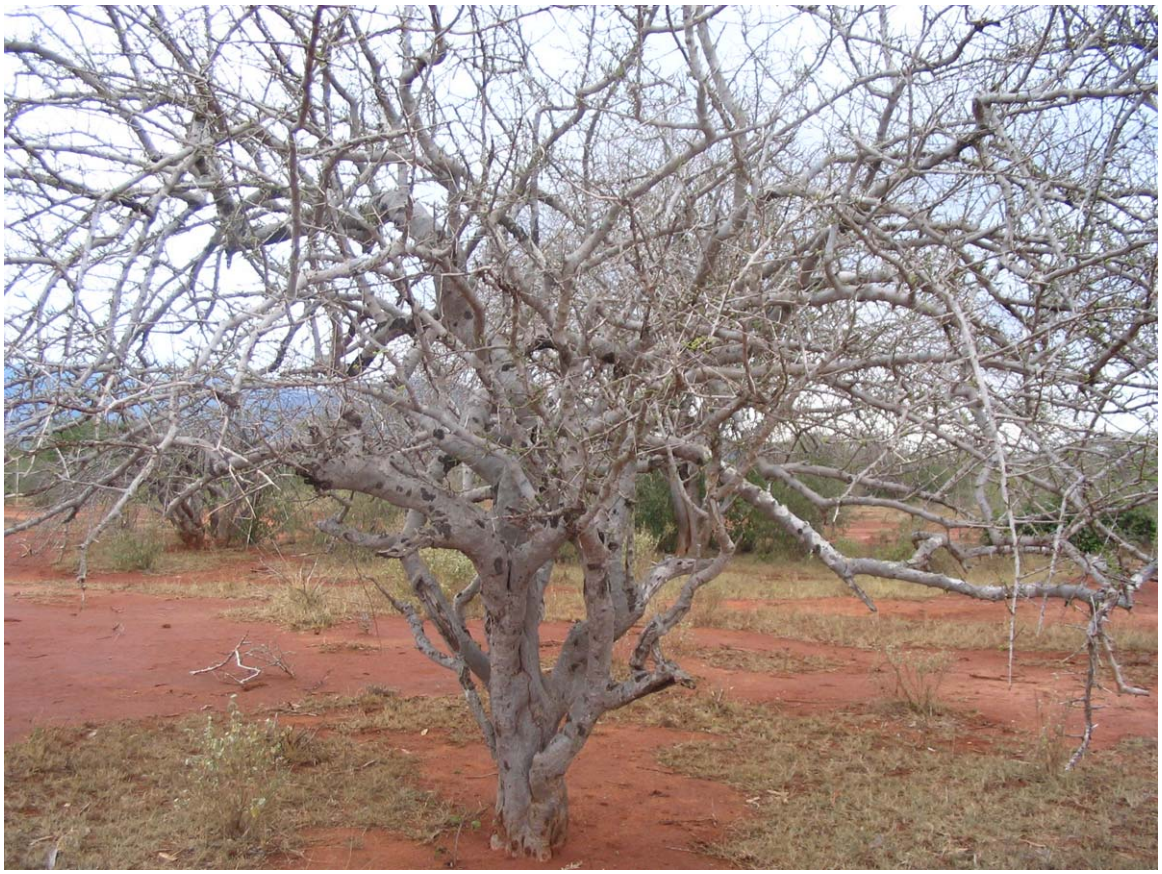
Production and Marketing of Gum Resins:
Frankincense, Myrrh and Opoponax



NGARA

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Cover Photo: *Boswellia neglecta* in Tanzania (Top)
Myrrh from *Commiphora myrrha* in Wajir District, Kenya(Bottom)

Preface

Gum resins (Frankincense, Myrrh and Opoponax) are, like gum arabic, important commodities from the drylands of sub-saharan Africa with potential for spurring economic development of the communities and countries in the region. The gum resins are produced in the rural (remote) areas of producing countries, traded in urban centres and used in some of the sophisticated cities in the world. They therefore touch on the lives of a wide cross section of mankind in the society. Sound development of these commodities will thus have a huge impact on many people, and especially, the poor communities living in the rural areas in Africa who have fewer options for economic development due to the harsh climatic conditions. It is especially important to note that the tree resources i.e. Acacia, Boswellia and Commpiphora species are considered startegic by the Acacia Operation project funded by the Italian Cooperation and operated by FAO in the rehabilitation of arid and semi arid areas.

Sound development of the commodities will require a good understanding of trade and marketing aspects from production to export at national, regional and international levels. There is need for good information on import statistics in regard to trade volumes, requirements and opportunities thereof, among others, to better organise producer countries respond to the needs.There is also need for importers to have good information on supplies (or potential) including aspects of botanical sources and handling pratices to be assured of reliability of supply and quality.

However, information on gum resins has been hard to come by compared to gum arabic despite the old age tradition in the trade and market of these commodities. Difficulties in the identification of some of the botanical sources, inadequate information on quality in producing countries as well as trade requirements from importing countries have been identified as impediments to sound development of the sub-sector, which otherwise has great potential in the region.

Following publication of the report on production and marketing of gum arabic in December 2004, NGARA continued to work on the production of a related report on gum resins. There was obvious paucity of information in the producing as well as importing countries. After extensive consultation, suitable people were identified to assist with the documentaion, analysis and eventual production of the various country reports as well as an report on international trade and markets. This report is therefore one of the very first to examine the gum resins sector in detail.We hope that availability of this information will assist in better understanidng of the gum resins sub-sector and its subsequent development for the benefit of all.

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Chapter 1.0 Overview of International Trade and Markets

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Summary

Frankincense (from Boswellia spp.) is traded in the greatest volumes and is available in the greatest number of different grades; it ranges in appearance from pale pieces or tears up to several centimetres in size to smaller pieces, and from powder and siftings to large, reddish-brown or dark agglomerated masses. Myrrh and opoponax (from Commiphora spp.) are traded in smaller volumes and have fewer clean, pale grades to choose from. All of the resins have a fragrant aroma due to the presence of essential oil and this accounts for their commercial importance.

The markets and end-uses for the resins fall into three main sectors: fragrance (chiefly for incense use – either in religious ceremonies or around the home – but with some fine fragrance applications); flavour (principally 'maidi' for chewing but with some minor uses of the oils as flavouring agents); and pharmaceutical applications. The latter includes both allopathic medicine (where, for example, proprietary preparations of myrrh tincture are used in mouthwashes and gargles for inflammatory disorders of the mouth and pharynx) and traditional Chinese medicines which incorporate Ru Xiang (frankincense) and Mo Yao (myrrh). Frankincense and myrrh are also used in a variety of skin care products, either as toners and emollients or, in the case of frankincense, as an anti-wrinkle moisturiser. Incense use, in all its forms, is unquestionably the greatest outlet and, in addition to Eritrean-type frankincense being used by the Orthodox and Roman Catholic Churches, China is believed to be using an increasing proportion of its imports for the manufacture of incense sticks rather than (as was previously supposed) traditional medicines. Opoponax use appears now to be minimal.

Although only China and Saudi Arabia specify frankincense and myrrh in their trade statistics, examination of the European Union and US data for a broader classification of natural gums and resins for certain specified countries of origin (most importantly Ethiopia, Somalia and Kenya but also including Sudan, Eritrea and Djibouti) does help to build a picture of world trade. Total world demand is estimated at around 2500 tonnes/year but this figure is subject to some qualification and much uncertainty. China and Europe are the largest markets but the Middle East, North Africa and (to a lesser degree) the US also import significant amounts directly from source. Within Europe Germany is the biggest importer (and re-exporter) of the resins. For these particular types of resins prices appear to be stable. Myrrh, the highest priced resin, reaches US$3.50-4.00/kg but present prices are significantly lower than they were a decade ago. Although there are discernible changes in demand for the resins in some sectors of the market (increasing in pharmaceuticals/cosmetics, decreasing in perfumery), and demand for opoponax appears to have declined considerably, overall demand is fairly stable. Importers state that there are no supply problems and, with no new uses on the horizon which might lead to a significant increase in demand for any of the resins, there are no grounds for attempting to increase production.

Consistency of quality is an issue with end-users but not, apparently, a major one. There has been no systematic analysis of commercial shipments on a scientific basis although myrrh and opoponax are known to be more susceptible to quality variation than frankincense. In part, this is due to the fact that the botanical origin of a particular consignment is not known with any certainty and it may not even be from a single botanical source. It would undoubtedly generate confidence for end-users if producer countries were to take steps to ensure that their shipments were as homogeneous as possible and from single botanical sources. Although any natural product is at risk from the threat of synthetic substitutes, the use of frankincense, myrrh and opoponax depends on their characteristic fragrance properties rather than functional properties (as is the case for gum arabic, for example) and this makes it much less easy for them to be substituted. Value-added processing – the production of essential oils and extracts – is something that might be considered by producer countries but any economic gains would be very modest and the capital costs involved in setting up, for example, steam distillation using stainless steel equipment would preferably require the equipment to be shared with other essential oil-bearing crops, so as to spread the cost and maximise use. The risks involved in making such an investment are likely to outweigh any benefits.

1.1 Description of Frankincense, Myrrh and Opoponax

1.1.1 Terminology

Frankincense, myrrh and opoponax are the hardened, resinous exudates obtained from trees of certain Boswellia and Commiphora species. The resins, particularly frankincense, are used in unprocessed form for both fragrance and flavour purposes but there is some production of the distilled essential oils and extracts.

The terms frankincense and olibanum are used interchangeably in commercial parlance, with the latter probably being used to a greater extent. They are also used rather loosely at times with no clear indication of which botanical source the resins are derived from. Occasionally, as is the case in Indonesia, a term may be used when it has no connection whatsoever with Boswellia or Commiphora species: gum benzoin is misleadingly called frankincense in Indonesian trade statistics and this misclassification needs to be recognised whenever Indonesia appears as a source country. Since FAO uses the term frankincense in its terms of reference, this word, rather than olibanum, is used here. Unless indicated otherwise, the terms frankincense, myrrh and opoponax denote the resins obtained from northeast African and Arabian species of Boswellia and Commiphora.

Within the primary producer (source) countries, local terms are used to distinguish between different types of resin. Frankincense is known as maidi or beyo according to its source and maidi itself, for example, is sorted into six or more different grades, each with its own local name.

1.1.2 Appearance

Of the three major types of resin discussed here, frankincense is traded in the greatest volumes and is available in the greatest number of different grades. It ranges in appearance from pale pieces or tears up to several centimetres in size to smaller (but still separate) pieces, and from powder and siftings to large, reddish-brown or dark agglomerated masses formed during handling and transit from a mixture of different types. Myrrh and opoponax are traded in smaller volumes and have fewer clean, pale grades to choose from.

All of the resins have a fragrant aroma due to the presence of essential oil and this accounts for their commercial importance, whether they remain in the raw, unprocessed form (to be used as incense) or whether they are distilled or extracted. Myrrh generally has a heavier, less fine fragrance than frankincense.

1.1.3 Chemistry

The chemical compositions of the volatile oils account for the sensory characteristics of the resins and determine the fragrance and flavour uses to which they are put. However, the non-volatile constituents are almost certainly responsible for some of the biological properties of the resins and these are attracting increased research in connection with potential (and actual) medicinal applications.

The volatile essential oils consist of mixtures of mono-, sesqui- and diterpenoids, the precise composition varying according to the type of resin and the species from which they are derived.

Frankincense oils are usually richer in the lower-boiling monoterpenes than, say, myrrh oil and this makes the latter more problematic in terms of its recovery by distillation of the resin.

The non-volatile constituents include numerous triterpenoids of the lupane, oleanolic and ursolic acid types, either as the free acids, acetyl esters or ketones. Boswellia resins (frankincense) contain the so-called α- and β-boswellic acids: 3α-hydroxy-olean-12-en-24-oic acid and 3α-hydroxy-urs-12-en-24-oic acid, respectively.

1.2 Plant sources

The botanical origin of the incense resins, and the names ascribed to their sources, has been a subject of much uncertainty and discussion over many years. Difficulties in identification arising from the variability of the plants themselves has been compounded by the use – for chemotaxonomic purposes – of commercial samples of resin of uncertain origin. And much of the 'popular' literature and that put out by commercial companies is simply out-of-date information regurgitated from a variety of sources.

1.2.1 Frankincense

Frankincense of Middle Eastern origin is said by some sources to come principally from three species of Boswellia: B. carteri and B. frereana in Somalia, and B. sacra in southern Arabia. Some other Boswellia spp. are sources of resin and these include B. bhau-dajiana Birdw. and B. neglecta S. Moore in Somalia, and B. papyrifera Hochst. in Ethiopia and Sudan ('Eritrean type' frankincense). Indian frankincense (salai guggul) comes from B. serrata Roxb.

Following research in the late 1980s, Thulin and Warfa (1987) concluded that B. carteri Birdw. is simply a variable form of B. sacra Flückiger and should not be afforded separate species status. B. frereana Birdw. is a distinct and fairly uniform species, easily distinguished from B. sacra. More recent studies have thrown further light on the subject – e.g. Dagne et al. (1997) and Gachathi (1997) – but it remains a difficult and confusing one.

In Somalia two types of frankincense are distinguished locally: 'maidi' (also spelt maydi or meydi) from B. frereana and 'beyo' ('Somali type' frankincense) from B. sacra (syn. B. carteri?). As will be seen, the two types have somewhat different uses.

The Boswellia species which yield the classical frankincense of commerce are all small trees or shrubs growing in the dry areas of northeast Africa and southern Arabia. They are able to grow in very steep or exposed situations and are often found in rocky slopes or gullies. B. sacra is a small tree, occasionally up to 8 m tall, and occurs in South Yemen, Oman and northern Somalia. (Those who regard B. sacra and B. carteri as distinct species identify the former as growing in Arabia and the latter in Somalia). B. frereana (known as the yagar tree) grows to a similar height as B. sacra but is restricted to northern Somalia. B. serrata occurs in the drier parts of northern India.

1.2.2 Myrrh and opoponax

The situation for Commiphora, the source of myrrh and opoponax, is even more complex than for Boswellia. Commiphora species are small trees or shrubs with short, thorny branches. True myrrh is produced by C. myrrha (Nees) Engl. (syn. C. molmol Engl.), a variable species found in

southern Arabia and northeast Africa (chiefly Somalia) as far south as northeast Kenya, but numerous other Commiphora spp. yield resin and it is not clear to what extent these enter commerce, either as adulterants or as inferior types of myrrh. Other resin-producing Commiphora occur in southern Arabia, Sudan, Ethiopia, Eritrea, Somalia and Kenya and include C. abyssinica Engl., C. foliacea, C. playfairii Engl. and C. serrulata Engl. The various pharmacopoeias cited in section 1.3.1 (i) below continue to refer to myrrh as being obtained from "Commiphora molmol Engler and other species of Commiphora". Indian false myrrh (bdellium) comes from C. mukul (Hook. ex Stocks) Engl.

The name opoponax is derived from that of its original source, Opopanax chironium, but production today is entirely from Commiphora spp. C. guidottii, C. erythraea (Ehrenb.) Engl. (syn. C. erythraea var. glabrescens?) and C. kataf (Forsk.) Engl. are the main sources, abundant in many parts of southern Arabia, Somalia, eastern Ethiopia and Kenya. Opoponax is sometimes referred to as sweet myrrh or bisabol myrrh.

1.3. Markets and End-Uses of Frankincense, Myrrh and Opoponax

The discussion below provides as much descriptive information as it has been possible to clean. It has not been possible to accurately quantify the amounts of the resins used in the different segments of the market or in the particular end-uses. Some idea of the size of geographical markets can be obtained from trade statistics (section 1.4) – for all their deficiencies – and some comments on the comparative sizes of the end-uses (as offered by trade sources) are given in the Conclusions (section 1.7).

1.3.1 Pharmaceuticals

(i) Pharmacopoeia preparations

Apart from Chinese medicine (see below), myrrh is much more widely described in official pharmacopoeias than frankincense and this is reflected in the relative numbers of proprietary products containing these resins, which are available in the West.

Martindale (e.g. 2005), used as an authoritative reference to pharmaceutical preparations worldwide, refers briefly to the anti-inflammatory properties of Indian frankincense ("from Boswellia serrata") but otherwise limits its discussion of classical frankincense ("from Boswellia sacra (B. carteri) or other species of Boswellia") to the statement that it is "used in incense and as a fumigant, in Chinese medicine, and for its aromatic properties". Indian frankincense is included in herbal preparations for musculosceletal and joint disorders and is under investigation for use in inflammatory bowel disease and asthma.

In the latest (2004) British and European Pharmacopoeias (which are identical), identification and analytical criteria are given for myrrh and for a myrrh tincture (i.e. a solution of myrrh, or its extract, in alcohol). The analytical criteria for myrrh are summarised elsewhere in this report (1.6.2).

The United States Pharmacopoeia (2004) also gives a specification for myrrh (2.6.2) and for a "Myrrh topical solution". The preparation of the latter uses the quantities shown below:

Myrrh	200 g
Alcohol/water (85:15)	900 ml
Alcohol	to 1000 ml

Martindale refers to a number of different proprietary preparations. Myrrh tincture is used in mouthwashes and gargles for inflammatory disorders of the mouth and pharynx, e.g. the two German formulations Inspirol P and Lomasatin M. In Spain, Buco Regis is used for similar purposes and contains myrrh in combination with ipecacuanha, methyl salicylate and menthol. A Canadian cold sore lotion contains myrrh. In Switzerland, Baume is used for treating gastrointestinal disorders and contains myrrh in combination with other plant extracts, including benzoin and tolu balsam. In the UK, Herbal Indigestion Naturtabs contain myrrh, as does Allcock's Porous Capsicum Plaster. Myrrh has also been used as a carminative.

(ii) Chinese medicinal preparations

The People's Republic of China is known to import frankincense and myrrh for use in traditional medicines and the Chinese Materia Medica (2002) describes the indications and applications of Ru Xiang (frankincense) and Mo Yao (myrrh).

Ru Xiang is described as being "the gum resin obtained from Boswellia carterii Birdw. and other related species, family Burseaceae". It is indicated for pain in the stomach and abdomen, abscesses and sores, knocks and falls, and painful menstruation, and may be taken internally or externally. Modern research is cited as evidence that it: dilates blood vessels and diminishes external resistance in order to lower blood pressure and improve microcirculation; decreases blood viscosity; and alleviates pain and reduces inflammation.

Mo Yao is the "gum resin obtained from the stem of Commiphora myrrha Engl., family Burseraceae, and other related species". It is indicated for pain in the chest and abdomen, menstrual block, abscesses and sores, and knocks and falls, and, like Ru Xiang, may be taken internally or externally. Modern research, again, is cited, indicating that Mo Yao increases myocardial oxygen consumption, improves microcirculation, decreases blood viscosity and inhibits haematoblastic concentration; and reduces the level of blood lipids, alleviates pain and inhibits inflammation.

Both resins have side effects and are contraindicated for women during pregnancy. Both, too, are often given in combination with each other or with other medicinal plants or resins. One such formulation, Qi Li San, contains frankincense, myrrh, dragon's blood, catechu and carthamus.

(iii) Other medicinal applications

A lot of work has been carried out, particularly in Egypt, investigating the treatment of schistosomiasis (bilharziasis) and fascioliasis using myrrh. Both are major tropical diseases in Africa. In tests of a commercial preparation, Mirazid, it was concluded as recently as 2004 (e.g. Soliman et al.) that "Mirazid proved to be safe and very effective in treatment of S. haematobium and S. mansoni infections under field conditions". However, others (Botros et al. 2004) have cast doubt on the antischistosomal activity of myrrh and it remains to be seen

whether more research can verify its efficacy and lead to any significant new demand for myrrh in the pharmaceutical field.

In aromatherapy, frankincense, myrrh and opoponax oils attract a large number of claims and they are said to be beneficial for treating anything from colds, 'flu, asthma and bronchitis to arthritis, eczema and diarrhoea, and for helping to soothe and dispel anxiety, nervous tension and stress. Frankincense and myrrh undoubtedly have much popular appeal in the marketplace and reference is frequently made to their use "since antiquity" in promoting sales.

1.3.2 Fragrances

(i) Incense use

The major fragrance use is for burning as incense, either in religious ceremonies or around the home. In Arabia and elsewhere, frankincense is burnt in mosques, but its use in the home to provide a pleasant fragrance has decreased as increasing affluence has led to the use of higher-priced materials such as sandalwood. Egypt imports many of the lower grades of maidi for use as incense. A leading European importer reports that China, too, uses low quality frankincense for incense sticks and that this application now absorbs more of its imports than what was previously believed by some to be the largest end-use, traditional medicines.

In Europe and Latin America, substantial amounts of Eritrean-type frankincense (i.e. ex Ethiopia and Sudan) are used as incense by the Orthodox and Roman Catholic Churches. It is often formulated with other natural fragrance materials such as benzoin, but including also myrrh. Use in the home (with charcoal-burning disks) is minimal but all three resins are advertised and widely available on the Internet as natural incenses.

(ii) Perfumery use

Distillation of the crude resin yields volatile oils and these have their own characteristic, balsamic odours which find use in perfumery, although during this study several European traders have offered the view that perfumery use is declining. Frankincense oil is used both as a base and as a fixative in soaps, cosmetics and perfumes, especially Oriental, spice and men's fragrances. In citrus colognes it modifies the sweetness of bergamot and orange oils. Frankincense absolute (prepared by alcohol extraction of the resin or its resinoid) is used as a fixative with its distinct lemony-green, fresh, balsamic note and in combination with spice oils and other oils with which it blends well. Frankincense resinoid (prepared by extraction of the resin with a hydrocarbon solvent) is used as a fixative and as a fragrance component in its own right – it is more versatile in its applications than the oil.

