty to the gum-collectors which essentially means that the present lease system does and cannot not guarantee the sustainable utilization of resources.
- Understanding of the reproductive ecologies of most the species has been found difficult particularly for *Boswellia papyrifera* whose population in natural stands is rapidly dwindling. Although propagation technique has been developed for it, application of the method is not appropriately observed or probably not well disseminated. Guidelines and manuals are lacking on such aspects as seed collection and handling, propagation techniques, seedling production, planting and management of stands;
- There is no industrial technology in the processing of natural gums and resins in Ethiopia. Currently exports involve crude or unprocessed forms. Distillation and solvent extraction of aromatic gums to produce essential oils and resinoids is done in the industrialized countries, which adds significant value to the products. These processing and value additional are not available in Ethiopia;

- Traditional cleaning and sorting is still practiced. Consequently, quality assurance and hygienic aspects of NWFP production, handling, transport and marketing are receiving little attention;
- Consistency of quality is an issue with end-users. This is more important when it comes most of the NWFP products. Virtually all collectors have no information on the market requirements of the various commodities. While there is very little information on the need to collect and keep separate gums from different species of *Acacia*, frankincense from different *Boswellia* species, and myrrh from different species of *Commiphora*. Most of the collections on gum arabic contain samples from more than one species of *Acacia* (e.g. *A. drepanolobium* or *A. mellifera*), deliberate or non-deliberate, while collections of frankincense usually contains mixture of samples of *Boswellia* and *Commiphora* species. This practice is a major deterrent for credibility in demand and supply. In fact, one of the key factors that downplayed value and importance of gums and resins trade in Ethiopia is failure to guarantee consistent quality in supply. Adulteration is a major problem. This is so because traders have no means to ascertain whether the gums and resins in the trade batch are pure or not;
- One of the problem related to quality assurance indicated above has to do with the absence of systematic analysis of commercial shipments on a scientific basis. In other words there is poor knowledge of the chemistry of the products, and absence of standards. So far, the Quality and Standard Authority of Ethiopia has not developed a standard for NWFPs. This problem becomes very apparent when Ethiopian producers are requested by the external buyer to check the quality before placing an order. Indeed, compliance with international standards is found very difficult at the present;
- Handling and production systems for Borana and Ogaden type olibanums are not well developed as compared to the Tigray type frankincense. Grading is less practiced and collection is restricted to natural exudates for the Borana and Ogaden type. Problem with collection of natural exudates that affect quality include over exposure to radiation that bakes the resins and discolours them, or premature collection that lead the gum to be messy losing granulation due to high moisture content. Sometimes collections are made on fallen granules from the ground, which contaminates them with soil and other foreign materials;
- Careless storage and use of inappropriate containers are also common quality degrading factors in all sorts of gums and incense production in Ethiopia (Fig.6). Stages and transportation with substances such as petroleum and volatile items is often common in the local areas. Containers used for transport and storage are not clean and airtight, and collected olibanum stay for quite some time in the field under high temperatures. The prolonged stay under high temperatures and in perforated containers can cause loss of significant proportion of their essential oils, leading to quality degradation;



Plate 5. Commonly used collection vessels (a) and transportation sacks (b).

- Degradation of the resource base is another major challenge observed today. In view of the current uses and potential industrial, local and socio-economic significance of gum and resin resources, sustainable extraction of the products deserve special attention. Lack of proper forest management practices is leading to decline of the stock of gum and resin producing vegetation, and their ecosystem. The following are major threats identified: clearing and conversion of woodlands to arable farming; resettlement and immigration; excessive wood harvesting for fuel wood; improper harvesting/tapping of gums and resins; overgrazing by livestock; human induced bush fires; bush encroachment and lack of regeneration;
- Sustainable collection requires some understanding about the physiology, ecology and phenological cycle (flowering, fruiting and seed dispersal season) of gum and resin producing plant species. Understanding the mechanism by which harvesting affects the vegetative growth, reproduction and resin production while sustaining the economic benefits from the resources and resolving marketing constraints are valuable;
- Marketing of NWFPs is constrained by lack of export marketing information (quality, packaging, price information, information about importers, information about applications);
- Local markets are constrained by the fact that producers (farmers and pastoralists) are price takers. They have little bargaining power;
- Slow process of land leasing and lack of monitoring of the production process will, eventually unless controlled/regulated, damage the natural stock from over exploitation.
- There is poor value added processing capacity (knowledge, skill and equipment) on all the gums and incenses produced in Ethiopia also hold back the optimization of returns from the sector;
- Conflicting policies, programs and strategies, particularly the impact from non-forestry policies such as resettlement, economic and rural development policies and strategies are negatively affecting the resource base, and

- Low financial and technical capacity for most private entrepreneurs currently interested in the sub-sector particularly to engage in value added processing and large scale development activities is also one of the observed constraints.