Myrrh oil has a warm, sweet-balsamic, slightly spicy medicinal odour and is used in perfumes of the heavy floral and Oriental types. Myrrh absolute and myrrh resinoid are both used as fixatives and sweeteners in Oriental-spicy and woody bases and blend well with other oils and with the heavier floral perfume bases. Opoponax oil is sometimes used to 'cut' or stretch other oils. Opoponax resinoid is used as a fixative where its dark colour is not a drawback.

Aromatherapy has already been referred to in connection with the medicinal uses of the oils in section 1.3.1 (iii) and their fragrance properties are an essential part of their appeal to consumers.

1.3.3 Flavours

(i) Chewing

The 'clean', distinctive flavour of certain types of frankincense makes them highly valued for chewing and this constitutes an important use in local and regional markets. Maidi, in particular, is considered by Somalis and others to be of superior quality to other types, due to its lemon scent, sweet taste and pale colour, and the top grades are regarded as a prestigious chewing product in Saudi Arabia. There, it is usually consumed in households of above average income and is often used during social gatherings. Apart from being a pleasant form of confectionery, consumers believe it freshens the breath, cleans the teeth and improves digestion. In Saudi Arabia maidi is used both by the resident population and by pilgrims during the annual Haj (who also buy it to take home as a gift). Frankincense is also popular for chewing by the people of some North African countries, e.g. Libya.

(ii) Other flavour uses

Myrrh and opoponax oils are occasionally used as flavouring agents: the former in oral preparations such as mouthwashes and some beverages which require a slightly bitter flavour, and the latter in liqueurs (opoponax oil has a heavy-sweet body and wine-like notes). Myrrh is also used to give a smoky flavour to some foods and snacks.

1.3.4 Other uses

Maidi burns evenly, like candles, and in Somalia the lower grades are used locally to produce light at night. Lower grades of maidi are used in Saudi Arabia to fumigate pitchers used for drinking water. Beyo produces a larger flame and is used like a fire lighter to start fires. It is also used as a fumigant around the home and to keep snakes and insects away.

Frankincense and myrrh are used in a variety of skin care products. Their astringent properties make them useful as toners for ageing skin and as emollients they moisten, soften, protect or soothe the skin. Frankincense is used in some creams for mature skin and is known as an anti-wrinkle moisturiser.

1.4. International Trade

1.4.1 Preliminary remarks

In most cases – and unlike some other natural gums and resins, notably gum arabic and benzoin – frankincense, myrrh and opoponax are not specifically recorded in trade statistics, and this makes the task of quantifying international trade almost impossible. The reason for not separating imports or exports of these items in the published statistics is simply because the size of the trade does not warrant it. Imports of the resins, where they occur, are subsumed within the natural gums and resins category of commodities [see below, 1.4.2 (ii)].

Fortunately, China – an important market for frankincense and myrrh – does record the resins separately in its import statistics, and so, too, does Saudi Arabia – an important regional market. In all other cases the best that can be done is to identify within the import data

relating to, say, the European Union and the United States, those countries of origin under the 'Other natural gums and resins' heading (from which e.g. gum arabic has been excluded) which are producers of the three resins (or countries in the producing region that may serve as intermediaries in international trade). If all reasonable steps are taken to exclude gums and resins other than frankincense, myrrh and opoponax (particularly gum arabic) for these countries, then the resulting data may give some clue as to the magnitude of the trade.

It is worth noting that if the Chinese import statistics are examined at the hierarchical level below that for 'Olibanum, myrrh and dragon's blood' (13019020), i.e. 'Other natural gums, resins, gum-resins and balsams' [excluding lacs and gum arabic] (130190), then although the total volumes for each year are much greater for the latter category, the volumes for e.g. Somalia, Ethiopia, Kenya and Djibouti are precisely the same for both categories. In other words, use of the 'Other natural gums and resins' heading for China would have correctly identified the imports from these countries as being those of interest in this study.

In the discussion below, data for Somalia, Ethiopia, Eritrea, Kenya, Yemen, United Arab Emirates, Saudi Arabia and Djibouti have been extracted from the published statistics. In addition, Sudan has been included as a country of origin in the import data for China since the Chinese statistics specify frankincense and myrrh; in the European Union and United States statistics it would be unwise to do so because any such data could inadvertently include karaya and other gums and resins Sudan is known to produce.

A discussion of estimates of total world production and trade is deferred till later (section 1.7, Conclusions).

1.4.2 Overview of international trade

(i) Trading channels

The remit of the present study does not permit a detailed examination of the present situation in either the source countries (Somalia, Ethiopia and elsewhere) or those countries which serve as intermediate destinations, although it will be known from other parts of the FAO project. It is presumed, however, that Djibouti remains an important first stop for shipments coming out of Somalia, given its proximity and role as a free-port (Coulter 1987). A more recent account of the trade (Anon. 2003) states that Bosasso is a key Somali point of export. However, as is common with some other commodities, the desire of collectors and merchants to get as high a price as possible or to avoid payment of taxes means that there is a significant illegal cross-border trade as well as exports from smaller ports along the Red Sea.

Saudi Arabia and some of the Gulf States are important final destinations within the region and their requirements can be met by direct exports. For the wider international markets some processors and end-users import directly from source but many prefer to deal with traders in their own country, who in turn may purchase the resins from large, long-established importers elsewhere, such as Germany (Hamburg) and France (Marseilles) – in Europe – or the USA (New York). So in Europe, for example, there are imports and re-exports of the raw resin occurring all the time. The processors, too, may either use the oil or extract for their own purposes or sell it to other end-users (at home or abroad).

(ii) Classification of frankincense, myrrh and opoponax

The classification numbers and nomenclature used by the countries whose statistics are analysed below are shown in Table 1.1. As noted above, only China and Ethiopia separate out frankincense and myrrh in their trade statistics. Other countries include them within the natural gums and resins category of commodities although it has been possible to narrow this category down somewhat by excluding from the data gum arabic (and in some case other items such as lac, karaya and tragacanth).

Most countries use the Harmonised Commodity Description and Coding System (usually known simply as the Harmonised System) of the Customs Cooperation Council, in which a numbering hierarchy groups commodities according to type, and becomes increasingly more specific as the number of digits increases. A few countries, usually in the older data, show the SITC number (Standard International Trade Classification, Revision 3) of the United Nations.

1.4.3 Export data

Of the producer countries, it has only proved possible to obtain limited data for Ethiopia, and exports, and destinations, for the period 1993-97 are shown in Table 1.2 (volume). Note that gum arabic is excluded from the figures.

Table 1.1 Frankincense, myrrh and opoponax: Trade classification and descriptions of headings, which incorporate them or separately specify them

	HS number	SITC number	Description
European Union	13019090	-	Natural gums, resins, gum-resins and balsams excluding gum arabic, mastic [and lac]
United States	1301909090	-	Other natural gums, resins and gum-resins [excluding gum arabic, lacs, balsams, karaya and tragacanth]
China	13019020	-	Olibanum, myrrh and dragon's blood
Ethiopia	13019000	-	Other natural gums, resins, gum-resins, natural oleoresins and balsams [excluding gum arabic]
Ethiopia (pre-1994)	-	292220	Gums used as incense
Ethiopia (pre-1994)	-	292290	Other natural gums, resins and balsams
Saudi Arabia	13019070	-	Frankincense
	13019050	-	Myrrh

There is an upward trend in exports over the five years, with a marked increase in 1997 over the previous year. Saudi Arabia and the Gulf States/UAE appear in the list of destinations, in line with expectation, and the Yemen and Djibouti are probable intermediate destinations. Large traditional importers of gums and resins (Germany and France) also appear and China is a major destination in 1995 and 1997. Significant exports to Greece in the last three years of data may reflect use of frankincense and myrrh by the Greek Orthodox Church.

Table 1.2: Other' natural gums and resins: Volume of exports from Ethiopia, and destinations, 1993-97 (tonnes)

	[a]1993	[b]1994	[b]1995	[b]1996	[b]1997
Total	181	317	623	852	2 106
Of which to:					
Saudi Arabia	94	61	22	96	179
Yemen	-	43	14	15	69
Gulf States/UAE[c]	-	80	-	-	133
Djibouti	-	-	-	47	-
Egypt	-	-	15	30	15
Tunisia	-	-	-	43	-
Israel	-	~	10	3	10
Germany	41	113	290	435	332
France	5	20	10	15	509
Greece	-	-	12	60	104
Netherlands	-	-	-	18	15
Portugal	20	-	-	-	-
UK	7	-	-	-	-
Italy	4	-	-	-	-
Switzerland	-	-	-	-	5
China, PR	-	-	250	-	705
Singapore	10	-	-	-	-
India	-	-	-	-	30
Canada	-	-	-	90	-

Source: National statistics
Notes: a 'Other natural gums, resins and balsams' + 'Gums used as incense'
b 'Other natural gums, resins, gum-resins, natural oleoresins and balsams' (excluding gum arabic)
c 1994 = Gulf States, 1997 = UAE

The best that can be deduced from these figures is that they represent an upper limit on Ethiopian exports of frankincense, myrrh and opoponax in terms of officially recorded statistics. What other gums and resins might be included in the data, and the extent to which all shipments of frankincense, myrrh and opoponax have been properly declared and classified, is not known.

The only other export data for a producing country known to the author are those of 'incense gum' from Somalia for the period 1975-1980 (Coulter 1987). They are not reproduced here because they are now rather old, and mainly of historical interest, but exports declined from a high of 684 tonnes in 1975 to a low of 81 tonnes in 1978 before recovering to 373 tonnes in 1980. A more recent statement regarding Somali exports (Anon. 2003) is that "Port figures for Bosasso in 1998 suggest that in the region of 300-400 tonnes of 'beyo' ['Somali-type' frankincense] was exported".

1.4.4 Import Data

The only two countries which separately record frankincense and myrrh in their import statistics – China and Saudi Arabia – are discussed first, followed by those in the European Union and the United States where partially aggregated statistics are examined.

(i) China

Imports of olibanum [frankincense], myrrh and dragon's blood for the 10 years 1995-2004 are shown in Table 1.3. The contribution of dragon's blood to the overall totals is likely to be small and for the countries of origin listed here it should be nil.

Table 1.3 Olibanum, myrrh and dragon's blood[a]: Volume of imports into China from selected sources, 1995-2004 (tonnes)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total	1 886	1 070	1 101	938	1 723	1 205	1 551	1 494	1 730	2 791
Of which from:										
Somalia	796	361	176	32	86	39	-	-	-	-
Ethiopia	750	250	516	279	1 013	590	840	705	762	1 256
Eritrea	-	-	-	59	31	-	18	-	-	-
Kenya	208	147	116	364	581	534	641	715	775	1 338
Yemen	-	-	-	-	-	-	-	-	-	-
UAE	-	-	-	-	-	-	-	-	-	-
Djibouti	-	-	-	-	-	30	30	-	180	189
Sudan	100	284	242	88	-	-	-	17	-	-
Others	32	28	51	116	12	12	22	57	13	8

Source: National statistics (via World Trade Atlas)

Note: a Dragon's blood is principally resin from Daemonorops spp (Indonesia); much lesser amounts come from Dracaena and Croton spp.

The annual average for the decade is 1550 tonnes but imports reached almost 2800 tonnes in 2004. For most years the sum of the figures given for the countries of origin specified in the table is not far short of the actual total. Much of the balance ('Others') is accounted for by imports from Indonesia and will therefore represent dragon's blood as well as, presumably, so-called frankincense which is actually misclassified benzoin. In 1998, most of the balance (83 tonnes) was from Thailand and it seems likely that this, too, is a misclassified item. In 2002, Hong Kong and Singapore accounted for most of the balance.

Ethiopia and Kenya have both been consistent suppliers of frankincense and/or myrrh*, each contributing broadly similar and substantial volumes in recent years although quantities of frankincense from Kenya are far less than in Ethiopia. Direct imports from Somalia, which were almost 800 tonnes in 1995, declined to nil in 2001 and have remained so since, although it is possible that some or all of the imports from Djibouti in 2003 and 2004 were of Somali origin.

Corresponding value and unit value figures for Chinese imports are shown in Table 1.4.

Total value was virtually the same, and greatest, at the beginning and end of the period (US$2.6 million) but the larger volume imported in 2004 reflected the lower unit value (US$0.93/kg) compared to 1995 (US$1.38/kg). Kenyan imports have consistently been more highly valued than those from Ethiopia (which have shown remarkably little variation over the decade) but it is impossible to know whether this is a reflection of better overall quality or simply the result of different proportions of frankincense and myrrh in the shipments for each country.

* Note that Kenya, although a genuine producer of myrrh, does not itself produce frankincense. It may, however, acquire (and subsequently export) frankincense of Somali-origin through unofficial cross-border trade.

Table 1.4: Olibanum, myrrh and dragon's blood[a]: Value and unit value of imports into China from selected sources, 1995-2004 ('000 US$, US$/kg)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total value	2 612	2 054	1 474	1 092	1 660	1 261	1 682	1 734	1 613	2 589
(Unit value)	(1.38)	(1.92)	(1.34)	(1.16)	(0.96)	(1.05)	(1.08)	(1.16)	(0.93)	(0.93)
Of which from:										
Somalia	1 253	499	215	34	61	36	-	-	-	-
	(1.57)	(1.38)	(1.22)	(1.06)	(0.71)	(0.91)	-	-	-	-
Ethiopia	605	184	432	226	764	461	653	521	550	922
	(0.81)	(0.74)	(0.84)	(0.81)	(0.75)	(0.78)	(0.78)	(0.74)	(0.72)	(0.73)
Eritrea	-	-	-	36	19	-	9	-	-	-
	-	-	-	(0.61)	(0.61)	-	(0.50)	-	-	-
Kenya	283	219	141	352	602	489	562	629	707	1 308
	(1.36)	(1.49)	(1.22)	(0.97)	(1.04)	(0.91)	(0.88)	(0.88)	(0.91)	(0.98)
Yemen	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
UAE	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Djibouti	-	-	-	-	-	22	22	-	131	147
	-	-	-	-	-	(0.73)	(0.73)	-	(0.73)	(0.78)
Sudan	85	245	198	73	-	-	-	14	-	-
	(0.85)	(0.86)	(0.82)	(0.83)	-	-	-	(0.83)	-	-
Others										

Source: National statistics (via World Trade Atlas)

Note: a Dragon's blood is principally resin from Daemonorops spp (Indonesia); much lesser amounts come from Dracaena and Croton spp.

(ii) Saudi Arabia

Imports of frankincense and myrrh for the period 1994-2000, the latest data available to the author, are shown in Table 1.5.

In the source data for frankincense the figures for non-specified 'Others' are often substantial; in 2000 only Somalia is listed as a country of origin and most of the total for that year is from non-specified sources. Ethiopia is never given as a source country but may be included in non-specified 'Others'. In 1994 and 1995 most of the specified 'Others' imports of frankincense were from Singapore; in 1998 and 1999 most were from Iran and Indonesia so may represent misclassified tragacanth and benzoin, respectively. Alternatively, imports from Iran (and possibly Singapore?) could be re-exports of Indian frankincense (from Boswellia serrata).
Imports of myrrh are much less than frankincense but both Somalia and Ethiopia are specified as countries of origin.

(iii)The European Union

In the import statistics which follow, the totals for each year give an indication of how large the catch-all classification is, although they do exclude the substantial gum arabic heading (and some others). As before, examination of certain specified countries of origin may indirectly help to build a picture of the imports into Europe of frankincense, myrrh and opoponax. Whatever the deficiencies it is the best that can be done.

Table 1.5: Frankincense and myrrh: Volume of imports into Saudi Arabia, and sources, 1994-2000 (tonnes)

	1994	1995	1996	1997	1998	1999	2000
Frankincense							
Total[a]	790	[b] 708	430	366	455	697	651
Of which from:							
Somalia	380	260	85	?	140	226	177
Ethiopia	[c]?	?	?	?	?	?	?
Others (specified)	178	148	80	16	206	341	-
Others (not specified)	232	300	265	350	109	130	474
Myrrh							
Total	51	101	122	67	[d]-?	154	-?
Of which from:							
Somalia	?	47	56	?	-?	79	-?
Ethiopia	30	45	27	36	-?	69	-?
Others (not specified)	21	9	39	31	-?	6	-?

Source: National statistics

Notes: a For some years Indonesia is specified as a source, indicating that a significant part of the totals may include misclassified benzoin (which is misleadingly called frankincense in Indonesian trade statistics)

b Includes 112 tonnes separately listed as 'olibanum' from non-specified sources

c Not specified in source data but may be included in 'Others'

d Myrrh not listed separately but may be included in classification 'Other resins'

Table 1.6 shows the volume of imports into the European Union for the eight years 1997-2004. Somalia and Ethiopia are both seen to be suppliers of natural resins to the EU, and significantly bigger ones than Eritrea and Kenya. Ethiopia appears to be more important in volume terms than Somalia (mean annual averages of 424 tonnes and 233 tonnes, respectively).

Table 1.7 – Table 1.11 look closely at the EU import statistics for five individual countries: Germany, France, the Netherlands, UK and Italy, respectively. It is important to remember that the selected countries of origin have been chosen to represent potential primary sources of frankincense, myrrh and opoponax, together with some potential regional intermediate sources, and any imports recorded from them represent direct imports. It is also important to note that the totals in Tables 1.6-1.13 do not match the sum of the individual countries listed because the totals are those for the "Natural gums and resins" classification in toto and would be represented by scores of additional countries if they were all listed. By selectively listing only those shown (i.e. the principal producers of frankincense and myrrh), and with gums such as gum arabic and others excluded, the figures should be somewhere near the truth (for frankincense and myrrh). A significant proportion of the resins imported into, say, Germany and France, is re-exported to other EU countries. This means that although the quantities imported directly into some countries (such as the UK) from producer countries may be very small, there could be (and are) significant indirect imports, which are not seen in Tables 1.7-1.11.

Table 1.6 Natural gums and resins[a]: Volume of imports into the European Union[b] from selected sources, 1997-2004 (tonnes)

	1997	1998	1999	2000	2001	2002	2003	2004
Total	20 474	30 442	28 508	27 777	24 782	23 957	17 266	39 320
Of which from:								
Somalia	258	210	223	315	264	217	197	182
Ethiopia	453	405	450	512	474	273	432	391
Eritrea	31	47	24	5	-	-	-	20
Kenya	119	62	39	37	54	40	66	49
Yemen	32	14	47	21	41	139	57	80
UAE	33	-	-	9	21	21	8	23
Saudi Arabia	-	27	1 130	100	38	70	3	3
Djibouti	-	15	-	-	-	20	29	-

Source: Eurostat (via World Trade Atlas)
Notes: a 'Natural gums, resins, gum-resins and balsams excluding gum arabic, mastic' (and lac)
b The 15 member states before expansion: UK, Ireland, France, Germany, Italy, Netherlands, Belgium, Luxembourg, Spain, Portugal, Greece, Denmark, Sweden, Finland and Austria.

Table 1.7: Natural gums and resins[a]: Volume of imports into Germany from selected sources, 1997-2004 (tonnes)

	1997	1998	1999	2000	2001	2002	2003	2004
Total	3 132	3 849	4 243	5 419	4 067	4 513	2 560	2 609
Of which from:								
Somalia	49	24	37	135	41	75	41	29
Ethiopia	269	178	275	331	205	240	195	165
Eritrea	16	47	19	-	-	-	-	-
Kenya	97	58	39	35	51	40	66	49
Yemen	30	14	20	5	14	55	41	65
UAE	15	-	-	3	12	10	-	15
Saudi Arabia	-	-	-	-	-	-	-	-
Djibouti	-	-	-	-	-	-	12	-

Source: Eurostat (via World Trade Atlas)
Note: a 'Natural gums, resins, gum-resins and balsams excluding gum arabic, mastic' (and lac)

One thing that becomes apparent is that imports into Germany (Table 1.7) and France (Table 1.8) are skewed heavily in favour of either Ethiopia (for Germany) or Somalia (for France). Based on mean annual averages, Germany and France between them account for 90% of the EU imports of Somali resins but only 57% of Ethiopian resins. The Netherlands (Table 1.9) only appear to import directly from Ethiopia while the small quantities imported directly into Italy come almost exclusively from Somalia.