Beekeeping sub-sector: Beekeepers are confronted with several problems related to production and marketing including the fact that the development of the sub-sector has been held back by the poor development assistance to strengthen the human capacity (extension, training, financial auditing and monitoring of recording systems among others), and development of strong and coordinated marketing system. Poor beekeeping knowledge, traditional nature of current production, shortage of trained manpower for innovative technology as well as extension services at producer level, absconding honeybee, shortage of beekeeping equipment, pests and predators, pesticide threat and deforestation are some of the prominent challenges. The cultural beehives are not suitable for hygienic production of quality honey. Most farmers don't use proper methods of honey harvesting and storage – for example most farmers do not have honey and wax separators. Due to production and post production handling constraints the moisture content of the product is beyond the standard range and critical for the business. Due to poor knowledge and equipment farmers fail to supply honey with standard moisture content and acceptable solid content levels. In fact the Ethiopian Standard Authority has issued standards for honey and beeswax but most farmers are not aware of these standards.

The honey industry in Ethiopia faces production, processing and marketing problems. Honey is produced mainly for domestic marketing, where individual households sell nearly 90% or more of the honey produced to markets (consumers and private traders) in nearby towns. The increased honey supply during harvest season often coincides with high supply in the market resulting in a glut that suppresses the price. . . The individual honey producers are essentially price takers and have low bargaining power.

On the other hand honey production is constrained by the poor understanding of the various quality aspects of the product. Producers adulterate their honey with sugar and this is the priority problem identified by honey traders. Improving the quality of honey has to do with production, harvesting and storage by farmers. As farmers reported one of the reasons for quality problem could be low beekeeping skills. The other problem for the poor quality of honey that traders noted is that there are unlicensed traders/honey collectors who might be mixing honey with sugar.

Edible plants sub-sectors: Culturally Ethiopians are generally limit themselves to the consumption of the commonly cultivated crops and neglect wild plants. Strong traditions, practices, beliefs and religious taboos still obstruct people's psychological and mental willingness to openly collect, domesticate, cultivate and use wild-food plants. This is an area that needs to be addressed through rigorous public awareness campaigns and education. In the southern part of Ethiopia, where there are many different tribes still strongly bound to their indigenous beliefs, practices and traditions, there are fewer religious and external constraints than in other parts of the country. The cultural restrictions are pronounced in the central and northern areas. The threat of deforestation and degradation of natural habitats due to various human activities are, however, emerging to be even more acute constraints.

Another constraint is the threat from deforestation. In general, the following are the most important constraints identified:

- Information sources on the nutritional composition of Ethiopian edible wild plant species is limited;
- Despite the much acclaimed diversity, saliency and potential of wild edibles to livelihood improvement and poverty reduction, there is no practical action specifically targeted towards their conservation and utilization on a larger scale. Interventions by universities, research institutes (e.g., agriculture, forestry, rural development and biodiversity conservation) and other stakeholders are critically needed.
- Young people regard them as low status vegetables, actually associated with poor people;
- Generally low yielding and the majority of the vegetables have a bitter taste (alkaloids) or sliminess, which enhance their unpopularity especially among the young, and
- Most require special preparation methods making them difficult to adopt.

Medicinal plants: Owing to large scale deforestation and loss of habitats, the major problem facing traditional medicinal plants in Ethiopia is the decline in supply. Very limited efforts are being made for the conservation of the medicinal plants, and only one good example:- Conservation and Sustainable Use of Medicinal Plants Project (CSMPP) hosted at IBC can be made of mention in this case. However, compared to the medicinal plants of the highlands of Ethiopia, those in the lowland ASALs are relatively in good status due to the low level of deforestation.

The most pressing constraints hindering enhanced utilization of herbal medicines is the inadequacy of modern analytical instruments and the human capacity for phytochemical work and preclinical studies. Current research activities in medicinal plants is carried out in a fragmented fashion preventing the attainment of positive results that have significant contribution to the improvement of the healthcare status of the population. Unfortunately, the use and practice of traditional medicine is in oral nature and hence the rapid changes in relationships, in the name of modernity, in the producing areas means that the knowledge and information is not being passed on to the next generation. In any case, with the advent of formal education and to some extent modern medicine, the young members in most of the remote areas have little or no interest in learning and/or using the traditional ethnomedical lore. Indeed, documentation of ethnobotanical knowledge and practice is critically essential and urgent.

Aloe: Major constraint with aloe is the fact that there is very little awareness of the commercialization of this ample resource by the resident and transient communities. It seems that throughout the country, apart from a small pilot project initiated by SOS Sahel in Borana (Yabello), which even is known little nationally, there has been no commercial harvesting, production, handling and processing of indigenous aloe species in the entire ASALs of Ethiopia.

J. Recommendations and Way forward

For the communities in the ASALs of Ethiopia to diversify their resource base and to improve

their livelihoods and ability to adapt to the changing environmental and social conditions, this NWFPs based bio-enterprising program initiated by IGAD is an indispensable and timely effort. It will assist communities in the IGAD region to make use of resources that have not yet been optimally utilized and can therefore be used as income diversification strategy. For this goal to be realized the support of the program should base itself firmly on commercial principles and provide supports in diverse areas that enable the communities to understand, evaluate the cost and benefits of the alternative, and sustainably engage in the business. As clearly outlined in the sections above, there has been little efforts done so far in Ethiopia to promote bio-enterprising of the NWFPs in the ASALs. Therefore, a lot needs to be done by government, IGAD and other development partners to promote the economic, social and ecological roles of the NWFPs in ASALs.

In the following section specific recommendations and areas of interventions needed for the most promising NWFPs have been outlined.

Gum and incense: At the present there is enough stock of naturally grown gum-resin bearing woodland resources in Ethiopia. Besides, there is vast area suitable for developing the resources. Production of gums and resins is already increasing over the last decades and it is expected to intensify as economic development endeavors in the country would put more pressure on the natural resource basis for intensive exploitation. Designing and promoting sustainable production system therefore is required to not only to conserve the resources but enhance their sustainable socio-economic and ecological significances. To achieve such dual goals, it is essential to incur concerted and integrated multidimensional management and development interventions. The multi-dimension management interventions require multi-institutional collaboration and integration of their actions to optimize impact for the sustained production and development of the resources. The activities may be shared among various institutions and stakeholders from federal through regional to local levels including development partners and the private sectors. Some of the priority activities recommended for intervention may include:

- Conducting a national scale resource inventory (ground and/or remote sensing based), assessing with high level of accuracy the available resource base in order to provide reliable information on the quantity, type and quality of currently marketable gum and resin products as well as potentially suitable areas for future development to business community.
- Training and retraining of producers and traders to increase awareness on the need for sustainable management, build and improve capacity and technical skills of all concerned (local and business community and development/extension agents) with silvicultural management techniques and also establish systems for continued support provision in managing the forest resources.
- Train and retrain producers on subjects of quality control, handling and transporting gums and resins commodities.
- Creating sufficient incentives through improved and sustained market links, market networks, timely provision of market information, product diversification and supporting strong enterprise development;

- Facilitating and supporting the establishment of transparent and effective producers and traders association and strengthening their function through sustainable technical support.
- Important measures to ensure gum and resin qualities are chemical characterization of each type, testing of each batch and labeling with localities and botanical origin. For this to be made possible, establishment of commercial test laboratories and setting of standards are fundamental. This process, when applied widely, can train farmers and retailers not to mix, but to collect and trade gums and resins of different botanical sources differently. Recognizing the differences in gum quality and their end uses (applications) between the different species and/or even varieties is important in producing gums and resins that guarantee customer (importers) satisfaction and assure users on safety grounds;
- Strengthening the collaboration of pertinent institutions on issues of appropriate research undertakings that advance the management, production and commercialization of gums and related Dry land products.
- Creating the required infrastructure for documentation and dissemination of information, best practices and lesson learnt from within and outside the country in areas related to gum and other Dry land product management and commercialization, and
- Aggressively pursuing for value added processing at various scales to enhance the economic gains from the products and also create more employment opportunity, while also creating inland capacity for further finished product processing and exporting.

Honey and beeswax:

- Production related issues which are likely to affect the quality of the honey e.g. the use of chemicals on the nearby agricultural fields and improved production and harvesting techniques are areas of priority intervention;
- Processing techniques. Beekeepers have to be trained and facilitated on how to process crude honey and separate with bees wax so as to sell the two separately because beeswax is even more valuable than the pure honey in economic terms;
- There is a need to motivate beekeepers to raise their production through provision of improved beehives as well as promotion of bulking centres for collective marketing. This is essential to attract buyers who prefer continuous supply in bulk quantity.
- While still building on traditional practices, it is important to improve beehives to gradually replace the traditional ones because ease of harvesting procedures association with the modern hives render them more convenient to the beekeepers to maximize production;
- Supporting and demonstrating practical apicultural tools for small holders;
- Market and marketing is a major bottleneck for the sector. It is essential to establish linkages between producer farmers and their associations, and private business capable to transfer technologies appropriate to farmers and work for common benefit, and
- The diversification of the products (pollen, propolis, royal jelly) is important in terms of maximising the returns from this sub-sector. Developing the apitherapy, as value addition hive products, also promotes to involvement of women.