Table 1.8: Natural gums and resins[a]: Volume of imports into France from selected sources, 1997-2004 (tonnes)

	1997	1998	1999	2000	2001	2002	2003	2004
Total	3 582	3 895	3 651	4 049	4 083	3 617	2 986	3 118
Of which from:								
Somalia	186	152	182	159	196	122	111	143
Ethiopia	6	42	-	15	7	1	10	-
Eritrea	15	-	5	-	-	-	-	20
Kenya	21	4	-	2	3	-	-	-
Yemen	2	-	27	16	25	84	16	16
UAE	1	-	-	6	9	11	1	7
Saudi Arabia	-	27	20	-	-	-	2	1
Djibouti	-	15	-	-	-	3	-	-

Source: Eurostat (via World Trade Atlas)
Note: a 'Natural gums, resins, gum-resins and balsams excluding gum arabic, mastic' (and lac)

Table 1.9: Natural gums and resins[a]: Volume of imports into the Netherlands from selected sources, 1997-2004 (tonnes)

	1997	1998	1999	2000	2001	2002	2003	2004
Total	488	1 034	1 991	1 628	1 094	690	911	25 257
Of which from:								
Somalia	-	-	-	-	-	-	-	-
Ethiopia	52	30	20	-	30	32	17	46
Eritrea	-	-	-	-	-	-	-	-
Kenya	-	-	-	-	-	-	-	-
Yemen	-	-	-	-	-	-	-	-
UAE	-	-	-	-	-	-	-	-
Saudi Arabia	-	-	-	-	-	-	1	2
Djibouti	-	-	-	-	-	17	17	-

Source: Eurostat (via World Trade Atlas)
Note: a 'Natural gums, resins, gum-resins and balsams excluding gum arabic, mastic' (and lac)

Table 1.10: Natural gums and resins[a]: Volume of imports into the United Kingdom from selected sources, 1997-2004 (tonnes)

	1997	1998	1999	2000	2001	2002	2003	2004
Total	3 064	1 912	5 892	3 425	2 349	3 260	4 046	2 434
Of which from:								
Somalia	2	3	~	1	-	-	10	-
Ethiopia	2	5	2	2	3	-	-	-
Eritrea	-	-	-	-	-	-	-	-
Kenya	-	-	-	-	-	-	-	-
Yemen	-	1	1	-	2	-	-	~
UAE	15	~	~	-	~	~	4	~
Saudi Arabia	-	-	1 109	100	38	70	-	-
Djibouti	-	-	-	-	-	-	-	-

Source: Eurostat (via World Trade Atlas)
Note: a 'Natural gums, resins, gum-resins and balsams excluding gum arabic, mastic' (and lac)

Table 1.11: Natural gums and resins[a]: Volume of imports into Italy from selected sources, 1997-2004 (tonnes)

	1997	1998	1999	2000	2001	2002	2003	2004
Total	1 047	1 835	1 072	1 394	2 073	2 711	3 449	3 679
Of which from:								
Somalia	14	9	5	9	9	7	-	-
Ethiopia	-	1	4	-	-	-	-	-
Eritrea	-	-	-	-	-	-	-	-
Kenya	-	-	-	-	-	-	-	-
Yemen	-	-	-	-	-	-	-	-
UAE	-	-	-	-	-	-	2	-
Saudi Arabia	-	-	-	-	-	-	-	-
Djibouti	-	-	-	-	-	-	-	-

Source: Eurostat (via World Trade Atlas)
Note: a 'Natural gums, resins, gum-resins and balsams excluding gum arabic, mastic' (and lac)

(iv) United States

Imports of 'other' natural gums and resins into the United States for the 10 years 1995-2004 are shown in Table 1.12. The figures exclude gum arabic, karaya and tragacanth as well as lacs and balsams.

The quantities imported directly from Somalia, Ethiopia and Kenya are very small compared to the totals; they average 17 tonnes, 30 tonnes and 8 tonnes per year, respectively. It is likely, therefore, that additional imports of frankincense, myrrh and opoponax (which it is impossible to identify) enter the United States as re-exports from Europe.

Table 1.12: 'Other' natural gums and resins[a]: Volume of imports into the United States from selected sources, 1995-2004 (tonnes)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total	23 704	2 628	4 406	3 363	3 224	3 579	3 945	3 331	4 082	3 298
Of which from:										
Somalia	23	40	23	8	19	7	10	13	13	13
Ethiopia	21	10	19	25	34	42	33	40	42	34
Eritrea	20	1	-	-	5	-	-	-	-	10
Kenya	-	16	-	18	14	17	-	-	16	1
Yemen	3	4	1	-	1	-	-	-	-	-
UAE	-	1	1	4	3	1	2	-	-	-

Source: National statistics (via World Trade Atlas)
Note: a 'Other natural gums, resins and gum-resins' (excluding gum arabic, lacs, balsams, karaya and tragacanth)

Corresponding value and unit value data for the period 1995-2004 are shown in Table 1.13. The unit value figures for Somalia and Ethiopia show no particular trend – apart from 1995, they fluctuate between US$2.00 and US$2.90/kg.

Table 1.13: 'Other' natural gums and resins[a]: Value and unit value of imports into the United States from selected sources, 1995-2004 ('000 US$, US$/kg)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total value	19 188	6 966	8 136	9 867	9 975	8 667	5 941	5 676	7 302	5 765
(Unit value)	(0.81)	(2.65)	(1.85)	(2.93)	(3.09)	(2.42)	(1.51)	(1.70)	(1.79)	(1.75)
Of which from:										
Somalia	38	82	58	21	42	14	26	30	39	32
	(1.69)	(2.04)	(2.51)	(2.63)	(2.20)	(2.00)	(2.54)	(2.40)	(2.90)	(2.42)
Ethiopia	34	24	54	62	72	101	77	89	95	78
	(1.62)	(2.39)	(2.81)	(2.49)	(2.12)	(2.40)	(2.32)	(2.22)	(2.29)	(2.31)
Eritrea	80	2	-	-	9	-	-	-	-	17
	(4.00)	(2.00)	-	-	(1.80)	-	-	-	-	(1.74)
Kenya	-	20	-	30	15	17	-	-	20	7
	-	(1.25)	-	(1.67)	(1.07)	(1.03)	-	-	(1.29)	(7.00)
Yemen	9	8	2	-	14	-	-	-	-	-
	(2.71)	(2.16)	(3.77)	-	(13.32)	-	-	-	-	-
UAE	-	13	19	145	14	6	10	-	-	-
	-	(23.09)	(26.46)	(32.81)	(4.62)	(6.46)	(6.19)	-	-	-

Source: National statistics (via World Trade Atlas)
Note: a 'Other natural gums, resins and gum-resins' (excluding gum arabic, lacs, balsams, karaya and tragacanth)

1.5. Value Added Processing

Some of the end uses for the resins, notably for chewing or for burning, utilise them in their raw form, although where, for example, frankincense is burnt as incense by the Orthodox and Catholic Churches it has usually been pre-formulated and is a mixture with other aromatic resins. In many of the other applications the raw resin is either distilled to yield an essential oil or extracted with a suitable solvent before use.

1.5.1 Essential oils

As referred to earlier (1.1.3), the aromatic properties of all three resins stem from the presence of volatile, essential oils and these oils can, in principle, be obtained from the resin using classical steam distillation.

On the whole, this is fairly easily done with frankincense but, in the case of myrrh, the presence of a higher proportion of high-boiling sesquiterpenes in the oil means not only that the distillation takes longer but the specific gravity of the oil is closer to 1.0 and the oil is therefore less ready to separate as a discrete layer from the water on condensation. The latter problem may be overcome either by co-entraining the oil vapours with e.g. p-cymene; or by dissolving the myrrh in a suitable solvent and carrying out a molecular distillation; or, more simply, by adding salt to the steam-distilled condensate and thus 'salting out' the oil to settle as a layer above the brine solution.

The use of live steam in the steam distillation enables 1-2 tonne batches of frankincense to be distilled in approximately 8 hours. Batches of several tens of kilos of myrrh take around 4 hours. Oil yields are typically in the range 7-10% for frankincense and about 5% for myrrh and opoponax. Somali-type frankincense is generally preferred over the Eritrean type because it gives a slightly higher yield and the oil has a better, more citrussy odour.

1.5.2 Extracts

An extract is simply the soluble portion of the resin produced by treatment of the raw material with a suitable organic solvent, with or without the application of heat. The terms 'resinoid' and 'absolute' are frequently applied to resin extracts although the terms are not used rigorously or consistently and this sometimes leads to confusion. Strictly, resinoids are extracts of the resin (whether it be frankincense, myrrh or opoponax) in which the solvent is a hydrocarbon or has a hydrocarbon nature. An absolute is a highly concentrated alcoholic extract of the resin, prepared either directly from it or from the previously prepared resinoid. If the latter, then the resulting extract will be of a more refined nature, with different odour properties to those of the direct extract.

The insoluble part of the extract consists of any foreign matter such as pieces of bark, sand or dirt and any organic matter which is insoluble under the conditions of the extraction. The soluble extract is separated from the insoluble part by decantation or centrifugation, or by filtration using a filter press after addition of filter aid. The solvent may be retained to give a liquid extract or evaporated off to give a soft (semi-solid) or hard (solid) extract, depending on how much solvent is removed.

The extraction yield depends very much on the quality of the raw resin. One UK manufacturer quoted a typical yield for the hot alcohol extraction of frankincense of around 70%. The hard extract is a glassy solid, pale brown or amber in the case of frankincense and darker for myrrh and opoponax.

The extract is often redissolved in a solvent carrier such as benzyl benzoate, benzyl alcohol or propylene glycol. The producer formulates the extract in whatever solvent the customer requires, according to the particular application. The UK manufacturer referred to above states that benzyl esters (e.g. benzyl benzoate) are often preferred for fragrance applications and propylene glycol for flavours.

Note that tinctures are alcoholic extracts prepared by prolonged maceration of the finely divided resin with alcohol without the application of heat. Thus "Myrrh topical solution" specified in the United States Pharmacopoeia is prepared by stirring the ground myrrh with the prescribed alcohol-water mixture, decanting and filtering the resulting tincture, and diluting the clear filtrate with alcohol.

1.6 Quality, Grades and Prices

1.6.1 Quality

There are two aspects to quality: intrinsic quality, which is a reflection of the chemistry of the particular resin, and the quality which is determined by its treatment and handling subsequent to exudation from the tree.

The intrinsic quality is genetically determined at the species, provenance and individual tree level. Thus, frankincense from Boswellia frereana (maidi) is different to that from B. sacra (beyo). And myrrh from Commiphora myrrha is different to opoponax from C. erythraea. These inherent differences are what make processors and end-users want a particular resin or type of resin to suit their needs. They know from experience that any divergence from this will not give them the particular fragrance (or other) properties they desire.

Even within a species, however, it is possible for resin from different natural populations, as well as individual trees within the population, to have different chemical (and therefore different sensory) characteristics. There has been no systematic study of the intrinsic variability of frankincense, myrrh and opoponax within the natural resource. Neither has there been any thorough analysis of commercial shipments although myrrh and opoponax are known to be more susceptible to quality variation than frankincense. (This may be due in large part to the fact that the botanical origin of a particular consignment is not known with any certainty and it may not even be from a single botanical source). But one processor reports that even different batches of frankincense sometimes have different odour properties. So lack of homogeneity is something that end-users have to contend with (to a greater or lesser degree).

The tapping and collection process itself also leads to variable quality: some pieces of resin have bits of bark and dirt adhering to them and this remain the case even after the 'cleaning' and grading. Once it has been collected, the major sources of quality deterioration of the resin are the repeated handling it receives in passing from the collector to the exporter, and the conditions in which it is stored at the various points in the marketing chain. There will be some breakdown of the large pieces to smaller ones but sticking and agglomeration into irregular masses caused by high ambient temperatures is a problem, particularly if there is a loss of valuable volatile oil at the same time. Pieces of good quality selected myrrh should be slightly sticky on breaking since this usually indicates a high oil content.

1.6.2 Analytical Parameters

The British, European and United States Pharmacopoeias, as well as the British Herbal Pharmacopoeia, give identification and analytical criteria for myrrh intended for pharmaceutical use and the tests to be used to determine these criteria. Table 1.14 summarises the specifications.

Alcohol solubility is important since this gives an indication of foreign matter present (and any alcohol-insoluble organic matter) and a measure of extractive yield; ash gives an indication of non-organic matter. Volatile oil is clearly important to commercial producers of myrrh oil but it is not obvious why a minimum content should be specified for pharmaceutical applications. It may be that its inclusion in the specification helps to ensure that myrrh, rather than some other material that would otherwise comply with the analytical criteria, meets the tests.

Table 1.14: Pharmacopoeia specifications for myrrh

	Loss on drying	Alcohol-insoluble matter	Foreign matter	Foreign organic matter	Total ash	Acid-insoluble ash	Volatile oil
British/European	max 15.0%	max 70%	-	-	max 7.0%	-	-
US	max 15.0%	30-60%	-	max 2%	max 10.0%	max 5.0%	min 6.0%
British Herbal	-	max 70%	max 4%	-	max 9%	max 5%	min 6%

Apart from myrrh destined for pharmaceutical use there are no other national or international standards for the resins or, indeed, the distilled oils or extracts. In the end-use countries quality is judged largely subjectively on the basis of appearance and aroma as perceived by the prospective buyer. If a processor obtains a lower yield of, say, oil from a consignment of resin it may result in some haggling over the final price.

1.6.3 Grades and prices

The resins are sorted and graded according to size, colour and state of cleanliness before being bagged for export. In Somalia there are up to seven grades of maidi and three grades of beyo. The larger, paler lumps used for chewing are more highly valued than the smaller, darker coloured pieces and the powder and siftings. Myrrh generally has far fewer grades, perhaps two or three.

Prices for the different types and grades of the three resins are detailed below. It has not been possible to obtain reliable time series for prices and it is therefore impossible to judge trends other than through the subjective views of traders. End-users or processors in e.g. the UK purchase their requirements from British importers but these in turn invariably purchase from other European sources, particularly importers/exporters in Germany. One German trader has stated that France, too, sources supplies mainly from Germany. The prices given below are those quoted by German importers in July 2005 (C & F Hamburg) and should be regarded as indicative only. One source has provided a range of prices without distinguishing between different grades.

Frankincense – Ethiopia (~ Sudan)

1st choice	US$2.00/kg	
Pea size	US$1.60/kg	
Siftings	US$1.30/kg	
4th grade	< US$1.30/kg	(intended for China)
5th grade	<< US$1.30/kg	
Unspecified	US$1.50-2.50/kg	

Frankincense – Somalia

1st choice	US$2.50/kg
'Graded'	US$1.50/kg
Unspecified	US$1.50-2.50/kg

Myrrh

1st choice	US$3.50/kg	(intended for pharmaceutical use)
Pea size	US$3.00/kg	(intended for incense use)
Siftings	US$2.00/kg	
Unspecified	US$2.00-4.00/kg	

Myrrh – Kenya

Unspecified	US$1.50-3.00/kg

Opoponax – Somalia

Unspecified	US$2.00-2.50/kg

In early 1994 (Coppen 1995), top-grade Somali frankincense (used for perfumery purposes) was priced at about US$6/kg C & F Hamburg; top-grade Eritrean-type frankincense (for incense) was approximately US$3/kg. Clean Somali myrrh was available at US$5/kg and Somali opoponax was priced at US$3.50/kg (clean) and US$3.00/kg (natural). So even without allowing for inflation, present prices are significantly lower than they were a decade ago.

German importers report that prices are stable and have been for some time.

1.7 Conclusions

1.7.1 World Demand (by Country/Region)

Lack of reliable trade statistics of myrrh, opoponax and frankincense made it difficult to provide a good estimate of the world demand. Educated case on international trade has been made therefore based on available data. Volumes traded in the local market will be covered in country reports.

China is the largest single importer of frankincense and myrrh (Table 1.3), with Ethiopia, Somalia and Kenya providing annual averages (during the period 1995-2004) of approximately:

Ethiopia	700 tonnes
Somalia	150 tonnes
Kenya	550 tonnes

If the imports from Djibouti are averaged over the ten-year period and assumed to originate largely from Somalia then the figures become:

Ethiopia	700 tonnes
Somalia	200 tonnes
Kenya	550 tonnes
Total	1450 tonnes

The African contribution to Chinese imports is completed by Sudan (average 70 tonnes) and Eritrea (10 tonnes).

The European Union collectively is the next most important geographical market (Table 1.6) with Ethiopia, Somalia and Kenya providing annual averages during the period 1997-2004 – for what is assumed to be principally frankincense, myrrh and opoponax – of approximately:

Ethiopia	420 tonnes
Somalia	230 tonnes
Kenya	60 tonnes
Total	710 tonnes

Imports into the EU from Sudan cannot be reliably estimated and those from Eritrea and Djibouti are small. Officially recorded imports into the EU are therefore around half (in volume terms) of those going into China.

Direct imports from the producing countries into the United States (Table 1.12) are relatively small (more probably comes via re-exports from Europe*) but for the period 1995-2004 amounted annually to approximately:

Ethiopia	30 tonnes
Somalia	20 tonnes
Kenya	10 tonnes
Total	60 tonnes

The split of Saudi Arabian imports of frankincense and myrrh (Table 1.5) between the source countries Ethiopia and Somalia is impossible to estimate because of the vagaries of the statistics, but imports from Somalia averaged about 270 tonnes/year. This figure could be significantly higher if some of the unspecified sources ('Others') are imports of Somali origin.

Using the above figures – with all their deficiencies – demand for the three resins in the major markets (as reflected by direct imports from Ethiopia, Somalia and Kenya alone) is estimated at around 2500 tonnes/year:

Ethiopia	1150 tonnes
Somalia	720 tonnes
Kenya	620 tonnes
Total	2490 tonnes

* Note that Latin America is also a destination for some re-exports from Europe.

This total takes no account of e.g. significant North African demand for chewing-grade frankincense. While it cannot be quantified, anecdotal evidence suggests that opoponax demand is very small indeed; “Nobody is using opoponax” was one comment from a large European importer.

1.7.2 World Demand (by End-Use)

It is not possible to quantify demand by end-use but there is no question that incense use, in all its forms, is the greatest outlet. As already noted, China is believed to be using an increasing proportion of its imports for the manufacture of incense sticks rather than (as was previously supposed) traditional medicines.

In the West, European sources that were consulted identified pharmaceutical and cosmetic uses as being the only sectors to be showing some signs of increase. There was general agreement that use of the resins in perfumery was declining; one source put total annual consumption in this sector at around 100 tonnes, mainly of Somali frankincense.

1.7.3 Supply vs Demand

Although reliable information on the distribution and abundance of the resin-yielding species is not available, and the scattered occurrence of the trees makes detailed surveys a difficult and expensive option, Coulter (1987) was of the opinion that the total size of the natural resource and its potential productivity significantly outweighed demand for the products. Domestication of the trees would overcome problems of variability of quality caused by non-homogeneity of commercial shipments, but the inputs needed to establish and maintain trees in cultivation (such as irrigation) would be costly and unlikely to result in adequate economic returns, especially given prevailing prices for the resins.

None of the European processors or importers questioned during this study highlighted difficulties in supply as being a problem. On the contrary, they explicitly stated that they have experienced no supply problems.

1.7.4 Quality and Prices

There was agreement amongst traders and processors that there was some variability in the quality of frankincense and myrrh between countries of different origin but, because these differences were known to the end-users, they posed no great problem. Of greater concern (but still not such as to cause major problems) were the differences that were sometimes seen between shipments from the same geographical source, particularly of myrrh. One European importer commented that what his end-user customers wanted was ‘traceability’, i.e. confidence that individual consignments were homogeneous and from known sources.

Myrrh is somewhat higher priced than frankincense, and Somali frankincense (the preferred type for perfumery purposes) is slightly higher priced or about the same as frankincense of Ethiopian origin. European importers report that prices are broadly stable.

It is not possible to cite figures for oils or extracts but one European processor suggested that oil prices were 5-10 times the price of dry extract on a weight basis.

1.7.5 Value-Added Processing

Value-added processing in the country of origin is one area that might be developed and would offer the possibility of some gains in foreign exchange for the national economy. However, such gains would be very modest and the capital costs involved in setting up, for example, steam distillation using stainless steel equipment would preferably require the equipment to be shared with other essential oil-bearing crops, so as to spread the cost and maximise use. The effort needed to give potential customers of such value-added products confidence in switching their sources from long-time, traditional suppliers to those in countries which are politically and economically unstable cannot be over-estimated.

The risks involved in making such an investment, regardless of the mechanics of how it might be done – who would make it and under what terms, and who would receive it – are likely to outweigh any benefits.

1.7.6 Opportunities and Constraints for African Producers

There was general agreement amongst the European processors and importers that for these particular types of resins prices were stable. Although there were discernible changes in demand for the resins in some sectors of the market (increasing in pharmaceuticals/cosmetics, decreasing in perfumery), and demand for opoponax appears to have declined considerably, overall demand was deemed to be fairly stable. At any rate, there appears to be no pressure on prices (and therefore no adverse effect on demand) due to scarcity of supplies.

There are no new uses on the horizon which might lead to a significant increase in demand for any of the resins, but neither have there been any health and safety issues raised which could damage their reputation.

Although any natural product is at risk from the threat of synthetic substitutes (which can be manufactured with a high degree of consistency), the use of frankincense, myrrh and opoponax depends on their characteristic fragrance properties rather than functional properties (as is the case for gum arabic, for example) and this makes it much less easy for them to be substituted.

Consistency of quality, as with most natural products, is an issue but not, it appears, one that puts the business at risk. Nevertheless, although the variability is tolerated by end-users it would undoubtedly generate confidence if producer countries were to take steps to ensure that their shipments were as homogeneous as possible and from single botanical sources. This requires a combination of good quality-control practices throughout the channels of distribution (i.e. from collector to exporter) and education of all those concerned about the desirability of segregating resins from different botanical sources (even though it may not be possible to reward this by improved prices).

1.8 References

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APPENDIX 1.1: List of Organisations and Persons Visited or Contacted

United Kingdom

Frutarom (UK) Ltd — Dr John Heffernan, Research Manager
Belasis Avenue
Billingham
Cleveland TS23 1LQ

UK Trade & Investment
(formerly Export Market Information Centre)
Kingsgate House
66-74 Victoria Street
London SW1E 6SW

Germany

CE Roeper (GmbH & Co) — Mr Ruediger Dreyer, Director
Hans-Duncker Str. 13
D-21035 Hamburg

Ernst H Singelmann — Mr Carsten Singelmann, Director
Hopfensack 20
D-20457 Hamburg

Willy Benecke — Mr Thorsten Hauser, Director
Hovestr. 41
D-20539 Hamburg

Alfred L Wolff — Mr AW Duve, Director
Gr. Bäckerstr. 13
D-20095 Hamburg

France

Alland & Robert — Mr Frédéric Alland, Managing Director
9 Rue de Saintonge
75003 Paris

APPENDIX 1.2: 1987 Estimate of World Trade in Frankincense, Myrrh and Opoponax

In the absence of any other more recent data known to the author, and not knowing the outputs of the recently completed FAO fieldwork in the region, the study by Coulter (1987) – conducted with the benefit of research in Somalia, the Middle East and Europe – remains the most authoritative first-hand source of information on frankincense, myrrh and opoponax.

Since the quantitative data provided by Coulter are now almost 20 years old they are not discussed at length in the main body of the present report. However, they serve to give an indication (at the time) of relative magnitudes in the utilisation of the different types of frankincense and so are summarised below. Trade in opoponax appears likely to be much less now than was estimated for 1987.

Table 1.15: 1987 Estimate of World Trade in Frankincense, Myrrh and Opoponax (Tonnes)

	Producing country	World trade
Frankincense		
Eritrean type	Ethiopia, Sudan	2 000
Somali maidi	Somalia	800
Somali beyo	Somalia	200
Indian type	India	200
Myrrh	Somalia, (Ethiopia, Kenya)	1 100
Opoponax	Somalia, (Ethiopia, Kenya)	400

Source: Coppen 1995 (derived from Coulter 1987)

Chapter 2.0: Production and Marketing of Gums and Gum Resins in Eritrea

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Summary

Eritrea is divided into six agro ecological zones ranging from semi-desert in the coastal areas along the Red sea to the sub-humid in the eastern escarpments. About 50% of the total land area is moist or arid lowlands. These dry lands are endowed with indigenous plant species including Acacia, Boswellia and Commiphora species, important tree species that produce the commercial gums and gum resins for local market as well as for export. Major gums and resins exported from Eritrea are two: gum arabic and frankincense/ gum olibanum. Gum arabic is obtained mainly from Acacia senegal but inferior gum type "the gum Talha is also obtained from Acacia seyal. Frankincense is obtained from one species, Boswellia papyrifera. Myrrh, Opopanax and myrrh-like reins are products of the genus Commiphora species, most of which are indigenous. In spite of the wealth of these resources, however, since 1974, there are no export statistics indicating the exploitation of these species.

In Eritrea, there are no precise estimates showing the extent of the gum producing woodlands, especially by administrative regions and by species. This is because this sector has not received adequate attention in the face of its contribution to the national income as well as the role played to the rural households. Nonetheless, it is roughly estimated to be around 623, 900 ha of the bush land and woodland with a potential annual production of more than 3,500 tones. The present production level for both species is about 700 ton. Between 1995 and 2002, Eritrea exported about 11, 911 tons of gums and frankincense worth 57,526,993 Nakfa (equivalent to 5,752,699.30 USD). In spite of the significant role played by these non-wood forest products, much remains to revitalise this forestry sub-sector. This might need the liberalisation of trade and increased participation of the private sector to boost its production and commercialisation. The major destinations for the export of these commodities are the European Union (France, Germany and Denmark), the United States of America and Asia, Middle East and North Africa.

At the local level, the local communities have been exploiting and trading these commodities since time immemorial. This helps them to not only diversify their sources of income but also enable them to generate cash especially during period of crop failure. In some areas the contribution of Non-Wood Forest products may reach as high as 14% of the annual income of the rural households.

The quality assurance for both gums and gum resins is well advanced. The concessionaires have screening centres that enable them to optimise the quality of the products. The structure of the industry could, however, be improved in such a way that farmers gain the maximum

benefits from the output of the gums and gum resins. Efforts need to be done to ensure that farmers and pastoralists feel the sense of ownership for sustainable harvest.

In conclusion, the forest resources of the drier areas of Eritrea have never been utilised properly. These resources are regarded, usually, as marginal with little value as in most cases; emphasis is given to rainfed and irrigated agriculture at the expense of these woodlands. In order to influence agricultural and natural resources decision makers on the importance of these resources, efforts should be done to quantify the benefits gained out of them. The vegetation resource providing the gums and gum resins are under increased pressure from the expansion of agriculture. Efforts should be done to ensure sustainable utilisation of these resources.

2.1 Background

A century ago, forests covered about 30% of the total land area of Eritrea. This figure dwindled to 11% in 1952 (NEMP-E 1995; Bein et al. 1996). In 1960, it was estimated at 5% (MOA, 1994). Today, the closed and open forests cover less than 1%, while woodland and bush land cover 60% of the country (Table 2.1). The causes of the decline of forest resources of Eritrea show that several interrelated factors have contributed to it. The main reasons are land clearing for commercial and subsistence agriculture, overgrazing, consumption of wood for fuel, construction of traditional houses, drought and land clearing for military purposes (World Bank, 1994; NEMP-E, 1995; Haile et al. 1996; Bein, 1998).

Eritrea has a large variation in landscape and climatic features (Haggag, 1961). It has six agro ecological zones (FAO, 1997) namely: moist lowland, moist highland, arid lowland, arid highland, semi-desert and sub-humid. The diverse agro ecological conditions have given the country the potential to deliver diverse non-wood forest products (Ogbazghi, 2001, Ogbazghi and Bein, 2004).

The vegetation map of Africa (White 1983) documented the regions of the continent from which groups of associated unique species evolved the so-called regional centres of endemism. This map gave 20 major regional centres of endemism of which 4 (Sudanian, Somali-Masai, Afromontane, and Sahel region) are well represented in Eritrea (White 1983, Thulin, 1983, Friis, 1992). The Sahara regional transitional zone is limited to an isolated area along the Red Sea coast. In Eritrea, there are nine mapping units representing nine vegetation types. The relation between White's (1983) regional centres of endemism and the distinguished vegetation types in Eritrea is given in Table 2.2.

The north-eastern African region including Eritrea is well known for its resins and gums. These come mainly from three genera Acacia spp (Fabaceae), and Boswellia and Commiphora (Burseraceae). True gum arabic is extracted from Acacia sengeal (L.) Willd. which grows abundantly in the lowlands and mid altitude (400-1600 m) of Eritrea. Boswellia and Commiphora have a centre of diversity in the Somali Maasai regional centre of endemism as shown in Table 2.2 (White 1983).

Table 2.1: Vegetation types and areas covered in Eritrea.

Vegetation type	Area covered (Km^2)	Percentage of total area
Closed-Medium Forest	591	0.5
Open Forest	410	0.3
Riverine Forest	1,865	1.5
Mangrove	64	0.1
Closed-Medium Closed Woodland	4533	3.6
Open Woodland	9,541	7.6
Wooded Grassland	25,577	20.3
Bush Land	53,824	42.8
Agricultural Land	8,712	6.9
Barren Land	18,265	14.5
Others	234	0.2
Not Classified	2,172	1.7
Total	125,788	100.0

Source: Forest and wildlife sector review FAO (1997)

Table 2.2: Vegetation mapping units and the main vegetation types present in Eritrea (cf. White 1983).

Major centre of endemism	Vegetation type represented in Eritrea	Boswellia sp.	Commiphora spp.	Acacia spp.	Sterculia spp.
Afromontane region	Undifferentiated montane vegetation	X	Ö	X	X
Sudanian region	Undifferentiated woodland Ethiopian type	Ö	Ö	Ö	Ö
Somalia-Masai region and Sahel region	i) East African evergreen and semi-evergreen bushland and ticket	X	Ö	Ö	X
	ii) Somalia-Masai deciduous bushland and ticket	X	Ö	Ö	X
	iii) Somalia-Masai semi-desert grassland and bushland	X	Ö	Ö	X
Sahel region	i) Sahel Acacia wooded grassland and deciduous bushland	X	Ö	Ö	Ö
	ii) Semi-desert grassland and bushland	X	X	X	X
Sahara regional transition	Red Sea coastal desert	X	Ö	Ö	Ö
	Wadis and open desert	X	X	X	X

Ö= Present X= species absent

Boswellia papyrifera, Acacia senegal and Sterculia satigera are found mainly in the Sudanian and Sahelian regional centres of endemism. In the Sudanian region, they are mainly found in the undifferentiated woodland in the moist lowlands agroecological zone. In the Sahelian region, these species occur in the wooded grassland and deciduous bush lands. The species also extend to higher altitudes in the East African evergreen and semi-evergreen bushland and thickets (White, 1983, Ogbazghi, 2001). Unlike Boswellia papyrifera, the distribution of Commiphora species extends to the coastal areas, eastern and western escarpments as well as the western lowlands.

2.2 Major Gums and Gum Resins of Eritrea

2.2.1. Sources

In Eritrea, various gum and gum resin products are harvested and marketed in the local and export markets. A number of Acacia species produce gums. However, the most important commercial sources for export are gum Arabic and gum olibanum. While gum arabic is obtained from Acacia senegal, frankincense is obtained from Boswellia papyrifera. Various Commiphora species produce the commercial product Myrrh (gum hagar locally called Kerbe). In spite of its abundance, its exploitation as a commercial source of myrrh is poorly documented. Since 1974, there were neither sales statistics nor documents indicating it as an export commodity. Prior to 1974, there are indications that the country exported Myrrh, since then, however, there are no indications of its exploitation as a commercial source of export.

Except for Acacia senegal, planted as agro forestry plant in the western lowlands, as well as a an aforestation tree species, the other gums and resins are harvested from wild growing trees .The botanical description of the most important gum and resin producing species is described in the following sections.

a) Gum arabic (Acacia senegal)

In Eritrea, the true gum arabic is collected from three varieties of A. senegal: A. senegal var. senegal, A senegal var kerensis, and A senegal var leiorachis. Areas in Eritrea with good stocks of Acacia senegal are found in the moist and arid agro ecological zones in the western and north-western parts of the country.

A shrub or tree to 15 m, rounded, many low branches, or tall and thin. Bark is variable, smooth or peeling yellow and papery from red-brown base. Thorns: prickles in threes, the central one hooked downwards, the other two curved up, and brown to black. Leaves: compound, usually hairy, only 3-6 pairs pinnae on a stalk to 7 cm, leaflets narrow, very small, grey-green. Flowers are creamy spikes, one or more, 2-10 cm, fragrant; usually develop before the rainy season. Fruits, pods, variable, thin and flat, oblong to 14 cm, narrowing at ends, grey-yellow becoming papery brown, veins clear, splitting to release seed (Brenan and Wickens, 1983; Both, 1993; NFTA; 1991).

b) Gum talha (Acacia seyal)

A small to medium sized tree, up to 9 m, rather thin with layered branches or small more rounded. Bark is distinctive powdery, white to pale green or orange-red, often peeling to reveal greenish under bark. It has wide-angled pairs of strong white thorns to 8 cm. In the sub-species fistula, the bases of a pair are swollen to form round ant galls. Leaves are compound, 3-7 pair pinnae, raised glands just visible on leaf stalk. Its Flowers are fragrant, bright yellow in round heads over 1 cm across, several beside the thorns. Its fruits are in bunches of narrow, curved pods 7-20 cm, shiny light brown, narrowed between seeds, splitting open on the tree. The species is mostly found in seasonally flooded black cotton soils, in river valleys and wooded grassland in Zoba Gash-Barka, Anseba Debub and Northern red Sea at altitude range of 400-2000m above sea level (Bekele, et. al 1993; Bein et al. 1996).

c) Frankincense (gum-olibanum)

Boswellia papyrifera is a deciduous tree species reaching a height of up to 12 m with thick branches tipped with clusters of leaves. Its bark is smooth, pale yellow-brown, peeling-off in large papery pieces. A cut in the bark looks red-brown and a fragrant milky gum comes out of it. Leaves are large pinnately compound on a stalk about 45 cm long consisting of 6-8 pairs of leaflets and one at the tip. Each leaflet is oval in shape, 4-8 cm in size and densely haired below, the edge sharp or rounded–toothed, some times double toothed. Flowers are sweet smelling developing on pubescent panicles at the ends of thick branch-lets, appearing when the leaves have fallen off. The red flower stalk is to 35 cm long and bears the white-pink flowers with 5 petals and 10 yellow stamens. The fruit is a red capsule about 2 cm long, three-sided, consisting of three hard seeds with apical horn (Vollesen, 1989; Bein et al., 1996; Ogbazghi, 2001).

One type of frankincense is distinguished in Eritrea obtained from three varieties (sub-species or ecotypes) distinguishable by the colour of their barks (Whitish, Reddish and intermediate types). There is no systematic study on the yield of Olibanum harvested from these ecotypes (variants) but the whitish type, which grows abundantly at an altitude of 800-1000 m altitude yields higher than the reddish, and the intermediate types. Gum-olibanum is the one traded frankincense in Eritrea.

d) Myrrh (Commiphora spp.)

The flora of Ethiopia including Eritrea documented 52 species of Commiphora out of which at least 8 are found in Eritrea (Vollesen, 1989). The genus is found in association with Acacia-Boswellia species. Several Commiphora spp. produce currently or potentially marketable gum resins (Kuchar, 1995). Myrrh or opopanax are used to refer to the various resinous products obtained from Commiphora species, though distinction is often made between them depending on the specific source species in some literature (e.g. Thulin and Claeson, 1991). Commiphora gum is classified as scented/perfumery myrrh (called 'bissabol' or opopanax) and medicinal myrrh (called 'heerabol'). Myrrh (heerabol) is a typical name for the gum obtained from Commiphora myrrha (Nees) Engl and is called true myrrh (FAO, 1995). Opopanax/scented myrrh is the name given to the myrrh obtained from Commiphora guidottii Chior (Farah, 1994) or C erythraea (Ehrenb.) Engl or C. kataf (FAO, 1995).

Habit: Trees or shrubs; branches often terminating in spines; outer bark is often papery and peeling, inner bark usually greenish, with resinous- usually aromatic-sap, wood with milky latex. Leaves imparipinnate or 1-3-foliolate (rarely simple), often congested at branch ends. Flowers unisexual and dioecious (very rarely monoecious and/or bisexual), usually before the leaves appear or with new leaves, in panicles, cymes, racemes, fascicles or solitary. Calyx 4-lobed. Petals 4, free, linear to elliptic, re-curved apically. Stamens (4) 8, didynamous, antisepalous usually the longest; vestigial in female flowers. Disc 4- or 8- lobed or annular usually glabrous. Ovary 2(3)-locular; style short; stigma capitate (rarely clavate); ovary absent; or vestigial in male flowers. Fruit with a single 1(2) - seeded stone; exocarp fleshy or leathery, splitting into 2 or 4 valves; outer layer of endocarp forming a fleshy pseudaril (Vollesen, 1988).

In Eritrea there are many Commiphora species that yield gums that are sold under the name myrrh or opoponax such as Commiphora boranensis Vollesen, Engl., C. habessinica (Berg.) Engl., C. corrugata Gillett & Vollesen, C. erythraea (Ehrenb.) Engl and others (Tucker, 1986). The resin from C. erythrea (A. Rich.) often referred to as 'hagar' is also collected and traded widely in the towns of Eritrea. The chief Commiphora gum of economic importance in Eritrea is myrrh.

e) Gum karaya

There are two species Sterculia setigera and Sterculia african growing in south and southwestern parts of Eritrea. Nonetheless, the genus is wildly represented by the species of Sterculia setigera. In spite of its economic importance, little is known in literature about the product and the source species. This product is, traded only at the local market for medicinal purposes in (e.g. Barentu and Keren) mainly for medicinal purposes and is not included in the international trade list of Eritrea. In the future, it is paramount to launch a separate study dedicated to the non-wood forest products and their role in the international trade of the country.

f) Other gums

A number of Acacia species also produce gums that are traded locally for human medicine or ethno-veterinary medicine whose specific uses are not specified yet. Table 2.3 shows the various Acacia spp, which yield gums in Eritrea. Nonetheless, none- of them has significant role in the international trade.

About 10 Acacia, 1 Boswellia papyrifera and 8 Commiphora species are so far reported as Eritrea's potential bearers of gum, frankincense and myrrh/opopanax (Table 2.3). A study on the distribution and regeneration of Boswellia papyrifera in Eritrea shows that the stem densities per hectare for five areas namely Adi-Ketina Atawen, Ferhen, Molki and Shilalo were 186, 270, 80, and 239, respectively Ogbazghi (2001). The average yield per tree is 1.5 Kg per season. For the other species, such studies are lacking and deserve special attention in the future. Indeed, the analysis of the floristic composition, abundance and potential productivity of the dry land vegetation resources of the country clearly demonstrate that there is a high potential for the production of gum resins in the country.

2.3 Gum Production Potential in Eritrea

The National Action Programme (NAP) of Eritrea to combat desertification and mitigate the effects of drought estimates that the total area of gum resin bearing woodlands cover over 623,900 ha of land in Eritrea, with over 3,500 metric tons of natural gum production potential (Table 2.4). However, obtaining precise quantitative information on actual annual production by gum type in the country is inexistent. Several enterprises visited clearly indicated that, acquiring reliable data on annual production particularly for gums and resins produced in the country is not systematically documented. There are a number of reasons for that: 1) across border trade with neighbouring countries 2) lack of proper forest regulatory and management systems in place to document the place of collection, and the yield of each product 3) lack of forest product control that are responsible to quantify and/or control the production processes, and 4) poor documentation from purchasing enterprises and producers. Table 2.4 enlists the major gum and resin producing species.

Table 2.3: Economically valuable gum/resin producing Acacia, Commiphora and Boswellia spp. found in Eritrea

Acacia spp.	Commiphora spp.	Boswellia sp.	Sterculia sp.
Acacia etbaica Schweinf	Commiphora africana (A Rich.) Engl.	Boswellia papyrifera (Del.) Hochst.	Sterculia setigera
Acacia mellifera (Vahl.) Benth.	Commiphora habessinica (Berg) Engl.		
Acacia oerfota (Forssk.) Schweinf	Commiphora corrugata Gillett & Vollesen		
Acacia polyacantha	Commiphora kua (R Br Ex Royle) Vollesen		
Acacia senegal var senegal	Commiphora erythraea (Ehrenb.) Engl.		
Acacia senegal var kerensis	Commiphora gileadensis (L.) C.Chr.		
Acacia senegal var leiorachis	Commiphora guidotti Chiov		
Acacia seyal var fistula	Commiphora cyclophylla Chiov.		
Acacia seyal var seyal	Commiphora hildebrandtii (Engl.) Engl		
Acacia sieberiana D.C.	Commiphora schimperi (Berg) Engl.		

Sources: Vollesen, 1989, Kuchar, 1995, Bein et al 1996;, Ogbazghi, 2001, Ogbazghi and Bein 2004)

Table 2.4: Estimated Area coverage and actual and potential yields of major gum arabic and gum olibanum species and forest products

Commercial name	Species	Estimated area ($K.m^2$)	Estimated area in (ha)	Potential production (tons/year)	Current production /tons/year
Gum arabica	Acacia senegal	4,041	404, 100	>1000	250
Gum Olibanum	Boswellia papyrifera	2,198	219,800	>2,500	450
Total		6,239 Km^2	623,900	3,500	700

Source: The National Action Programme for Eritrea to combat desertification and mitigate the effects of drought (NAP) 2002.

Table 2.5 shows the area coverage of gums and gum resins production potential by zoba (administrative regions) of the country. Presently, the major gum arabic and gum olibanum producing zones are Anseba, Gash-Barka and Debub.

Commercialisation of gum-olibanum in Eritrea stated in 1925. Large-scale commercialisation started in 1932. Table 2.6 depicts the historical records of gum-olibanum production from 1962-1974 of natural gums and resins. It shows that there was great fluctuation in the production of incense with peak production for the year 1971 and the lowest 1968. The production trends in the case of gum arabic are much more stable.

Table 2.5: Frankincense, myrrh and gum Arabic production potential in Eritrea by administrative regions

Administrative region (Zoba)	Type of gum resin grown/ found	Occurrence and exploitation status
1) Southern Red Sea	1) Gum commiphora (myrrh, apopponax etc) 2) Gum (arabic + talha)	Not exploited
2) Northern Red Sea	1) Gum (arabic + talha)	Not exploited
3) Maekel	None	None
4) ANSEBA	1) Gum olibanum 2) Gum from commiphora (Myrrh, appoponax, etc) 3) Gum (arabic + talha)	Gum olibanum exploited
5) Gash-Barka	1) Gum olibanum 2) Gum commiphora (Myrrh, appoponax, etc) 3) Gum (arabic + talha) 4) Gum Karya Sterculia	Gum olibanum exploited
6) Debub	1) Gum olibanum 2) Gum commiphora (Myrrh, appoponax, etc) 3) Gum acacia (arabic + talha)	Gum olibanum exploited

Table2. 6: Historical profile of the production of gum-olibanum and gum arabic in Eritrea during the period 1962-1974

year	Gum-olibanum		Gum arabic	
	Metric tones	Equivalent price USD	Metric t tones	Equivalent price (USD)
1962	1,395	697,500	477	238,500
1963	1,962	981,000	641	320,500
1964	1,759	879,500	366	183,000
1965	1,617	808,500	377	188,500
1966	2,035	1,017,500	165	82,500
1967	797	398,500	412	206,000
1968	739	369,500	487	243,500
1969	1,728	864,000	193	96,500
1970	1,963	981,500	220	110,000
1971	2,351	1,175,500	599	299,500
1972	1,856	928,000	744	372,000
1974	1,500	750,000	941	470,500
Total	19,702	9,851,000	5,622	2,811,000

Source: 1962-1974: Asmara Chamber of commerce, Asmara, Eritrea. The exchange rate of the Ethiopian Birr against the USD was equivalent 1: 2.05.