Edible wild plants: Some of the species locally consumed locally at times of food shortages,

have the potential to become valuable staple foods and important alternatives to the usual cultivated food crops. Wild plant species that farmers highly value and appreciate when it comes to bridging food gap should be studied in more detail. For some species, modern agricultural research may improve their biophysical performance to the level similar to that that has been achieved with common staple crops. In addition research be undertaken to improve the palatability of wild plants, and especially those that are bitter or slimy. The study teams in Ethiopia have identified a number of useful indigenous food-producing tree species that farmers could easily domesticate if the proper propagation methods could be acquired and applied, instead of farmers relying on the uncontrolled occurrence of seedlings in the wild. It has to be stressed, however, that where environmental degradation is accelerating, such as in many highland areas of Ethiopia, germplasm collections of wild-food plants should be initiated before potentially valuable traits are lost forever. The followings are other suggested interventions:

- Nutritional study of identified plants
- Propagation and domestication
- Demonstration
- Packaging and marketing aspects
- Integration of wild foods into the diets of household members on a regular basis is constrained by non-domestication of wild food sources.
- The level of toxicity of some wild foods has yet to be determined through credible biochemical analysis process(es), and their nutritional value and palatability for humans ascertained. Some wild edible plants are known to have toxicity and can cause health problems (e.g. the leaves of *Balanites aegyptiaca*. Some also known to have anti-nutrients like nitrates, oxalates and phenolics. For those of anti-nutrient holding, documenting of the indigenous knowledge about the vegetables is important, especially in processing of the vegetables. Some communities have developed methods of processing the vegetables aimed at reducing the effects of anti-nutrients.
- Many of the bitter vegetables fruits and some roots) contain alkaloids, which can affect the central nervous system, if prepared without due care, knowledge and skill. Therefore the preparation of edible wild plants is very important, because some of these foods are poisonous. Some of the plants including vegetables have to be soaked in water and cooked for a long time or certain herbs need to be added when they are cooked to remove the toxin content. Different types of toxic components are mentioned below;
- Designing strategies for popularization and wider domestication is needed through comment extension services programmes such as kitchen gardening
- The nutritional conversion ratio for body intake of various compounds or nutrients in particular wild foods will need in-depth study. This will enable the recommendation of wild food preparation for users.

Herbal medicines: For the herbal medicine key recommendations and major areas of intervention include:

- Improving facilities and human resource for phytomedicine preparation, production and marketing;
- Increasing awareness and participation of community in the conservation of medicinal plants is essential by using various techniques such as conservation education, local organizations of traditional healers, and through provision of necessary technical support

- Identification of high diversity areas of medicinal plants in collaboration with traditional healers and other members of the local community, and establishment of field gene banks (in-situ management) of medicinal plants at various selected sites
- Strengthening the initiated national database of medicinal plants at Addis Ababa University, and
- Given the immense biodiversity of Ethiopia, the rapid growth in international demand for herbal medicines, there has been no market for herbal medicines of Ethiopian origin on international market. Thus, support for export is essential. Indeed, developing market places with market information systems and processing facilities would assist the entire industry.

Aloe: Ethiopia has huge potential for aloe related enterprise development. However, as indicated above, the key problem is that the economic potential of aloe has yet to be determined. For commercial utilization of this natural resource the following are recommended:

- identification and mapping of the different species with commercial potential found across the diverse ASAL regions of the country should be the first task,
- conduct product development study, which clarify the feasible exploitation and marketing of the resource with giving special focus to the knowledge, technology adoption, financial capability and availability of infrastructure of the area, and
- Value addition and exporting new product may be too complex for pastoralist and pastoralist business institutions and private traders also may not be interested to take risk at the start.

5. PRELIMINARY PROPOSAL FOR IGAD and OTHER DEVELOPMENT PARTNERS FOR FUNDING/INVESTMENT

Most of the NWFPs from ASALs of Ethiopia are underutilized. The only plant over exploited is probably *B. papyrifera*, the source of white frankincense. Interests in the NWFPs of ASALs for research as well as investment are of recent developments that should be encouraged and supported. Production and trade are generally unorganized and undeveloped. Market chains are often too long, and there is no organized and sustainable (steady) supply system. Proper mapping of sites with potential commercial production are lacking for some of the products such as essential oils and wild edible food products. Awareness among the community regarding the economic potential of the plants is generally low. Capacity, support and awareness creation activities through such mechanisms like extension services and farmers field schools are generally absent. Skills and equipment for value added process is very low, while financial capital has not been availed for bio-enterprise developments. Market linkages and partnership as well as poor knowledge of requirements for standards in market are also some of the determinants for expanded NWFPs production and trade. Indeed, there remains a lot to be done to promote the production, processing and marketing of the NWFPs of the ASALs of Ethiopia. With this regard there exists extensive areas of support and contribution from IGAD and other development partners to enhance the ecological, economic and livelihood support roles of NWFPs in the ASALs of Ethiopia. Six areas of support have been identified and listed each with several sub-components to improve the commercialization of the NWFPs and long-term viability of their forest resources.