2.4. Tapping, Sorting and Structure of the Industry

2.4.1. Tapping

i) Boswellia and Commiphora spp

Tapping of Boswellia trees takes place during the dry season, starting in late September, and continues until March. Tapping for frankincense involves making incisions in the bark and the phloem with a special tool locally known as “mingaf”. The gum solidifies while on the trees and it is collected every three weeks. Gum olibanum is available in small tears or lumps of white-yellowish-reddish colour (Ogbazghi, 2001). After collecting the dried resin, the original wound is re-opened to allow a steady flow of the more resin. Seven times per harvest season, each tree, is revisited and wounded. Off-season rains may interrupt tapping and resin collection activities.

According to the tappers, tree size determines the number of tapping points per individual tree. Small trees ranging 10-20 cm in diameter are tapped at four points and larger trees at six points. The tapping points should be facing east and westwards, as this is believed to enhance the yield. In spite of these guidelines, over-tapping and use of inappropriate tapping methods by unskilled labourers take place and damage Boswellia trees (Ogbazghi, 2001). Nonetheless, many people think that tapping is a non-destructive exploitation system, as trees are not felled for wood though present intensive tapping practices negatively affect the regeneration of Boswellia papyrifera and thus threatens the survival of the species. A study carried out showed that viable seeds for establishment trials could only be obtained from un-tapped trees (Ogbazghi, 2001) and that natural regeneration was only found in non-grazing areas with un-tapped Boswellia stands. How tapping affects the reproductive cycle, particularly the production of viable seeds is still unknown.

ii) Tapping of Acacia spp.

According to the MoA report (2002), the Sudanese introduced the business of gum arabic collection to Eritrea in the early 1950s. However, owing to the protracted war of liberation (1961-1991) this resource is not exploited to the fullest.

There are various ways of obtaining gum arabic. The first is the collection of natural gum exudates collected from trees and the second is tapping acacia trees for gums. Some farmers and pastoralists collect from acacia species gums that ooze naturally. In this case, the gum collection is not their sole occupation, and hence they accomplish collection side by side with herding and farming activities.

The second way of getting gums is tapping trees. This is particularly true for Acacia senegal and Acacia seyal. Presently, most of the gum comes form naturally growing trees. Since 1996, acacia plantations have been initiated as part of the forestation and reforestation efforts as well as to integrate the acacia species into the farming systems as an agro forestry intervention. The idea is to grow these multipurpose trees as alley crop or border shelterbelts to mitigate the adverse effects of land degradation. Integrating of this valuable species into the farming system would not only enable farmers to obtain maximum yield from the sale of gums but also get fodder to their livestock and wood for fire to their households.

Tapping of Acacia for gums starts at the beginning of the dry season. It takes place in October and November and lasts throughout the dry season. A two-edged axe especially made for that purpose is used for tapping. The axe on one edge cuts the bark of the tree and the other is used to peal-off the bark to allow the release of exudates. Nonetheless, tapping frequency, unlike in the case of Boswellia papyrifera, is done once, which is sufficient to trigger the release of the gum from the tree. There is no standard procedure involved in tapping of acacia trees in Eritrea. Mature acacias trees are tapped at several points on the truck and the main branches. The wound allows the gum to ooze out and it is left to solidify and dry while on the tree.

Studies have not yet been carried out to precisely quantify the yield of gum per tree. Preliminary estimates gave about 150-300 grams. Nonetheless, the average yield of individual trees varies from tree to tree and the time of the year and preceding amount of rainfall in that particular area. Good rainfall followed by dry and hot weather conditions are favourable for obtaining good harvest of gums. Gum production per tree increases with increase in the local temperature. Cold season may reduce or even stop gum production. Unusual rains may also interrupt gum collection.

2.5. Quality Control Aspects

Processing of natural frankincense takes place at the processing centres in Towns of Keren and Mendefera. It involves manual cleaning from impurities, selection and grading principally based on colour and tear sizes. In the case of gum olibanum, sieves of different mesh sizes, 6mm, 4mm and 2 mm, are used to sort the tear granules into different size grades, while eye sorting is done for colour. While five major grades are identified at most processing centres, sometimes refined sub-divisions as grade one to grade four are observed in commerce. The first choice/first grade olibanum is an evenly bigger and pure white tear, a second grade is a pea size and whitish tear, third grade called sifting are fine but white pieces (Table 2.7). The fourth grade consists of bigger granules of brown to dark coloured tears, and finally the fifth grade

called grabbling consist a mixture of powdery resins of both darker and whiter pieces as well as impurities like bark that are often left behind the higher grades. All the grading is done manually. While the first, second and third grades are exported, the fourth and fifth grades are sold on the domestic market.

On the other hand, myrrh is sorted into five grades (grade 1 to 5), while gum arabic & talha in most cases are only cleaned but not sorted into different grades. Information obtained from the various enterprises engaged in natural gum trade indicate that prices for the various natural gum and quality grades are more or less stable for the last five and so years.

Table 3.7: Quality grades and export prices for various natural gums and resins in Eritrea

Gum type	Quality grade	Price in U.S.D/ kg
Gum-olibanum	Grade 1. Pure white without powder and homogenous in size and colour	2.67
	Grade 2. slightly darker without powder and homogenous in size and colour	1.67
	Grade 3. whitish with some powder	1.33
	Grade 4. fourth grade containing (siftings) hetergenous size	0.73
	Grade 5. Fourth grade special with barks and other impurities	0.20
Gum arabic	Grade 1	4.80 - 5.00
	Grade 2	3.80-4.80
	Grade 3	2.80-3.80
	Grade 4	1.80-2.80

2.6 Natural Gum Export Trend and its Value in Eritrea

The production and marketing of gum arabica and gum-olibanum are quite different. In the case of gum-olibanum harvest, there are licensed concessionaires engaged in this enterprise since 1932. Contractual workers collect during gum collection period, which begins each year at the end of the rainy season in September and ends in March, which marks the beginning of the short rains. The dried gum oloibanum (incense) is filled in locally made fibber or plastic bags which are stored in temporary sheds impermeable to rain. These products are transported to the nearest stores in the Towns of Mai-Mine, Mendefera in Debub and Tokombya and Keren for Gash-Barka and Anseba regions respectively. The crude product is screened into five grades based on visual appearance of the colour of the grains and the size of the grains. Mostly, trucks are used to transport the products, but in case of inaccessible sites to vehicles, camels, donkeys or humans transport it the nearest station where transportation facilities are available.

In the case of gum arabic, the collection and marketing aspects is longer than that of gum-olibanum, which is dominated by the concessionaires. In this case, the marketing starts from producers (the tappers) who sell their products to the intermediary, who are usually merchants. The intermediaries in turn sell their produce to the bigger companies involved in the export business. The intermediaries carry the products to established sellers in the local market. The local market transfers the products to towns. Collectors from the district markets sell to the whole sellers who transport the products to national level where the products are sold either to private enterprises or to the national store. Then, the products are sorted, graded, and finally prepared for shipment.

The quantity of natural gum export and the value of foreign currency that Eritrea is earning from the export show inconsistency from one year to year. This is probably due to at least two major reasons. First, the participation of private enterprises in production, processing and export of natural gums and resins has decreased. Secondly, the area covered by Boswellia papyrifera tree that produces gum-olibanum population has decreased mainly due to overexploitation of the resource base.

Historically the exploitation of gum-olibanum has been the right of two major concessionaires; one in Keren (exploiting the resources in Anseba and Gash-Barka) and the other in Mendefera (exploiting Debub and parts of Gash-Barka). However, today there are over seven private registered enterprises that are actively engaged in exporting natural gums and resins from Eritrea (Table 2.8). The majority of the private enterprises trade in gum olibanum and they are active in exporting than presenting their products on local markets. Between 1995 and 2002, Eritrea exported 11,911 tonnes of gums and gum-olibanum (Table 2.9) and earned 57, 526,993 Nakfa (7,259,866 U.S.D). Gum arabic dominates, with over 80% of the export from Eritrea.

Table 2.8: Major natural gum exporting private enterprises and their contact addresses in Eritrea

Enterprise	Type Of Product Exported	Telephone	Fax	P. O Box	City	Address
Africa General Trading	Gum Arabic	291-1-121483	NA	5352	Asmara	
Ageca (Eritrea) Company	Gum Arabic	291-1-120988	291-1- 122386	876	Asmara	Mereb No 189
Amanios Mekonnen	Gum Arabic	291-1-127279	-	4508	Asmara	
Azieb International	Gum Arabic and Gum Olibanum	291-1121462/117343	291-1-121462	2- Lorenzo Taezaz	Asmara	175.9 Acss N^{o} 2
Berhanu Brothers P.L.C.	Gum Arabic	291-1- 116414	291-1-125140	1013	Asmara	
Falcon Internationla Pvt. Ltd. Company	Gum Arabic	1210238/126467	291-1-120801/129393	3659	Asmara	Harenet Ave. 117
Hellens International	Gum Arabic	121086	124507	1487	Asmara	Beleza Street 175.15 No^{1}
Natna Holding	Gum Arabic	291-1-126560	291-1-127286	5399	Asmara	
Ogbamichael Yimesghen Co. (Okc)	Gum Arabic	291-1-202352/120680/122749	291-1-202352	3778/1805	Asmara	Abdrbabu 173. 11
Red Sea Trading Corporation	Gum Arabic	291-1-127846	291-1-124353	332	Asmara	Fleket Stret 176 N^{o} 11
Sacif (Eritrea) Pvt. Ltd. Co	Gum Arabic and Gum Olibanum	291-1-120747	291-1-120354	521	Asmara	Nakfa Street Number 175 House No 10
T.C.I.P.L.C.		291-1-201517	291-1-120300	5259	Asmara	
Yemen		291-1-120252	291-1-122430	5414	Asmara	

Table 2.9: Amount of natural gums and gum resins (including gum olibanum, myrrh, opopanax, balsam and gum arabic) export from Eritrea and their value

Year	Type of gum/gum resin		Total Export	
	Gum Arabic (value)	Gum resins (value)	Quantity (kg)	Value (Nakfa)
1995	1,4764,090	2,850,458		17,614,548
1996	2,861,515	999,327		3,860,842
1997	4,414,084	325,536		4,739,620
1998	3,224,030	1,202,217		4,426,247
1999	5,337,735	4,710,468		10,048,203
2000	6,629,041	524,307		7,153,348
2001	5,963,250	661,596		6,624,846
2002	2801,362	257,977		3,059,339
Total	45,995,107	11,531,886		57,526,993

1. Gum arabic denotes gums from Acacia senegal and from Acacia seyal
2. Gum resin denote frankincense, myrrh, opopanax, and other gum resins of commerce from Eritrea

Major destinations of gum arabic and gum olibanum from Eritrea are shown in Table 2.10. The table shows that France followed by USA and the Republic of Sudan remain as the main trade partners in these enterprises. The total earning from this business also showed a decline owing to the border conflict as well as the adverse effects of droughts that have negatively affected the production of gums and gum resins.

Table 2.9: Major destination of Eritrean Natural Gums and Gum Resins in the world market in the last eight years by gum type

Country	1995	1996	1997	1998	1999	2000	2001	2002	Total
China					79,975				79,975
Denmark	2808,000								2,808,000
Ethiopia	127,790								127,790
France	5724,960	1,760,725	2,256,470	717,700	1,818,590	6,629,041	3,207,340	2,656,397	24,771,223
Germany	3,292,800			383446					3,676,246
Hong Kong		2160							2,160
Japan	501,120								501,120
Netherlands								36820	36,820
Saudi A	547,200				344105			106345	997,650
Sudan	19,100	4950	49954	47124			2755910	1800	2,878,838
Sweden	112,320								112,320
UK	529,200								529,200
USA	1,101,600	1093680	2107660	2075760	3095065				9,473,765
Total	14,764,090	28,61,515	4,414,084	3,224,030	5,337,735	6,629,041	5,963,250	2,801,362	45,995,107

Source: Ministry of Finance, Customs Department External trade statistics (1995-2002)

Table 2.10: Major destination of Eritrean Natural Gum-Olibanum in the world market in the last eight years by gum type

Country	1995	1996	1997	1998	1999	2000	2001	2002	Total
China				85,680	419,555	86,427			591,662
Denmark	1684,800								1,684,800
Ethiopia	429,249	665,124	78,840	6,575					1,179,788
France					1,888,555		438,945		2,327,500
Germany					1,407,050				1,407,050
Saudi A	532,260	324,000	12,960	1,036,140		40,000			1,945,360
Sudan	16,050	10,203	39,336	73,822	257,763	397,880	176,331	257,977	1,229,362
Tunisia	188,100		194,400		201,790				584,290
UK					249,150				249,150
Yemen							46,320		46,320
Singapore					286,605				286,605
Total	2,850,459	999,327	325,536	1,202,217	4,710,468	524,307	661,596	257,977	11,531,887

Source: Ministry of Finance, Customs Department External trade statistics (1995-2002)

2.7 Constraints in production and commercialization

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 (Ogbazghi, 2001). Nonetheless, 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. Unfortunately, owing to the lack of proper forest management practices, the stock of gum and resin producing vegetation, their ecosystem and the benefits expected of them is severely deteriorating in Eritrea. According to Ogbazghi (2001), Ogbazghi and Bein (2004) the forest and woodlands in Eritrea are under serious threat mainly as a result of four major processes of over exploitation: (1) clearing and conversion of woodlands to arable farming, 2) resettlement programs, 2) excessive wood harvesting for fuelwood; 3) improper harvesting/tapping of gums and resins, 4) overgrazing by livestock

Similarly, there are various other factors hampering the expanded commercialization of gum resin products. Some of the major market constraining factors in development of the resources and their commercialization are: 1) decline of the gum producing trees as result of land degradation and drought 2) lack of quality control measures 3) parallel across border trade 4) lack of tree tenure to guarantee incentives to farmers and pastoralist so as to conserve and manage the woodlands 5) lack of enforced legal regulatory measures to control the over exploitation of trees. A detailed analysis follows.

2.7.1. Factors affecting the production

The main issues addressed in relation to the gum and resin producing species are: unwise peeling of the bark of Acacia senegal for the production of gum arabic, as well as the cutting of those trees for fuel wood and farm fences, resulting in land degradation. Production of gum olibanum, which was around 2,500 tons/year in the early 1930s has recently declined to around

450 tonnes/ha owing to unwise tapping, indiscriminate cutting and excessive trimming of Boswellia papyrifera to feed livestock during periods dry season from late October to early March.

There are several human induced factors, which affect the population structure of the Boswellia stands. The main ones are land clearing, grazing and tapping trees for gum resins. The trees removed from cultivated land or cut as fodder plants are the extreme case, which targets not only the gum producing species but also other species. The second is grazing pressure, which affects seedling survival and establishment as well as sapling growth and development.

i) Improper tapping

Frankincense production for either commerce or local use is done through tapping; which involves creation of incisions (wounding) to the body of the frankincense trees. Incisions are made by peeling off the bark of the trees using sharp instruments called Mingaf. The depth, intensity and frequency of incisions depend on the experience of the taper as there is no standard training offered on the practice. However, intense tapping and improper wounding are harmful to the frankincense trees. Particularly, repeated stabbing with the attempt to harvest more incense, as often practiced in most areas, is injurious to the trees. Furthermore, deep incisions that affects the sapwood of the trees causes drying and death of the trees. In the cases where the trees withstand the deeper incisions, healing may take longer time and trees suffer from the recovery as tapping takes place during dry seasons when growth conditions are poor to allow quick healing. This ultimately declines trees' vitality and productivity.

Incisions predispose frankincense trees to insect and pathogenic infection. Incision creates route to allow woodborers and other parasites to get access and infect the frankincense trees. The infection coupled with the weakened resistance of the trees due to the intense wounding in dry seasons, causes frequent death of frankincense trees (Farah, 1994; Tilahun, 1998, Ogbazghi, 2001). According to Farah (1994), the over all damages done to frankincense trees owing to improper tapping is over 50%.

ii) Deforestation

In Eritrea, the population pressure coupled with continuous influx and resettlement programs is endangering the plant density and the habitat of resin producing vegetation in the country. Clearing of the woodlands for farming and settlement and overexploitation for fuel wood are becoming the major threat to the future of the resin producing vegetation as well as the biological resources associated with them. Besides, assessments of Boswellia papyrifera population in the country show lack of natural regeneration leading to the listing of the species as one of the endangered species in Eritrea (Ogbazghi 2001).

iii) Over grazing

Grazing pressure has intensified during the last century because of improved veterinary services; the livestock population has increased substantially. From 1946 to 1976, the number of goats, sheep and cattle increased by 46% (Bein, 1998). Last estimate gave 1.65 million Tropical Livestock Units (FAO, 1994, Haile et al. 1996). Grazing pressure is widespread throughout the country and is particularly severe during the dry season when tapping activities take place.

The negative impact of grazing on the regeneration of woody plant species is well documented. Studies on the restoration of montane tree species in the northern highlands and other areas of Eritrea showed that grazing remains a bottleneck to the regeneration of woody plant species in the country (Jones 1991, FAO, 1997b). Grazing disrupts regeneration both directly and indirectly. Directly, it involves the removal of the whole plant or parts of the vegetative or reproductive structures of a plant. Indirectly, livestock trample the soil surface resulting in seedling mortality and in soil compaction, which limits recruitment and seedling establishment (Crawley 1983, 1992, Breman and Kessler 1995, Barnes et al. 1998). In Eritrea, the long dry season and recurrent droughts exacerbate the consequences of grazing. Slow growing Boswellia papyrifera seedlings are unable to escape grazing during the prolonged juvenile stage of their development. Livestock can easily damage germinants and young seedlings. Their leaves are succulent and plants lack defensive morphological structures such as thorns or spines.

There are no systematic data on the effect of the size of the livestock population on the forest cover but widespread degradation and lack of regeneration of many tree species due to overgrazing is evident everywhere. Eritrea's woodlands and bush lands where gum production takes place are situated in the agro-pastoral and pastoral zones, where they support large livestock population. In these areas, the animals graze freely in all types of habitats except in limited locations where enclosures are put to enhance the natural regeneration of the forest and woodlands. Apparently, the ecological disturbances and damages caused by overgrazing, particularly the negative impacts on natural regeneration of gum resin producing vegetation such as Boswellia papyrifera is immense (Bein, 1998; Ogbazghi, 2001).

iv) Land use change

Recent studies on the causes of the decline of forest resources of Eritrea show that several interrelated factors have contributed to it. The main reasons are land clearing for commercial and subsistence agriculture, overgrazing, consumption of wood for fuel, construction of traditional houses, drought and land clearing for military purposes (World Bank 1994, NEMP-E 1995, Haile et al. 1996, Bein 1998).
During the long history of subsistence agriculture and especially after the introduction of commercial agriculture, many forests were converted into agricultural land. Fiori (1912) noted the seriousness of the problem during the first half of the last century.

With the increase in population, land clearing extended to steep areas unsuitable for cultivation. Furthermore, increased demands for firewood and the use of wood for the construction of traditional houses have adversely affected the forest cover (Haile et al., 1996). Licensed commercial exploitation of timber, fuel-wood and charcoal has further aggravated the problem (Jones 1991, Bein 1998). This is likely to remain as it is because the main source of domestic energy in the country is still wood (Habtesion, 1997, FAO, 1997).

v) Climatic variability

During the past decades, there has been a persistent fluctuation of rainfall. Rainfall records in Asmara (1903-1932) show that out of the 30 years only in 13 years the rainfall exceeded the mean annual rainfall of 518 mm and that in the remaining 17 years, it was much less (Civil Aviation Authority, Asmara unpublished data). Later rainfall records (1933-1962) of the same area and other meteorological stations in the country show a similar pattern. The effects of

drought on the vegetation are unknown but Ogbazghi (2001) noted that a period of drought was usually followed by tree mortality. The drought of 1968-1973 in the Sahel region severely affected tree species. The effect of drought in this area was exacerbated by increased population pressure (White 1983, Workineh, 1987).

vi) Armed conflicts

The negative effects of the 30 years liberation war (1961-1991), on forest resources have been emphasized in the Environmental Management and Action Plan of Eritrea (NEMP-E, 1995;Bein, 1996). The most recent border conflict with Ethiopia (1998-2000) has also resulted in massive destruction of forests and woodlands in the Gash-Barka Zone where these resources are found. It is, however, difficult, if not impossible, to give precise figures on the extent of deforestation caused by war. Frequent bombardment and fire killed trees and many were cut to provide firewood and to construct trenches and military sheds. As the forest and woodlands were regarded as hiding place for guerrilla fighters they were regarded a nuisance and recklessly cleared (Haile et al. 1998).

2.7.2. Factors affecting the commercialization of the resources

i) Lack of quality awareness

Lack of quality awareness and backwardness of the production, storage, processing and transportation techniques are among the limiting factors for good prices and thus expansion of natural gum commercialisation in Eritrea. In this connection, there is a dire need to improve the quality, particularly purity of gums and gum resins produced and marketed in order to retain or increase markets.

ii) Lack of integrated marketing networks

The current marketing chain does not allow the fast expedition of the production from the place of production to the export outlets.

iii) Uncontrolled trade

Registered enterprises complained that lack of control on both domestic and export trade of gum resin products in Eritrea is affecting the expansion of commercialization of the product. There are many unregistered traders who do not pay regular tax thus affecting the competitiveness of registered tax paying traders. Because of this, it is discouraging the regular traders from expanding their commerce of gum resin products of the country. Also transactions in export trade are holding money for long time and are affecting the turnover, and thus the quantity of trade per year.

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Chapter 3.0 Production and Marketing of Gums and Gum Resins in Ethiopia

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Summary

Ethiopia's drylands are endowed with native plant species in the genera Acacia, Commiphora, Boswellia and Sterculia, important tree species known to produce commercial gums and gum resins. Major gums and gum resins of international commerce produced in Ethiopia are gum arabic, frankincense/olibanum, myrrh, opoponax and gum karaya. Gum arabic of commerce in Ethiopia is obtained from two Acacia species: Acacia senegal and A. seyal both of which are collected and traded separately. Frankincense/olibanum is a gum resin tapped from several species of the genus Boswellia, and in Ethiopia five Boswellia species produce three different quality olibanum namely Tigray, Ogaden and Borena type frankincense. Myrrh, opoponax and myrrh like gum resins are products of Commiphora species, several of which are either indigenous or even endemic to Ethiopia. Gum karaya is produced by species of the genus Sterculia mainly from the species Sterculia setigera, which is also indigenous to Ethiopia. The commerce of gum karaya is undeveloped in the country unlike the other gums and gum resins.

Ethiopia is estimated to have over 3.5 million ha of woodlands and bushlands with an estimated 30, 000 tons of gums and gum resins production potential, although small proportion of this potential is tapped annually at the present. At the national scale, between 1996 and 2003, Ethiopia exported 16, 019 tons of natural gums and gum resins (gum arabic, frankincense, myrrh and opopanax), which was worth 176, 682,488 Birr (20, 473, 058 USD). The gums and gum resins sub-sector is playing significant economic role both at the local and national level, and their contribution is growing every year. Some elements of this growth are the liberalization of the trade and increased participation of private entrepreneurs. In the past gums and gum resins trade was solely monopolized by the Natural gum processing and marketing Enterprise (NGPME), whose contribution has fallen to only 44% of the total export from Ethiopia today. Major destinations for the gums and gum resins from Ethiopia are Asia, Europe, North Africa and the Middle East.

At the local level, communities in dryland areas have been tapping and trading gums and gum resins in an effort to diversify their economic base and address the issue of food insecurity. This potential, if integrated and balanced with other opportunities for dryland management, can contribute to the economic well-being of the communities and long term viability of dryland ecosystems, and thus offer a sustainable alternative for dryland development.

Though the quality assurance for gum olibanum, specifically for the Tigray type olibanum is well advanced in Ethiopia, for the rest gums and gum resins a lot remains to be done to optimise the economic gains. In addition, the structure of the industry needs to be improved in such ways that will allow the producers (farmers) to gain a fair share of the income and thus be motivated to produce more quality gums and gum resins.

In conclusion, the potentialities of gums and gum resins in drylands development have never been fully utilized in Ethiopia because of lack of awareness on the value of these resources at policy level. Indeed, the importance of gums and gum resins resources has generally been neglected and the emphasis is put on conventional agriculture in the dryland regions. Consequently, the vegetation resources that offer gums and gum resins and their ecosystems are facing increasing degradation due to resettlement programs, land expansion for arable farming, overgrazing and recurrent human induced fires, which appear as major constraints for the production and commercialisation of the resources.

3.1 Background

In Ethiopia, forest resources comprise 5% of high forest, 72% of other woodlands, shrublands, savanna and grasslands, 16% of cultivated land, and 7% of others (Earth Trends, 2003). The high richness in biological diversity of the vegetation resources (Shibru and Martha, 1998; Mulugeta, 2004) gives the country the potential to deliver diverse forest products particularly in the form of non-wood forest products (NWFPs) (Pol, 2002). Various gum resins obtained from one of the most widespread vegetation types (Acacia-Commiphora woodland) in the country represent a group of NWFPs in Ethiopia. The Acacia -Commiphora woodland and thickets in Ethiopia are endowed with several native Acacia, Commiphora, Boswellia and other tree and shrub species known to yield economically important gums and gum resins such as gum arabic, gum talha, frankincense (gum olibanum), myrrh, opoponax, etc. These gum resins have been playing and continue to play significant roles in the economy of Ethiopia (Mulugeta and Demel, 2003). The gum belt in Ethiopia runs in a semi-circle around the northern, western, southern and eastern parts of the country, mainly in the drier low lying arid to semi-arid lands at altitudes below 1700 m.

Ethiopia is well recognized with respect to the production and supply of natural gums and resins from biblical time, and still today the country is one of the major producers and exporters of various kinds of natural gums and resins. In fact, in terms of forest products exports, the economic benefits obtained from gum and resin bearing dryland vegetations of the country far outweigh the forests of the humid and sub-humid combined (Mulugeta and Demel, 2003). Nevertheless, the actual production, marketing channels and constraints for commercialization of the oleo-gum resin resources of Ethiopia are poorly documented.

3.2 Major Gums and Gum Resins of Ethiopia and Their Botanical Sources

In Ethiopia various gum and gum resin products are produced and marketed. Gum arabic, gum karaya, myrrh, opoponax, hagar, and frankincense (olibanum) are some of the important gum and gum resin products collected and traded in the country.

3.2.1 Gum arabic

In Ethiopia gum arabic in most reports refers to the gum collected from A. senegal and A. seyal, though the two are clearly collected and delivered separately since they are purchased on a different price basis. In some reports the two are referred to separately as gum arabic and gum talha, the former refering to the gum from Acacia senegal and the later to the gum obtained from Acacia seyal. Gum talha of A. seyal has higher price than the true gum arabic from A. senegal in the case of Ethiopia (e.g. Mulugeta et al., 2003). Gum arabic from A. senegal is collected from two varieties in Ethiopia namely A. senegal var. kerensis, and A. senegal var. senegal. Areas in Ethiopia with good stocks of A. senegal and A. seyal are found in western, southern and south-eastern lowlands in areas often referred to as the 'gum belt'. IR and ^{13}C NMR analyses of gum from A. senegal collected from Metema, North-western Ethiopia, showed a nearly identical chemistry with a gum sample from A. senegal obtained from Kordofan in Sudan (Ermias, 2003).

3.2.2 Gum karaya

Gum karaya is obtained from species in the genus Sterculia (Girmy Fitwi, 2000). There are several species of this genus growing in north and Northwest Ethiopia. The genus is wildly represented by the species of Sterculia setigera. However, little is know in literature about the product and the source species.

In general, about 10 Acacia, 6 Boswellia and 17 Commiphora species are so far reported in Ethiopia as potential bearers of gum, frankincense and myrrh/opopanax (Table 3.1). This forms the highest diversity of commercial Acacia, Boswellia and Commiphora distribution in Eastern Africa (Lisanework, nd). According to some of the studies, particularly those carried out in the south-eastern parts of Ethiopia, the gum and incense yielding species comprise over 60% of the stem density in the Acacia-Commiphora woodland vegetation stands (Mulugeta et al., 2003; Lisanework, nd). Indeed, the analysis of the floristic composition, abundance and potential productivity of the dryland vegetation resources of the country clearly demonstrate that there is a high potential for the production of gum resins in the country (Mulugeta and Demel, 2003).

3.2.3 Commiphora Gum Resins

Fifty-two species of Commiphora are known to exist in Ethiopia, and 14 (25%) of the species are endemic (Vollesen, 1989). As in the case of Boswellia species diversity, the southeastern Acacia-Commiphora woodlands are the richest in the diversity of Commiphora species. Thirty-five (67%) of the Commiphora species found in the country have been recorded in the southeastern woodlands, including 9 (64 %) of the endemics to Ethiopia (Vollesen, 1989; Kuchar, 1995).

Several of the species in the genus Commiphora produce currently or potentially marketable gum resins (Kuchar, 1995). Myrrh, bdellium or opopanax are used to refer to the various resinous products obtained from Commiphora species, though distinction is often made between the three depending on the specific source species. In some literature (e.g. Thulin and Claeson, 1991) Commiphora gum resins are classified as scented/perfumery myrrh (called 'bissabol' or opopanax) and medicinal myrrh (called 'heerabol'). Myrrh (heerabol) is a typical name for the gum resin obtained from Commiphora myrrha (Nees) Engl. and is called true myrrh (FAO, 1995). This is probably the myrrh used dominantly in medical context (Mulugeta and Demel, 2003). Opopanax/scented myrrh is the name given to the myrrh obtained from Commiphora guidottii Chior (Thulin and Claeson, 1991; Farah, 1994) or C. erythraea (Ehrenb.) Engl. or C. kataf (FAO, 1995).

There are still many Commiphora species that yield gum resins that are sold under the name myrrh or opoponax such as Commiphora boranensis Vollesen, Engl., C. habessinica (Berg.) Engl., C. corrugata Gillett & Vollesen, C. erythraea (Ehrenb.) Engl. and others in Ethiopia (Tucker, 1986; Mulugeta et al., 2003). The resin from C. erythrea (A. Rich.) often referred to as 'hagar' is also collected and traded widely in the south and southeastern parts of Ethiopia (Mulugeta et al., 2003). The chief Commiphora gum resins of economic importance in Ethiopia are myrrh, opoponax and hagar.

3.2.4 Frankincense (Olibanum)

Frankincense is gum resin obtained from several species of Boswellia trees. Frankincense, incense, olibanum, resin, and aromatic products, are all used to refer to the products of Boswellia trees. As the product is odoriferous, it is often referred to as incense in general terms while technically this product is referred to as gum-resin (Farah, 1994). The term olibanum is used inter-changeably with frankincense (Farah, 1994; Tilahun, 1997).

Three types of frankincense are distinguished from Ethiopia: Tigray type, Ogaden type and Borena type. The Tigray type olibanum is the most widely traded frankincense in Ethiopia, and is the gum-resin obtained from Boswellia papyrifera (Del.) Hochst. B. papyrifera is found dominantly in the northern and northwestern lowlands of Ethiopia. The Ogaden and Borena types are gum-resins produced in the east and south eastern parts of the country. The specific source species for these latter types of frankincense are not clear. However, resins from B. rivae (Engl.), B. ogadensis (Vollesen) (Somali name 'Gended'), B. neglecta (S. moore) (Somali name 'Murdufur') and B. microphylla (Chior.) (Somali name 'Muqlay') are collected and traded as frankincense in these areas (Girmay Fitwi, 2000; Mulugeta et al., 2003). Other species that yield resinous products designated as frankincense may also exist in these parts of Ethiopia, and may even include those species known from Somalia, for instance, B. sacra (Vollesen, 1989). The southeastern Acacia-Commiphora woodlands are the richest in diversity of Boswellia species in the country.

Table 3.1: Economically valuable gum/resin producing Acacia, Commiphora and Boswellia species found in the drylands of Ethiopia.

Acacia	Commiphora	Boswellia
A. etbaica Schweinf.	C. africana (A. Rich.) Engl.	B. microphylla Chiov.
A. drepanolobium	C. boranensis Vollesen	B. ogadensis Vollesen
A. horrida (L.) Willd.	C. corrugata Gillett & Vollesen	B. neglecta S. Moore
A. mellifera (Vahl.) Benth.	C. cyclophylla Chiov.	B. rivae Engl.
A. oerfota (Forssk.) Schweinf.	C. erosa Vollesen	B. papyrifera (Del.) Hochst.
A. polyacantha	C. gileadensis (L.) C.Chr.	B. pirrotae Chiov.
A. senegal var. senegal	C. guidotti Chiov.	B. sacra* Fluckige
A. senegal var. kerensis	C. habessinica (Berg) Engl.	
A. seyal var. fistula	C. hildebrandtii (Engl.) Engl	
A. seyal var. seyal	C. kua (R. Br. Ex Royle) Vollesen	
A. sieberiana DC.	C. erythraea (Ehrenb.) Engl.	
A. stuhlmannii Taub.	C. myrrha (Nees) Engl.	
	C. ogadensis Chiov.	
	C. rostrata Engl.	
	C. schimperi (Berg) Engl.	
	C. serrulata Engl.	
	C. truncata Engl.	

Sources: Vollesen, 1989, Kuchar, 1995; Mulugeta et al., 2003; Mulugeta and Demel, 2003; Lisanework, nd

* the existence of this species in the country is not certain.

3.3 Natural Gum Production Potential in Ethiopia

Estimates show that the total area of gum resin bearing woodlands cover over 3.5 million ha of land in Ethiopia, with about 30,000 metric tons of natural gum production potential (Table 3.2). However, obtaining precise quantitative information on actual annual production by gum type in the country is difficult. Several offices and private enterprises visited clearly indicated that,

acquiring reliable data on annual production, particularly for gums and resins produced in the south and southeast parts of the country are difficult. This is due to i) parallel trade across borders with neighbouring countries as well as within enterprises in the country, ii) lack of proper forest management, iii) lack of accountable forest product control offices that are responsible to quantify and/or control the production processes, and iv) poor documentation from purchasing enterprises and producers.

In the north, particularly for the Tigray and Amhara Regional States, data obtained from their respective bureaus of Agriculture showed 4,160 tons and 1,520 tons, respectively of average annual production of natural gum during the last six years. These figures on actual annual production for the two regional states are low when compared with the potentials presented in Table 3.2. On the other hand, data obtained from NGPME (Table 3.3), the major producer state enterprise in Ethiopia, show that except for the Tigray type olibanum, the production trend for the other gum and resin types is declining through time in the country.

Table 3.2: Frankincense, Myrrh and Gum Arabic Production Potential in Ethiopia by Administrative Regions

Regional State	Type of oleo-gum resin	Estimated total area (ha)	Estimated potential production (tons)	Source
Afar	1. Gum olibanum 2. Gum commiphora (myrrh, apopponax etc) 3. Gum acacia (arabic + talha)	65,000	1. 250 2. 500 3. 600	Girmay (2000)
Amhara	1. Gum olibanum (Tigray type) 3. Gum acacia (arabic + talha)	604,382	1. 2,000 3. 1,800	Abeje (2002); Anonymous (1997).
Beneshangule Gumuz	1. Gum olibanum 2. Gum commiphora (myrrh, appoponax, etc) 2. Gum acacia (arabic + talha)	100,000	1. 500 2. nd 3. 700	Girmay (2000)
ESNRS*	1. Gum olibanum (Ogaden type) 2. Gum commiphora (Myrrh, appoponax, etc) 3. Gum acacia (arabic + talha)	>1,000,000	1. 2500 2. 4500 3. 1,700	Girmay (2003); Mulugeta et al. (2003); Lisanework, nd
Gambella	1. Gum olibanum 2. Gum commiphora (Myrrh, appoponax, etc) 3. Gum acacia (arabic + talha)	420,000	1. ND 2. ND 3. 1,100	Girmay (2000)
Oromiya	1. Gum olibanum (Borena type) 2. Gum commiphora (Myrrh, appoponax, etc) 3. Gum acacia (arabic + talha)	430,000	1. 6,000 2. 1,500 3. 10,000	Girmay (2000)
Tigray	1. Gum olibanum (Tigray type) 2. Gum Commiphora 3. Gum acacia (arabic + talha)	940,000	1. 2,660 2. 150 3. 2,100	Tilahun, (1997); Girmay (2000)

*ESNRS = Ethiopian Somali National Regional State; ND denotes no data

Table 3.3: Production of Natural Gum and Gum Resins by NGPME (Tons)

Year	Gum Olibanum			Gum arabic		Gum commiphora	
	Trigray	Ogaden	Borena	Arabic	Talha	Myrrh	Opopanax
1996	NP	47.8	200.5	111.9	36.60	48.60	0.90
1997	NP	262.7	177.7	113.0	NP	74.30	5.30
1998	1182.30	5.80	10.60	NP	5.60	105.10	14.70
1999	717.80	0.06	0.01	NP	58.20	85.30	8.00
2000	1,422.3	0.15	1.80	3.65	NP	99.70	12.20
2001	1,750.0	0.34	14.90	NP	24.87	27.31	NP
2002	2,015.4	NP	3.06	NP	34.15	32.33	2.05
2003	1,808.5	2.01	1.51	NP	29.60	42.18	1.32

Source: NGPME; NP denotes no production

3.4 Tapping and Structure of the Industry

Gum tapping in Ethiopia differs from place to place and, hence, there is no one described method considered as standard (Mulugeta and Demel, 2003). A common tapping practice for gum olibanum in the north is by scrubbing the bark of frankincense trees using local tools. Tapping depth, width, frequency, etc. are all dependent on the experience of local tapper. There has been no backing from research to improve the traditional tapping practice in Ethiopia. In the south and south-eastern parts of the country, incense that oozed naturally is collected. In these parts of the country the producers are herdsmen, women and children (Mulugeta et al., 2003). Gum/resin collection is not their sole occupation, but they accomplish collection side by side with herding. Similarly, the majority of gum arabic and gum Commiphora (myrrh, hagar, opopanax, etc.) in Ethiopia are collected from natural exudation. Exception is in the northwest of Ethiopia where small scale tapping trial is exercised for the production of gum arabic.

Enterprises engaged in natural gum production and marketing in Ethiopia acquire the products from two sources: i) from products collected by hired tappers from forest stands obtained through concession and, ii) direct purchase of gum/resins collected from local collectors (farmers/nomads or producer cooperatives). The former procedure, which is common in the north and northwest parts of Ethiopia, involves direct employment and organization of experienced coordinators and tappers. The enterprises provide them with basic necessities for the collection mission. The workers are hired on contractual basis during gum collection period, which begins in September and terminates in June. The collected gum/resin is filled in sacks and stored in temporary stores in the field, some times for prolonged period as the stores are located far off-road, until transportation is organized for delivery. In case of inaccessible sites for vehicles the products are transported close to roads by means of camels, donkeys or humans. Then trucks transport the products to processing centers located in towns. In the second procedure, the marketing channel is very long. The marketing starts from producer-intermediary exchange where producers are selling the products to intermediaries. The intermediaries carry the products to established sellers in the local market. The local market transfers the products to District, nearby towns or to a near by NGPME branch office. Collectors

from the district markets and NGPME offices transport the products to national level where the products are either sold to private enterprises or to the national store of NGPME. Then, the products are sorted and graded, and finally prepared for shipment. Most of the private enterprises trade primarily gum olibanum, specifically the Tigray type olibanum. The lion share of gum arabic, gum talha and gum commiphora purchase, production and commerce from Ethiopia is conducted by NGPME.

3.5 Quality Control Aspects

Processing of natural gum at the processing centers involve manual cleaning from impurities, selection and grading principally based on color and tear sizes. In the case of gum olibanum (Tigray type), sieves of different mesh sizes, 6, 4 and 2 mm, are used to sort the tear granules into different size grades, while eye sorting is done for color. Five major grades are identified at most processing centers, sometimes refined sub-divisions as first choice grade A, first choice grade B, second grade, third grade, fourth grade special and normal, etc. are observed in commerce (Table 3.4). The first choice grade olibanum is a bigger and pure white tear, a second grade is a pea size and whitish tear, third grade called sifting are fine but white pieces. The fourth grade consists of bigger granules of brown to dark colored tears, and finally the fifth grade called grablings consist a mixture of powdery resins of both darker and whiter pieces as well as impurities like bark that are often left behind. All the grading like the collection is done manually. While the first, second and third grades are exported, the fourth and fifth grades are sold on domestic market. No grading is done for the Ogaden and Borena quality olibanum. On the other hand, myrrh is sorted into five grades (grade 1 to 5), while gum arabic & talha in most cases are only cleaned but not sorted into different grades. Information obtained from the various enterprises engaged in natural gum trade indicate that prices for the various natural gum and quality grades are more or less stable for the last five years.