1.Capacity building related support

- Training of researchers, development and government technical and management officers and field staff that are engaged in the areas of NRM in dry lands of the country. Topics of training may include business planning and entrepreneurship in the context of NWFPs, production techniques, product and forest certification and other relevant issues;
- Training of the producers and their associations/cooperatives in areas of improved production techniques, quality control, traceability and other relevant topics that boost their economic gains from NWFPs;
- Supporting and facilitating exchange visits across IGAD member countries to share experiences of successful NWFPs based entrepreneur development,

2.Infrastructure development and resource mapping support

- Despite the general recognition for the existence of large potential, there has been no national or even regional assessment, inventory and mapping of any of the NWFPs of the ASALs of Ethiopia. Existing information are often extrapolated from fragmentary local scale studies. Therefore support for national mapping of the distribution, concentration areas that offer short term potential for enterprising the resources is the highest priority area of support. In this regard the support needed may include logistic (e.g. GIS and RS laboratory, funding for inventory works and image purchases, logistic support for field assessment and laboratory equipment);
- Support through training and investment the improved management and sustainable extraction of the resources for the cause of establishing a viable and sustainable sales of the natural products;
- Infrastructural supports such as depot/collection centres or satellite workshops will also be needed for some of the emerging NWFPs based enterprises such as gum-incense producers, honey and beeswax, among others.
- Similar support to private entrepreneurs who are actors along the market/value chain but are constrained by infrastructure such as facilities for value added processing (e.g. laboratory equipment for quality control; essential oil extraction and facilities that enable enterprises to ensure consistent grading, high level maintenance of quality and hygiene standards, appropriate packaging and storage conditions) will be essential.

3.Demonstration and piloting related support

- Support in establishing pilot NWFPs enterprises or business development at few localities and on potential NWFPs and demonstration of how such a business firm need to be developed would make a big difference. Such demonstration sites in the long run will also be used as training centre(s) in the country.

4.Value addition and certification promotion related supports

- Building capacity on product and forest certification though training of all stakeholders and support actors in the establishment and management of the organic/natural certification or other forms of certification;
- Organic certification preparation and development of recording systems required for product traceability including the mapping and zoning of the indigenous

- materials for commercialisation and sustainable wild harvest protocols, and
- Also providing financial supports for the start-up fees of the certification.

5. Support to improve supply chain efficiency:

- Support for increased access to relevant technologies and market information through training, capacity building and the creation of marketplaces with requisite equipment and IT;
- Supporting and building the ability of smallholder farmers to organise themselves into effective Producer Associations capable of complex marketing and distribution operations;
- Facilitating access to credit by smallholder farmers through revolving fund mechanisms tied to the natural product enterprises.
- Facilitation of public-private sector partnerships
- Develop protocols to achieve market quality throughout the chain and provide training and information literature on these areas;
- Support in identification of suitable markets and market niches for the specific product types;
- Facilitating and supporting the extension system that support the producers.

6. Gender responsive support

- Promoting and encouraging at the community level the active engagement of youth and women as part of the commercial business development process.
- Developing bylaws of the producer groups to demand the active involvement of youth and women in income generating activities.
- Training in harvesting/production and value addition techniques that are appropriate for women participation and adequate to achieve the quality expected in target markets.

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ANNEXES

Annex 1. Major actors and holders of information for the various NTFPs of ASALs of Ethiopia.