Table 3.4: Quality grades and exports prices for various natural gums and resins in Ethiopia

Gum type	Quality grade	Price in USD/ kg
Gum olibanum	1. Pure white without powder (First choice grade A)	1.90 - 2.00
(Tigray type)	2. " (First choice grade B)	1.70 - 1.90
	3. Pea size (Second grade)	1.50 - 1.85
	4. Third grade (siftings)	1.20 - 1.35
	5. Fourth grade special	1.00 - 1.20
	6. Fourth grade normal	0.80 - 1.00
	6. Fifth grade (Grablings)	0.80 - 0.85
Gum myrrh /opopanax	Five grades (grade 1 - 5)	2.00 - 2.50
Gum arabic	No grade	0.68 - 2.50
Gum talha	No grade	1.00 - 3.00

3.6 Natural Gum Export Trend and its Value in Ethiopia

The quantity of natural gum exported and the value of foreign currency that Ethiopia is earning from the export are steadily increasing in Ethiopia during recent years (Fig. 3.1a & b). This is probably due to the increasing participation of private enterprises in production, processing and export of natural gums and resins. In the past, tapping, processing and marketing of natural

gum was dominated by a government enterprise, i.e. NGPME. However, today there are over seven private enterprises (Table 3.5) that are actively engaged in exporting natural gums and resins from Ethiopia. The private entrepreneurs share about 56% of the export and 55% of the export value at the present (Table 4.6). The majority of the private enterprises trade in gum olibanum, principally the Tigray type olibanum, and they are active in exporting than presenting their products on local markets. None the less some of the private entrepreneurs as well as NGPME present considerable share of their natural gum product on local market (Table 3.7). In fact, the domestic sale by NGPME is partly purchased by the private enterprises, which ultimately is exported. Between 1996 and 2003, Ethiopia exported 16, 019 tons of natural gums and gumresins and earned 176, 682,488 Birr (20, 473, 058 USD). Gum olibanum, principally Tigray type olibanum, dominates, with over 90% of the natural gumresin export from Ethiopia. On the other hand, exported quantity has increased for both gum arabic and gum resins (frankincense, myrrh and opopanax) as shown in Table 3.8.

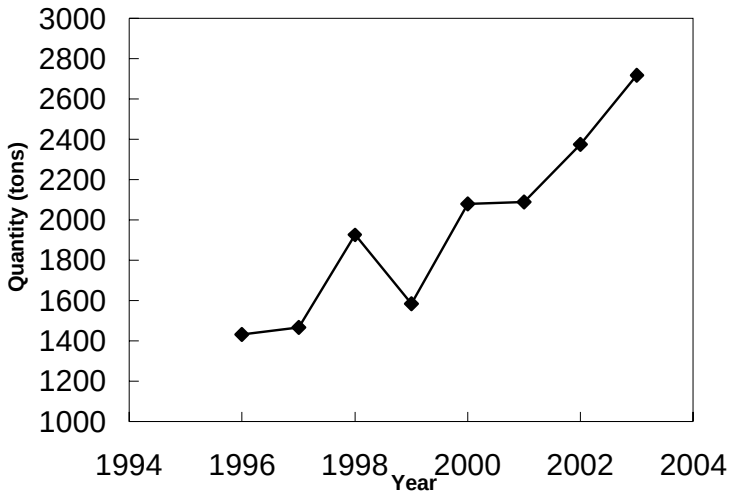

Fig. 3.1 a: Quantity of exported natural gum and gum resins

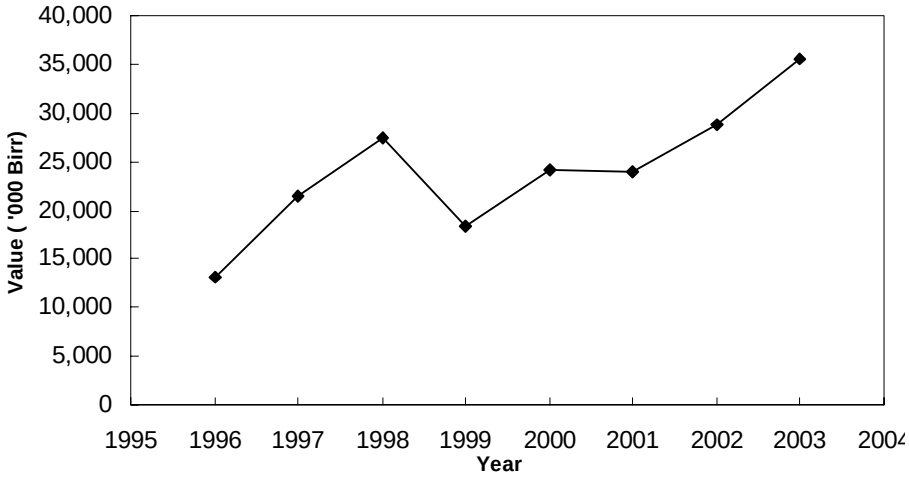

Fig 3.1 b: Value (in Eth. Birr) of exported natural gum and gum resins

Table 3.5: Major natural gum exporting private enterprises and their contact addresses in Ethiopia

No.	Enterprise name	Telephone	Fax	P.O. Box	City
1.	Abbebaye C.C. PLC	251 01 530775	251 01 513965	5304	Addis Ababa
2.	Genale Migs Trading P.L.C.	251 01 560352	251 01 513965	2259	Addis Ababa
3.	Darulea Nesredin	251 01 752572	25101756261	12672	Addis Ababa
4.	Guna Trading Houses P.L.C.	251 01 652288	251 01 654633	80316	Addis Ababa
5.	NGPME	251 01 518813/159932	251 01 518118	62322	Addis Ababa
6.	Ambassel Trading house	251 01 533502/525695	251 01 515315/505840	12617	Addis Ababa
7.	BWAP Export P.L.C.	-		5304	Addis Ababa
8.	Yahiya Seid Omer	251 01 751296	251 75 12 96	4202	Addis Ababa

Table 3.6: Amount of natural gums and gum resins (including gum olibanum, myrrh, opopanax, and gum arabic) export from Ethiopia and their value

Year	Type of gum/gum resin		Total Export	
	Gum arabic[1] (tons)	Gum resins[2] (tons)	Quantity (kg)	Value (Birr)
1996	30.12	1,435.9	1,466.0	13, 064,000
1997	46.86	1,878.1	1,925.0	21, 405,000
1998	44.52	1,604.5	1,649.0	22, 386,000
1999	15.0	1,579.0	1,594.0	18,415,786
2000	130.4	1,948,572	2,079,000	24,222,682
2001	830.1	1,378,900	2,209,000	23,909,507
2002	874.7	1,502.3	2,377,000	17,661,176

1. Gum arabic denotes gums from A.senegal and from A. seyal 1 US$ = 8 Birr
2. Gum resin denotes frankincense, myrrh, opopanax, from Ethiopia.

Table 3.7: Amount of natural gum, principally gum olibanum, traded on the domestic market in Ethiopia

Year	NGPME* (tons)	Ambassel Trading House (tons)	Guna Trading houses (tons)	Darulea Nesredin** (kg)
1996	1,727.7	ND	244.0	-
1997	845.7	ND	454.0	-
1998	410.5	95.6	1,004.0	-
1999	760.4	142.4	ND	-
2000	619.6	293.1	1,453.0	-
2001	644.4	140.9	1,523.0	-
2002	641.0	127.1	870.0	-

Source: Data obtained from the respective enterprises;
ND denotes no data;
* Domestic sale by NGPME does not necessarily imply that the amount is traded on local market since several of the private enterprises purchase part of their export from NGPME;

**Though the enterprise is active in domestic sale of natural gum was not willing to provide data;

Major destinations of exported natural gums and gum resins of Ethiopia among others are China, Tunisia, the Middle East mainly Saudi Arabia, United Arab Emirates and Yemen as well as several European countries (Table 3.8).

3.7. Constraints in Production and Commercialization

In view of the present and potential industrial, local and socio-economic significance of gum and resin resources, sustainable extraction of the products deserve special attention (Kindeya, 2003). Sustainable collection requires understanding about the physiology and ecology of gum and resin production, especially the mechanism by which harvesting affects the vegetative growth, reproduction and resin production (Abeje, 2002), while to sustain the economic benefits from the resources the identification and resolving marketing constraints are valuable. Sadly, owing to the lack of proper forest management, the stock of gum and resin producing vegetation, their ecosystem and the benefits expected of them is severely deteriorating in Ethiopia. According to Kindeya (2003) and Abeje (2002) dry woodlands in Ethiopia are under serious threat mainly as a result of the following processes: (i) clearing and conversion of woodlands to arable farming, ii) government resettlement programs, iii) excessive wood harvesting for fuel wood; iv) improper harvesting/tapping of gums and resins, v) overgrazing by livestock. Similarly, there are various other factors hampering the expanded commercialization of gum resin products. Some of the major market constraining factors in development of the resources and their commercialization are i) poor accessibility and thus higher production cost for the resources; ii) lack of quality control, and iii) parallel across border trade. These factors are discussed in detail in the following sections.

3.7.1 Factors Affecting the Resource Base

i) Improper Tapping and Damage to Tree Populations

Frankincense production, either for commerce or local use, is done through tapping in the north and western parts of Ethiopia. Tapping involves incisions (wounding) to the body of the frankincense trees. Incisions are made by shaving off the bark of the trees using sharp instruments such as axe or knife. The depth, intensity and frequency of incisions depend on the experience of the taper, and there is no standard training offered on the practice. However, intense tapping and improper wounding are harmful to the frankincense trees. Particularly, repeated stabbing with the attempt to harvest more incense, as often practiced in most areas, is injurious to the trees. Furthermore, deep incision that affects the inner bole (the sapwood) of the trees would cause drying and death of the trees (Wubalem et al., 2002). In the cases where the trees withstand the deeper incisions, healing may take longer time and trees suffer from the recovery since the wounding is made during dry seasons when growth conditions are poor to allow quick healing. This ultimately declines trees' vitality and productivity.

Table 3.8: Major destination of Ethiopian natural gum in the world market in the last five years by gum type (tons)

		1999	2000	2001	2002	2003
Gum arabic	Total	15.0	130.4	830.1	874.7	380.9
	Of which to:		ud			
	Belgium				16.0	
	China			320.0	345.0	60.0
	Djibouti				60.0	
	Egypt			15.0	15.3	
	Germany			300.0	120.0	60.00
	Greece	15,000		90.0	15.00	15.00
	Guatemala					31.00
	Iceland			0.10		
	India				10.00	
	Israel				0.45	
	Namibia				30.00	
	Saudi Arabia			15.00	0.50	26.60
	Tunisia			15.00	136.00	75.00
	Turkey					30.00
	United Arab Emirates			60.00	112.50	80.10
	USA				0.02	0.20
	Yemen			15.00	13.90	2.98
Olibanum, myrrh/ opopanax, and others	Total	1,579.3	2,078.6	1,208.7	1,501.0	2,338.8
	Of which to:					
	Belgium		3.90			
	Bulgaria					0.10
	Canada	0.05				
	China	583	740.0	390.0	650.0	632.03
	Djibouti			75,198		
	Egypt		64.60		30.92	16.17
	France		29.58	25.00	40.00	16.73
	Germany	417.70	453.00	149. 85	188.29	260.17
	Greece	133.70	134.70	75.00	149.98	180.00
	Guatemala					128.00
	Iceland			0.20		
	India		45.00	15.00	15.00	51.17
	Israel	4.86	9.21	2.10	7.99	8.52
	Mexico					15.00
	Netherlands		8.00	14.85	14.85	16.73
	Saudi Arabia	163.00	180.20	88.09	5.02	60.00
	Singapore	30.00				
	Switzerland			45.00	15.00	
	Tunisia	15.00	89.44	89.72	165.00	236.84
	UK					15.00
	United Arab Emirates	151.05	193.77	149.16	217.44	598.12
	USA	15.00	17.24	29.58	2.49	18.36
	Unknown destination					16.36
	Yemen	65.98	110.00	59.90		69.50

Source: Export promotion agency, National Bank of Ethiopia and Ethiopian Custom Authority;
ud denotes unknown destination

Incisions have also been indicated, though not certified scientifically, to predispose frankincense trees to insect and pathogenic infection (Farah, 1994; Tilahun, 1998). Incision creates route to allow woodborers and other parasites to get access and infect the frankincense trees. The infection coupled with the weakened resistance of the trees due to the intense wounding in dry seasons, cause frequent death of frankincense trees (Farah, 1994; Tilahun, 1998). Another improper tapping that is reported harmful to the frankincense trees is bark-burning practice. While light burning of the bark of frankincense trees is claimed to increase yield, trees subject to fire eventually face drying more frequently than those not exposed to burning (Farah, 1994). According to Farah (1994), the overall damage done to frankincense trees owing to improper tapping is tremendous, and perhaps over 50% of the frankincense trees subject to tapping are often damaged. Together with other damages such as overgrazing, fire and clearance for agriculture, improper tapping is causing a widespread damage including hampering natural regeneration. The deterioration of the woodland vegetation stocks in the drylands is the principal root cause for the advancing desertification in the region (Mulugeta and Demel, 2004).

ii) Deforestation, Overgrazing, Resettlement and Other Land Use Change Impacts

Despite the marginal environmental conditions, farming semiarid and arid lowlands where gum resin producing vegetation dominates are under increasing human pressure in Ethiopia. Native people settled in these areas coupled with continuous influx of landless immigrants and resettlement programs are endangering the populations and the habitat of gum resin producing vegetation in the country. Clearing of the woodlands for farming and settlement, deliberately setting fire, and harvesting for fuelwood are becoming major threats to the future of the gum resin producing vegetation as well as the biological resources associated with them (Abeje, 2002). For instance, in Tigray region more than 177,000 ha of Bosswellia forest is reported to have been destroyed in the last 20 years (Kindeya, 2003). Similar reports exist for Gonder (Abeje, 2002), and the Somali region (Mulugeta et al., 2003). Besides, assessments of Boswellia papyrifera population in the north and northwestern parts of Ethiopia showed lack of natural regeneration leading to the listing of the species as one of the endangered species in Ethiopia (Kindeya, 1995, 2003).

Moreover, in Ethiopia woodlands and bushlands are largely situated in the agro-pastoral and pastoral zones, where they support large livestock population (Mulugeta et al., 2003). The animals are allowed to graze freely in all types of forests without restrictions on numbers or seasons. Apparently, the ecological disturbances and damage caused by overgrazing, particularly the negative impacts on natural regeneration of woody species (Demel, 1997), including gum resin producing vegetation is immense (Woldeselassie, 2001; Abeje, 2002).

iii) Human-Induced Fire

Traditional savanna and woodland vegetation management particularly by cattle herders and pastoralists involve fire. Though the vegetation in dryland areas are evolved under cyclic fire, some species such as B. papyrifera need some fire-free years to allow enough regeneration and the development of seedlings into saplings and poles to maintain the populations (Menaut et al., 1995). However, in most cases woodland vegetations are exposed to annual burning that is badly affecting not only delicate seedlings but also mature trees (e.g. Abeje and Demel, in press). Besides, tapped trees of B. papyrifera are more easily affected by fire than untapped trees, since the resin oozing out of the trees is very inflammable to cause intense fire and thus tree death.

3.7.2 Factors affecting the commercialization of the resources

i) Location/Inaccessibility of the Resource Sites

Production, processing and marketing of natural gum in Ethiopia is also hampered by the inaccessibility of gum producing regions since they are located far from ports or market centres. In most cases the gum must be transported over 1000 kilometres of rough roads to the capital for processing and packing, and then to the port of Djibouti for shipment, which ultimately escalates the cost of production. In addition security risks in boarder areas contribute to the high production and/or transport cost.

ii) Lack of Quality Awareness

Lack of quality awareness and backwardness of production, storage, processing and transportation techniques are among the limiting factors for good prices and thus expansion of natural gum commercialisation in Ethiopia. Therefore, the need to improve the quality, particularly purity of gum and resins produced and marketed in order to retain or increase markets cannot be over-emphasized.

iii) Uncontrolled Trade and a Sluggish Transaction in Export Trade

Registered enterprises complained that lack of control on both domestic and export trade of gum resin products in Ethiopia is affecting the expansion of official commercialization of the product. The fact that unregistered traders do not pay tax is affecting the competitiveness of registered tax paying traders and is discouraging the later groups from expanding their commerce of gum resin products of the country. It is also indicated that too slow transactions in export trade is holding money for long time and is affecting the turnover, and thus the quantity of trade per year.

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Chapter 4.0 Production and Marketing of Gum Resins in Kenya

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Summary

Kenya has over 80% of its landmass classified as dryland where pastoralism is the main economic mainstay for the communities, especially in the more arid environments. The area suffers from high levels of poverty, attributed in part, to over dependence on pastoralism that tends to be affected by frequent droughts. However, the region has a rich diversity of natural resources, especially of plant origin, which can alleviate the problem of poverty, if properly developed. Some of these resources are sources of commercial gums and gum resins; gum arabic, myrrh, hagar and frankincense.

Myrrh and hagar are produced by species in the genus Commiphora. True myrrh is produced by Commiphora myrrha found in Wajir and Mandera Districts. Hagar is produced from Commiphora holtziana subsp. holtziana which grows in most parts of northern eastern Kenya and parts of Eastern Provinces.There are three species producing frankincense in the country. Boswellia neglecta is the major source of commercial olibanum. It is widespread throughout most the drylands though commercial production is confined to the northern part of the country. B. microphylla has limited distribution in Wajir and Mandera Districts while B. rivae has limited distribution in Mandera District.

Tapped myrrh is the major source of commercial myrrh while hagar and olibanum are collected from naturally exuding trees or from injuries caused by animals. No detailed inventory has been carried out to determine the production potential in the country though preliminary estimates have put it at 3, 500 MT in a year. There is no established criterion for sorting the gum resins in the country and most exporters are able to grade the resins based on the requirements of importers.

Kenya is a key player in the export of gum resins with China and Hong Kong being the main export markets while Germany is the leading destination in Europe. In the Middle East Saudi Arabia and the United Arab Emirates import modest quantities with Yemen emerging as a key importer. Reasonable quantities are also exported in the region with Egypt, South Africa Tanzania and Uganda among importing countries. Additionally, there is some cross border trade with Ethiopia and Somalia though actual volumes are not known. The country has exported an annual average of 900 MT over an eight year period (1996-2003).

The main constraints in the commercialization of gum resins are related to lack of adequate data on resources to allow for proper planning, sound production practices and inadequate market information including development of sound marketing system. Opportunities lie in the strengthening of the national association to properly develop the sector and promotion of value adding of the exported products.

4.1 Background

Kenya's drylands form a part of the vast East African dry region that extends northwards from central Tanzania through southern, eastern and northern Kenya. The drylands occur in areas, which receive less than 1,000mm of rainfall per annum. The rains are erratic, of short duration and often of high intensity with potential evaporation exceeding precipitation.

The drylands cover an estimated 80% of Kenya's total land mass. About 25% of the human population and slightly more than 50% of the livestock population occupy these areas. These dryland ecosystems are endowed with a rich diversity of flora and fauna that the local people have depended upon for several generations. However, due to historical reasons, communities in these areas continue to rely heavily on pastoral livestock production systems. There is lack of diversity in commercialisation of other dryland resources found in the area for development of alternative livelihoods.

The future for sustainable development of the drylands lies in the rational use of other resources. This entails recognising and developing the potential that exists in the vegetation resources for production of economically valuable products. Key amongst them are gum resins i.e. myrrh, myrrh like resins (hagar and opoponax) and frankincense.

4.2 Botanical Sources and Production Areas

4.2.1 Myrrh and Myrrh like Gum Resins

Myrrh and myrrh like resins are produced from species in the genus Commiphora of the Burseraceae family. There are about 50 species of Commiphora in Kenya that are widely distributed in the Acacia-Commiphora woodlands (Gachathi, 2002). However, only a few species are known to produce gum resins of commercial importance.

True myrrh is produced by Commiphora myrrha (also known as Mal Mal in Somali). It is a spiny shrubby tree growing to slightly over 4m tall with silvery or whitish grey peeling bark. C. myrrha is found in Wajir and Mandera Districts growing on shallow soils over limestone of granite rocky lava with rainfall of about 230-300mm per year.

Myrrh is traditionally used as a perfume, crushed and mixed with charcoal to make ink in Quranic schools and for treating wounds, boils and a wide range of stomach ulcers. Commercially, myrrh is used as an incense, perfumery and traditional medicine in the Far East, antiseptic and stimulant in tooth paste, and as an adhesive.

Hagar is a Somali name for gum resin with medicinal properties produced from Commiphora holtziana subsp. holtziana. The tree is spiny up to 6m tall with a well defined trunk, outer bark white to yellowish, peeling in large papery flakes. C. holtziana grows in most parts of northern eastern Kenya and parts of Eastern Provinces on well drained sandy soils with rainfall between 220-630mm.

Traditionally, hagar is used to kill and repel ticks, heal wounds and treat snakebites. In Kenya, commercial hagar is collected in Wajir, Mandera and Isiolo Districts and is exported to the Far East for use in traditional medicines and as an essential oil to Europe and the United States

Other gum resins collected and found mixed with resins of myrrh or hagar are from C. habessinica, C. schimperi, C. pseudopaolli and C. incisa.

4.2.2 Frankincense Producing Species

The main frankincense producing species are in the genus Boswellia in the family Burseraceae. The trees exude a watery fragrant substance from the bark that hardens to a resin on exposure which is used as incense. The commercial name of frankincense is olibanum

Boswellia neglecta is the major source of commercial olibanum in Kenya (Chikamai, 2001). It is a much branched shrub or tree up to 6m tall with bark dark grey, not peeling and often with circular ridges. The species is found in rocky and red loam or clay soils at 220-1350m above sea level and 250-600mm rainfall. It is widespread throughout most the drylands though commercial production is confined to the northern part of the country.

B. microphylla is a shrub or tree to 5m tall with a dark grey smooth or reticulately fissured but not peeling bark. It has limited distribution in Wajir and Mandera Districts on red sandy to gravely soils overlying limestone with 250-400 mm of rainfall.

B. rivae is a small tree to 6m tall with a yellowish to greyish bark that peels in small papery flakes or peels in thick irregular scales. It has limited distribution in Mandera District along the Daua River valley with 250-750mm of rainfall.