| NTFP type | The three top priority area for intervention | Major actors | Major holders of information | Type of information | Potential inventors |
|---------------------------|--|--|---|---|--|
| Gum and incense | <ul style="list-style-type: none"> Value added processing including organic certification Quality assurance including eco-labelling procedure Domestication and propagation | <ul style="list-style-type: none"> Forest Research Centre (FRC) of the Ethiopian Institute of Agricultural Research (EIAR) CIFOR – Ethiopian office WGCF Private sector NGOs Line ministries Farmers and pastoralists | FRC CIFOR NGPME | <ul style="list-style-type: none"> Research outputs Information on marketing | <ul style="list-style-type: none"> Private business people, particularly, big agri-business companies |
| Honey and Beeswax | <ul style="list-style-type: none"> Capacity building in modern apiaary, Value added processes including organic certification Quality assurance | <ul style="list-style-type: none"> EIAR MoA Private sector Farmers MoT/MOI NGOs | EIAR | Research data | <ul style="list-style-type: none"> Private sectors – small, medium and large companies, |
| Edible wild plants | <ul style="list-style-type: none"> Domestication Nutritional assessment Popularization, marketing and trade | <ul style="list-style-type: none"> Addis Ababa University Farmers/pastoralists IBC | AAU IBC | Data base | <ul style="list-style-type: none"> small private, and individual entrepreneurs |
| Medicinal plants | <ul style="list-style-type: none"> Safety and dosage Pharmaceutical tests and processing Trade | <ul style="list-style-type: none"> AAU IBC MoH | AAU IBC | Data base | <ul style="list-style-type: none"> State and Private companies, - |
| Essential oils | <ul style="list-style-type: none"> Extraction and packaging Marketing and trade | <ul style="list-style-type: none"> EIAR Private sectors Industries Line ministries (Ministry of Trade and industry) | -EIAR -Private sector (Ariti Herbal Company) | <ul style="list-style-type: none"> Research reports and data on growth, yield among others. distillation and yield, quality among others. | <ul style="list-style-type: none"> small, medium (individual or groups) and big companies |

Annex 2. Log frame for improving the production, marketing and economic value of NWFPs from the ASALs of Ethiopia

| Overall goal | Components | Indicators of achievement | Means of verification | Important risks and assumption |
|--|---|---|---|--|
| Improving livelihoods of ASALs community in Ethiopia through improved management and better income generation from NTFPs | Component1: Gum and incense | | | |
| | Component goal: Value added processing and marketing of gum and incense from ASALs of Ethiopia enhanced | | | |
| | Component purpose: Increase domestic and international trade of gum and incense through improved quality assurance, supply chain and product diversification. | | | |
| | Component outputs and activities: <ul style="list-style-type: none"> Market chains of gum and resins mapped; Quality assurance from harvest to shipment improved; Skill and awareness on quality product delivery acquired; Small demonstrations of essential oil extraction from incense established; Market information delivery system introduced; Marketing and production cooperatives trained and acquired skills in quality assurance and marketing systems, and Organic certification of gums and incenses processed, and national standards formulated. | <ul style="list-style-type: none"> Quantity of gum and resin traded; Improved financial gains from improved marketing chains Number of trainings offered and number of participants No. of demonstration plants established | <ul style="list-style-type: none"> Reports Income gains claimed by producers and traders | <ul style="list-style-type: none"> Global market such as the financial recessions; Drought Conflicts |
| | Component 2: Honey and Beeswax | | | |
| | Component goal: Quality and quantity of beekeeping products produced and traded from the ASALs of Ethiopia increased, and their economic importance enhanced. | | | |
| | Component purpose: Expand the adoption of modern apiculture in the ASALs, and thereby | | | |
| | increase the quantity and quality of bee keeping products; | | | |
| | Component outputs and activities: <ul style="list-style-type: none"> Pastoralists and farmers of ASALs capacitated in apiculture and modern hive usage; Training on quality assurance and standards offered; Producers organized into cooperatives; Market links established, the supply of both the honey and wax through the development of well-structured supply chain increased; Organic and fair trade certification to provide competitive advantage and price premiums in the international market achieved; training and capacity building commenced on the development of apitherapy products such as propolis, royal jelly and pollen. training and extension support in establishing protocols for handling, processing and storage provided, Transparency and traceability recording and financial handling skills throughout the supply chain developed, | <ul style="list-style-type: none"> Number of modern bee hives acquired; Quantity of honey and beeswax marketed No of farmers trained No. of cooperatives (associations formed) Exchange visit organised No. of commercial partnerships for the export of organic and fair-trade certified table honey and wax. Trial sites established for the piloting of the apitherapy products (pollen, propolis, royal jelly) | <ul style="list-style-type: none"> Reports No. of trainees that attended modern apiculture, No. of hives supplied and adopted Quantity of apiary products traded from intervention area over the baseline | <ul style="list-style-type: none"> Climate change not affecting water and nectar availability Global economic condition Conflicts |
| | Component 3: Edible wild plants: | | | |
| | Component goal: Domestication, promotion and marketing of selected high nutritional value edible wild plant species of the ASALs of Ethiopia realized. | | | |
| | Component outputs and activities: <ul style="list-style-type: none"> Selection of promising (on nutritional assessment basis) five edible wild plants of ASALs of Ethiopia accomplished; Germ plasm of superior provenance for the priority species identified, and their biology studied; Information on the nutritional contents and | <ul style="list-style-type: none"> Number of surveys conducted and reports available, Number of plant species selected Field manuals/guidelines published, | <ul style="list-style-type: none"> Reports Manuals prepared, No. of published articles | <ul style="list-style-type: none"> Global market (such as the financial recessions); Drought Conflicts |

| | | | | |
|--|---|---|--|---|
| | <ul style="list-style-type: none"> productivity compiled; Public awareness, extension guide and use manuals prepared, and their promotion successfully conducted, and Marketing support provided. | <ul style="list-style-type: none"> Research reports on nutritional contents | | |
| Component 4: Traditional herbal medicines | | | | |
| | <p>Component goal: Identification, and documentation of traditional knowledge of several herbal medicines realized, and pharmaceutical promotion of very promising five herbal medicinal plants achieved.</p> <p>Outputs and activities:</p> <ul style="list-style-type: none"> Community sensitized and organized for the production of selected, high value medicinal plants; At least five herbal medicines of high pharmaceutical potential selected, based on identification of effective and safe active components for the main targeted diseases and disorders (i.e. Efficacy trials made); A botanical assessment of plant populations and establishment of sustainability protocols will then be followed by training of the producer groups; Domestication of the medicinal plants will be encouraged and assisted through training and support in setting up the community/producer groups' medicinal gardens. It is likely that this will take off if the price returns for the dried materials is sufficiently rewarding. | <ul style="list-style-type: none"> Number of surveys conducted and reports available, Number of plant species selected Research reports on efficacy tests Clinical trails conducted | <ul style="list-style-type: none"> Reports No. of published articles | Facilities availability for pharmaceutical test |
| Component 5: Essential oils, Aloes and related products | | | | |
| | <p>Component goal: Essential oil and associated products production and trade from promising plants including Aloes from ASALs of Ethiopia initiated, and their contribute to economic wellbeing of the community enhanced</p> | | | |
| | <p>Component activities and outputs:</p> <ul style="list-style-type: none"> Botanical assessment of plant populations of the indigenous plant materials to be used in the body care products, and establish sustainability protocols, and training of the producer groups in the sustainable harvesting techniques; Preparation for organic certification and first inspection should be made at the earliest point as this will have a big impact on the marketability and price return of the oils in the export market; Construction of the essential oil equipment – one mobile still (stainless steel, in-direct steam) with two pots (alembic) of 1000 litres plus boiler, and 2 stills (stainless steel, in-direct steam) - one static open steam still and one vacuum stir still and boiler based at the central processing centre; Equipping the processing facilities at the central processing centre and training of the processing personnel should take place in the first quarter of the initiative. The distillation operators will need to be careful training and will be required to strictly abide to the distillation and essential oil handling protocols. | | | |

Annex 3. Lists of some common edible wild plant species in the ASAs of Ethiopia including parts used, and their distribution habitats.

| No. | Scientific Names | Family | Parts used | Habit | Habitat distribution | Very promising plant for intervention |
|-----|--|---------------|------------|-------|----------------------|---------------------------------------|
| | <i>Acacia senegal</i> | Fabaceae | G | Tree | Woodland | |
| | <i>Acacia sieberiana</i> var. woodii | Fabaceae | G | Tree | Woodland | |
| | <i>Acacia tortilis</i> (Forssk.) Hayne | Fabaceae | B | Tree | Woodland | |
| | <i>Aloe</i> spp. | Aloaceae | N | Herb | Rocky degraded land | |
| | <i>Amaranthus caudatus</i> L. | Amaranthaceae | Se | Herb | Farmland | X |
| | <i>Amaranthus graecizans</i> L. | Amaranthaceae | YL | Herb | Farmland | |
| | <i>Annona senegalensis</i> Pers. | Annonaceae | F | Tree | Woodland | |
| | <i>Balanites aegyptiaca</i> (L.) Del. | Balanitaceae | F, L | Tree | Woodland | X |
| | <i>Balanites rotundifolia</i> (Van Tiegh.) Blatter | Balanitaceae | F | Shrub | Woodland | X |
| | <i>Borassus aethiopum</i> Mart | Araceae | F | Tree | | |
| | <i>Bridelia micrantha</i> (Hochst.) Baill. | Euphorbiaceae | Se | Shrub | Woodland | |
| | <i>Cadaba forinosa</i> Forssk. | Capparidaceae | L | Shrub | | |
| | <i>Capsicum annum</i> L. | Solanaceae | F | Herb | River banks | |
| | <i>Carissa spinarum</i> L. | Apocynaceae | F | Shrub | Woodland | x |
| | <i>Caylusea abyssinica</i> (Fresen.) Fisch. and Mey. | Resedaceae | L | Herb | Farmland | |

| | | | | | | |
|--|---|----------------|------|---------|-------------------|---|
| | <i>Celtis africana</i> Burm. f. | Ulmaceae | F | Tree | Woodland | |
| | <i>Celtis toka</i> (Forssk.) Hepper and Wood. | | F | Tree | | |
| | <i>Clausena</i> <i>anisata</i> (Willd.) Benth. | Rutaceae | F | Shrub | Woodland | X |
| | <i>Cleome</i> <i>gynandra</i> L. | | Leaf | Shrub | | |
| | <i>Coccinia</i> <i>grandis</i> (L.) Voigt | Cucurbitaceae | F | Climber | | |
| | <i>Commelina</i> <i>diffusa</i> Burm. f. | Commelinaceae | YL | Herb | Disturbed land | |
| | <i>Convolvulus</i> <i>glomeratus</i> Choisy | Convolvulaceae | L | Herb | | |
| | <i>Corchorus</i> <i>olitorius</i> L. | Tiliaceae | L | Herb | | |
| | <i>Corchorus</i> <i>trilocularis</i> L. | Tiliaceae | YL | Herb | Farmland | |
| | <i>Cordia africana</i> Lam | Boraginaceae | F | Tree | Woodland | |
| | <i>Cordia ovalis</i> R. Br. ex D.C. | Boraginaceae | F | Shrub | Woodland | |
| | <i>Cordia sinensis</i> Lam. | Boraginaceae | F | Tree | | |
| | <i>Cyphostemma</i> <i>adenocaulis</i> (A. Rich.) Wild and Drummond | Vitaceae | R | Herb | | |
| | Dioscorea praeheasilis Benth. | Dioscoreaceae | R | Climber | River banks | |
| | Diospyros abysinica (Hiern) F. White | Ebenaceae | F | Tree | Woodland | |
| | <i>Diospyros</i> <i>mespiliformis</i> Hochst.ex A. DC. | Ebenaceae | F | Tree | | |
| | <i>Dobera glabra</i> (Forssk.) Poir. | Salvadoraceae | Se | Tree | Woodland | X |

| | | | | | | |
|--|--|----------------|----|-------|----------------------|---|
| | <i>Dombeya torrida</i> (G. F. Gamel) P. Bamps. | Sterculiaceae | F | Tree | Woodland | |
| | <i>Dovyalis abyssinica</i> (A.Rich.) Warb. | Flacourtiaceae | F | Tree | Woodlands | |
| | <i>Ehretia cymosa</i> Thonn. | Boraginaceae | F | Tree | Woodland | |
| | <i>Embelia schimperi</i> Vatke | Myrsinaceae | F | Shrub | Forest | |
| | <i>Euclea divinorum</i> Hiern. | Ebenaceae | Se | Shrub | Woodland | |
| | <i>Ficus sur</i> Forssk. | Moraceae | F | Tree | Open and river banks | |
| | <i>Ficus sycomorus</i> L. | Moraceae | F | Tree | | |
| | <i>Ficus vasta</i> Forssk. | Moraceae | F | Tree | | |
| | <i>Flueggea leucopyrus</i> Willd. | Euphorbiaceae | Se | Shrub | Woodland | |
| | <i>Flueggea virosa</i> (Willd.) Voigt. | Euphorbiaceae | F | Tree | | |
| | <i>Grewia bicolor</i> Juss. | Tiliaceae | F | Tree | | X |
| | <i>Grewia kakothamnos</i> K. Schum. | Tiliaceae | F | Shrub | | |
| | <i>Grewia mollis</i> Juss. | Tiliaceae | F | Shrub | Woodland | |
| | <i>Grewia schweinfurthii</i> Burret | Tiliaceae | F | Shrub | Woodland | |
| | <i>Grewia villosa</i> Willd. | Tiliaceae | F | Shrub | | |

| | | | | | | |
|--|--|----------------|-------|---------|----------|--|
| | <i>Heliotropium steudneri</i> Vatke | | F | Tree | | |
| | <i>Hypoestes forskaolii</i> | Acanthaceae | L | Herb | Farmland | |
| | <i>Ipomoea plebeia</i> R. Br. | | L | Shrub | | |
| | <i>Kedrostis foetidissima</i> (Jacq.) Cogn. | | L | Climber | | |
| | <i>Lanata rhodesiensis</i> Mold. | Verbenaceae | Se, L | Shrub | Farmland | |
| | <i>Lecaniodiscus fraxinifolius</i> Bak. | Sapindaceae | F | Tree | | |
| | <i>Lepisanthes senegalensis</i> (Poir) Leenh. | Sapindaceae | F | Tree | Woodland | |
| | <i>Leptadenia hastata</i> (Pers.) Decne. | Asclepiadaceae | L/S | Shrub | | |
| | <i>Lucata</i> Spp. | Asteraceae | L | Herb | Farmland | |
| | <i>Lycium shawii</i> Roem. and Schult. | | L | Tree | | |
| | <i>Maerua oblongifolia</i> (Forssk.) A. Rich. | | L | Shrub | | |



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