Traditionally, the frankincense is used as chewing gum, incense or perfume as well as medicine for a wide range of ailments. Resins from B. microphylla and B. rivae are more preferred by the local communities as incense with the one from B. rivae being most preferred.

4.3 Harvesting and Post Harvest Handling

4.3.1 Harvesting and Potential Production

Tapped myrrh is the major source of commercial myrrh in Wajir and Mandera Districts, although wild harvests are done whenever possible. Experienced processors /merchants prefer wild harvest which is richer in the essential oils. Tapping is done using a special axe in the dry seasons (three weeks after the rains) mainly in May – October and occasionally in January-March. Tapping is mainly done by the “Malmaleys” a Somali word for tappers. A good tapper begins at the base of the tree trunk and removes a small area of back about 3 cm wide and 10 cm long using an axe. The tapped area is cleaned three times (at seven days interval) and first collection made after 21 days.

Hagar is collected from exudations caused by insects. Some hagar is collected from natural exudation or animal damage. Most of the hagar is however from wild harvests.

Olibanum from Kenya is mostly wild harvest collected by hand from the trunk and branches of trees or from the ground where the exudates collect after dripping from the tree. Limited quantities are collected from wounds on the tree trunk following injury to collect dye or tapping.

Generally information on potential production are scarce for lack of inventory data. Preliminary estimates carried out showed that production potential is about 3500MT for gum resins (Chikamai, 2001). An on-going regional initiative on resource assessment and mapping will assist in developing reliable estimates.

4.3.2 Post Harvest Handling

Harvested resin is collected in a jerrican or gallon in the field and transferred to polythene bags at the camp site or in the homestead (manyatta). Most of the resin is sold without sorting. However, at the level of exporters cleaning and some sorting is carried out. It involves removal of bark and any observable foreign matter (e.g. stones, insects or separation of nodules/lumps that are distinctly different from the rest). In the case of hagar post harvest losses can be to the tune of 30% in the form of bark, insects or adulterants. Normally, sorting is done based on the requirements of the exporter though there is no established criterion. However, in Ethiopia, myrrh and olibanum are sorted and graded on the basis of particle size and colour.

4.4 Valued Added Processing

There is only one company in Kenya (Vetochem Ltd) which steam distils gum for both the domestic and export markets. The equipment has a capacity of 250 litres and consists of a steam generator, a reaction vessel made of stainless steel, a condenser and collection vessel for the oil. Detailed description is given under profile of key players.

4.5 Trade and Marketing of Gum Resins

Export statistics for gum resins are poorly documented. The trade codes combine resins, gum resins, other natural gums and balsam making it difficult to segregate the resins (Chikamai et al, 2002). However, a rough estimate can be made on the understanding that trade volume of gum arabic is usually captured under a separate code and the country does not produce any other form of plant gum while balsam is not a produce from Kenya. Table 4.1 provides the trade statistics from 1996 to 2003. China and Hong Kong are the main export markets while Germany is the leading destination in Europe with Switzerland emerging a key destination. In the Middle East Saudi Arabia and the United Arab Emirates import modest quantities with Yemen emerging as a key importer. Limited quantities are exported to African countries notably DRC, Sudan, Tanzania and Uganda.

There is a lot of cross border gum resin trade especially through Ethiopia and the long porous border of Somalia that goes on unregistered. This is exacerbated by the lack of a strong traders association and insufficient capacity of various government agencies involved in monitoring trade. It would be useful to have the statistics of such gum resins exported through neighbouring countries to help capture actual production and hence the place of Kenya in the international trade. Equally important would be any gum resins brought into the country from neighbouring countries.

Meanwhile, Kenya imports reasonable quantities of gum resins, usually in a more refined form (Table 4.2). From the table it is clear that the main sources of imported gum resins are Thailand, India, France, USA, Italy and Germany. Spain was an important supplier in the mid 1990s while China supplied large quantities in 1996 but is more a net importer. Other

countries like UK and South Africa usually supply limited quantities. Unlike export data, import statistics are more reliable due to higher institutional organization from the points of origin. Most of the imported resins are used by the pharmaceutical and cosmetic industries.

Table 4.1: Kenya's Exports of Gum Resins and Destinations 1996-2003

Country	1996	1997	1998	1999	2000	2001	2002	2003
Of Which to :								
China	367	447.7	754.5	583	503.1	668.6	700.2	775
D.R.C			-	-	0.9	0.4	0.2	-
Egypt	53.5		-	-	88.6		-	-
France		7	-	-	-		-	-
Germany	32.5	204.8	112.7	33	43	60	60	53
Hongkong	94.4	107.5	188	51	97	124	61	136
India	-	30	-	-	-	-	7.3	
Japan	-	-	-	-	-	-	-	
Sudan	-	-	10	0.5	0.4	-	1.5	0.3
Tanzania	-	1.4	0.9	-	0.6	-	-	15
Uganda	-	-	-	-	18	-	-	0.2
Gambia	-	-	-	-	-	-	-	15
Yemen	-	-	-	-	48.5	16.7	-	15
E.P.Z	-	-	-	-	-	-	0.3	0.3
Singapore	-	-	-	-	19.5	-	12.6	45
Switzerland	-	-	-	-	-	96.1	132.6	29
U.S.A	-	-	14	-	0.4	-	-	15
U.A.E	-	-	15.6	16	6.8	15	10	54
Gambia	-	-	-	-	-	-	15	-
Uganda	0.3	2.1	1.1	0.1	-	0.3	0.3	-
Pakistan	-	-	-	-	-	-	17.6	-
Rwanda	-	-	-	-	0.2	0.3	-	-
U.K	-	-	-	-	15		15	-
Anonymous	-	-	-	-	-	32	-	-
Burundi	-	-	-	-	9	-	-	-
Chile	-	-	-	-	17	-	-	-
Thailand	-	-	-	-	15	-	-	-
Total Vol. (Tons)	547.7	800.5	1096.8	683.6	883.0	1013.4	1033.6	1152.5

Source: Customs. Kenya Revenue Authority (KRA)-Courtesy of CBIK

4.6 Mapping the Trade Chain from Collectors to Exporters

Mapping of the trade chain is considered important as it enables an understanding of the activities involved in trade from production to export and hence offers opportunities of streamlining the trade chain for improving benefit sharing.

Table 4.2: Kenya's Imports of Gum Resins and Country of Origin 1996-2003 *

Country	1996	1997	1998	1999	2000	2001	2002	2003
Of which to:								
India	-	-	-	2.3	20	12.5	15.3	36.1
U.S.A	9.8	0.82	9.8	5	2.9	10.5	7.6	5.1
Germany	1.59	1.1	0.9	15.5	1.7	1.97	4.3	2.4
Austria	0.48	-	-	-	6.6	0.96	1.0	1
U.K	0.22	0.4	0.38	0.3	4.2	1.7	-	0.6
Indonesia		-	-	-	-	-	0.3	7
South Africa		-	-	0.5	1.0	0.7	0.3	1.3
U.A.E		-	0.1	-	-	0.3	1.7 8	2.3
Israel	-	-	-	-	-	-	-	0.1
Italy	0.03	6.24	-	-	-	38.7	6.5	0.2
Hongkong		-	-	-	-	-	-	0.2
Malaysia		-	-	-	-	-	-	0.7
Egypt	-		-	-	-	-	0.3	-
Somalia	-	-	-	-	-	-	2	-
Thailand	18	36	54		36.2	18	9	-
Australia	0.48	-	-	-	-	-	-	-
Netherlands		0.25	-	-	0.25	-	3	-
Gambia	-		-	-	-	-	-	
Switzerland	0.03	0.5	-	-	-	0.2	-	-
Singapore	5	3	-	-	-	9	-	-
France	16.5	16	8	16.8	-	16	-	-
China	180		-	1.5	0.28	-	-	-
Japan	-	0.1	-	-	0.49	-	-	-
Taiwan	-	8	-	-	-	-	-	-
Spain	82.3	48.6	-	-	-	-	-	-
South Korea		-	0.09	-	-	-	-	-
Greece	0.5	-	-	-	-	-	-	-
Totals	314.5	121.1	73.3	41.9	73.7	109.9	49.2	55.9

Source: Customs, Kenya Revenue Authority (KRA)-Courtesy of CBIK

4.6.1 Collection

Collection is carried out by pastoralist peasants who include poor members of the community, women and/or children as they collect water/fuel wood or tend small stock or by organized tappers/collectors. Myrrh is usually tapped and when it is ready, a single collector can collect about 5kg in a day or 150kg in a month. The gum resins are usually stored in gunny bags. Sugar sacks with plastic lining are preferred in order to retain the essential oil and prevent loss of volatile components. Prices vary according to demand but currently range from Ksh. 40-70 per kg. Hagar and frankincense are normally collected from injuries caused by animals or natural exudation though there is occasional tapping. Current selling price ranges between Ksh. 20-30 per kg. Table 4.3 is a summary of collection activities and income.

* No comprehensive study has been carried out on the local consumption of the gum resins. Most consumers are the pharmaceutical and cosmetic industries

Table 4.3: A summary of Activities and income at Collection Stage

	Gum	Myrrh	Hagar	Olibanum
Average amount collected per day/individual (kg)	5	5	5	3
Average monthly collection (kg)	100	150	150	90
Operational costs (labour, transport etc.)	In Kind	In Kind	In Kind	In Kind
Average Sale price (Ksh/kg)	25	55	20	25
Gross Income per month per individual (Ksh)	2500	8250	3000	2250

Source: (Chikamai, 2001); 1US$ = Ksh. 75

Some of the problems experienced during collection include stealing of tapped mal mal by other collectors, insecurity (from wildlife and ethnic conflicts or banditry), hunger and thirst resulting from long distances away from homes and sometimes low capital outlay, high transport costs and accidents from falling, snake bites, thorns and illnesses.

4.6.2 Distribution

Distribution is normally carried out by three categories of people; collectors, duka owners and wholesalers/local merchants in district towns.

- Collectors carry the gum resins from either their homes or collection points in the field to selling points (duka owners or wholesalers) on foot or using draught animals. On foot, a collector carries up to 20 kg while by draught animals carry up to 100 kg.
- Duka owners are normally retail traders in remote production zones or local trading centers. In the case of myrrh and hagar, they could also be former collectors who have acquired reasonable capital from previous sales. Volumes handled by duka owners are quite variable and depend on, among others, capital outlay, market demand and/or availability.

Gum resins (Myrrh, hagar and olibanum) are usually sold natural with very limited cleaning. Duka owners sell to wholesalers at an average of Ksh. 10 over the purchase price and thus make a gross income of Ksh. 800 for 80 kg. Some of the constraints include:

- Low capital outlay to sustain the trade especially when the market is poor
- Harvesting immature resins
- Deliberate adulteration of the gum resins by collectors to increase weight
- Lack of market information to gauge market trends
- Inadequate storage facilities during times of poor prices.

Wholesalers/local merchants are found in large trading centers or district headquarters. Factors influencing volumes are akin to those for duka owners only that they handle large volumes. Like duka owners, there is limited cleaning except where there are special requirements from exporters or processors and this costs are usually factored in the sale price.

Wholesalers of gum resins make a higher margin. Myrrh is sold at an average of Ksh. 80 per kilo, hagar and olibanum for Ksh. 50 per kilo. This translates to a gross profit margin of Ksh. 15 for myrrh, and olibanum but Ksh. 20 for hagar. A summary of the activities is given in Table 5.4.

4.6.3 Export

National merchants are the key players. Key activities comprise transportation and documentation. Overall operating costs per kg. are given in Table 4.5.

Main constraints experienced by exporters include; adulteration, unreliable transport from the field as they depend on trucks coming from production zones that sometimes prefer to carry more competitive commodities and unreliable supply especially for large orders.

4.7 Constraints and Opportunities in the Commercialization of Gum Resins

4.7.1 Constraints

Some of the constraints hampering the gum resins sector include;

- Lack of adequate data on the resources -The amount and type of gum resin available in the different production sites is not available. It limits decision and planning for efficient production. The on-going regional initiative on resource assessment and mapping as well as development of databases will go a long way in addressing this constraint.
- Lack of sound production practices – affects the quality and quantity of gum resins produced. There is need to introduce and validate suitable tapping methods to improve yield and quality. Sound production also calls for proper post harvest handling procedures which result in value addition for premium grades and hence better prices.
- Inadequate market information system on market access, requirements and price trends. There is need to avail market information from the collector to the exporter. The data by Customs should also be disaggregated into different gum resin types. The CBIK has capacity to help GARA and other partners embrace sound market information systems through training. GARA should also network with relevant international agencies e.g. AIPG for updated information and support
- Lack of access to credit. It is important to avail credit at all levels to allow for efficient participation by the traders in the business. This is more so if the country will be able to build a buffer stock to respond to changes in the international market place.

Table 4.4: Activities and Incomes at Distribution Stage

		Gum	Myrrh	Hagar	Olibanum
Purchase Price (Ksh/kg)	Collector	-	-	-	-
	Duka owner	25	55	20	25
	Wholesaler	30	65	30	35
Cleaning/Sorting/Packing (Ksh/kg)	Collector	In Kind	In Kind	In Kind	In Kind
	Duka owner	"	"	"	"
	Wholesaler	1.00	1.00	1.00	1.00
Transport (Ksh/kg)	Collector	0.30	0.30	0.30	0.30
	Duka owner	3.00	3.00	3.00	3.00
	Wholesaler	3.00	3.00	3.00	3.00
Total cost (Ksh/kg)	Collector	-	-	-	-
	Duka owner	28.00	58.00	23.00	28.00
	Whole seller	34.00	69.00	34.00	39.00
Sale Price (Ksh/kg)	Collector	25.00	55.00	20.00	25.00
	Duka owner	30.00	65.00	30.00	35.00
	Whole seller	40.00	80.00	50.00	50.00
Profit (Ksh/kg)	Collector	-	-	-	-
	Duka owner	2.00	7.00	7.00	7.00
	Wholesaler	6.00	11.00	16.00	11.00
% Profit	Collector	-	-	-	-
	Duka owner	7.1%	12.1 %	30.4 %	25.0%
	Whole seller	17.6 %	15.9 %	47.0 %	28.2%

Source: Chikamai and Odera 2002

Table 4.5: Activities, costs and income at export level

Activity	Myrhh	Hagar	Olibanum
Purchase price	80.00	50.00	50.00
Cleaning/sorting/packing	3.00	3.00	3.00
Post harvest losses	24.00	15.00	15.00
Packing material	1.00	1.00	1.00
Transport costs	3.00	3.00	3.00
Documentation	7.50	7.50	7.50
Freight	5.30	5.30	5.30
Total costs	123.80	84.80	84.80
Sale price	263.00	90.00	90.00
Profit	139.20	5.20	5.20
% profit	112.40	6.10	6.10

4.7.2 Opportunities for Promoting Commercialization

- Strengthening GARA and establishment of Producer Associations. A strong GARA would lobby the government for enabling policies and assist the local communities involved in the sector in the establishment of producer associations. The establishment of producer associations would help the local communities' access credit and negotiate for better prices in line with prevailing market prices. Additionally, producer associations will be trained in sound production and post harvest handling resulting in good quality gum resins coming to the market and thereby better prices and increased demand.
- Opportunities also lie in promoting value adding in the country through establishing medium processing plants (steam distillation or extraction plants) that will result in export of semi processed and/or processed essential oils/resinoids, which fetch better prices.

4.8 Profile of Key Players in the Gum Resins Sector

4.8.1 Vetochem Limited

Is a Nairobi based private company, registered in 1994. Currently it is the only private company that processes gum resins through steam distillation of essential oils. It has an extraction capacity of about of 250 kg per day with 70% efficiency. It buys approximately 20 tonnes of olibanum, 4 tonnes of Myrrh and 1 tone of Opoponax per year. The company is ready to increase its share of processed and raw gum resins but is limited by supply.

4.8.2 Elegant Trading Company Limited

This is also a Nairobi based company registered in 1995. It is the leading exporter of Hagar and opoponax in the country. It has strong marketing arm and with a closed network of whole sellers producers/collectors mainly from Wajir District. The company has a future strategy to maintain a buffer stock of 200 tonnes of Hagar, 100 tonnes of Myrrh and 32 tonnes of opoponax. At its peak the company employs 30 people and has a total of 10 wholesalers who in turn have about 30 collectors each.

4.8.3 Gums and Resins Kenya Limited

This is a private company registered in 1997 with networks in the North Eastern Province with a stronger base in Garissa. In 1994 it exported 50 MT of Hagar and 20 opoponax to China. It has also handled about 20 MT of olibanum for another exporter.

Following a decline in the export market in the mid 1990s, Gums and Resins Kenya focused its attention on the local market. The company sells on average 3 tonnes of gum arabic annually to various industries in Nairobi. Major outlets are the printing and adhesive firms (for grade 2 and siftings/dust) and confectionery and pharmaceutical firms (for granulated export grade).

Gums and Resins Kenya also plans in future to go into small to medium scale processing and especially in the area of adhesive manufacture where it seems to have a comparative strength as one of the partners is a Chemical Engineer.

4.8.4 Arid Lands Resources Ltd.

This is a locally constituted limited company (2002). The directors are also closely linked to SALTLICK that for a long time has been working on gums promotion from an NGO perspective. It has an established network at the grassroots in the whole of Northern Kenya and is the most active in the export of gum arabic. It has put in place aggressive programme of market intelligence and research through networking with importers in Europe and the Far East. Annual exports are in the order of about 100 MT. It has also an extensive local market of about 20 MT annually. Recently, the organization has become involved in the trade of gum resins in the local market where in May 2005, it sold some 10 MT of olibanum to the local cosmetic industry.

4.8.5 Gums and Resins Association of Kenya (GARA)

GARA is an umbrella corporate body registered under the Societies act in 1997. The main objective of GARA is act as a voice for the stakeholders in the gums and resins sub-sector. The organization brings together institutions from the private, public and the civil societies sectors.

GARA has a diverse membership comprising collectors, traders, government and non-governmental organizations that have a common interest to improve the production, quality and marketing of gums and gum resins for the domestic and export markets.

Currently, the association has membership drawn from 8 organizations comprising 2 NGOs, 1 processor, 3 national merchants and 2 government organizations who are active.
Since its formation it has been involved in the following;

- A survey of the local market for gum arabic in Nairobi – Undertaken in 1998/99,
- Production of a book on commercial gums and gum resins in Kenya: sources of alternative livelihood and economic development in the drylands.
- A project entitled “enhancing gum arabic and resin production, quality control and marketing started in January 2001.

- A project on conflict resolution and human rights in North Eastern Province supported by USAID.

GARA recently finalized developing a strategic and operational plan and is actively involved in the establishment of producer associations in the country.

Table 4.6 provides contact details of some of the entrepreneurs (members of GARA).

Table 4.6: Gum Resin Enterprises and their contacts

Name of enterprise	Tel	Contact person	Postal address	Email address
Elegant Trading Company Ltd	0722718290	Quresh		quresh@africaonline.co.ke
Gums and Resins Kenya	0722491379	.Abdi Kadir Hassan	Phoenix Hse, 3rd floor, Kenyatta Ave.	aktally@yahoo.com
Sam Impex Kenya ltd	552392/ 652436		Lunga Lunga Road	
Arid Lands Resources Ltd	0722817492	Dennis Leete	Village Market,Isiolo	leete@wananchi.com
Veto Chem.	0733720068	Sadqa Haq	Lunga Lunga Road	Sadqa@africaonline.co.ke
Munnaissar Enterprises	20-797669	Munnaissar	Dandora,Nairobi	
Hassan Hassine	020-536053-64	Hassan Hassine	P.O Box 458605 Nairobi	

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5.0 Production and Marketing of Gum Resins in the Sudan

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5.1 Background

Frankincense and Myrrh are familiar names referred to by classical writers. These resins are of little importance at present time compared with their significance in earlier days. Nevertheless they still enter commerce. Their use by civilized man goes back to very early time indeed, well before the Christian era, Howes (1949). Frankincense was one of the important articles of trade with the Phoenicians. Myrrh was commonly used with frankincense and was a constituent of the celebrated "Kyphi" of the Egyptians used in fumigation, in medicine and in embalming.

Frankincense or gum olibanum as it is also called is obtained from species in the genus Boswellia. There are about a dozen species of Boswellia, all small trees or shrubs that occur in the dry areas in northeast Africa and southern Asia. In the Sudan we have only one species in the genus Boswellia i.e. is Boswellia papyrifera.

Gum olibanum from the species Boswellia is one of the key natural resources, which has the potential of generating income for local inhabitants in rural areas and hence raising their standard of living. Although the Sudan has good resources of Boswellia stands, its share of market remains relatively very small in relation to the resources potential. Until now the revenue from this commodity has been constrained by many factors of which the most important is the lack of information and technical know-how.

Myrrh is the aromatic resinous exudation from the trunks of several species of Commiphora, a large genius in the family Burseraceae consisting of about more than 160 species. In the Sudan, according to Elamin (1990), we have seven species, which are Commiphora abyssinica, C. africana, C. erthraea, C.gileadensis, C. pedunculata, C. quadricinta and C. schimperi. All of these species are localized on hilly and stony ground in Eastern and Central Sudan (Read Sea Hills, Kordofan, Darfur and Blue Nile Districts). However, in the Sudan Myrrh is now of little importance compared to Frankincense. There are no data available at present about its production, trade & potential.

5.2 Boswellia papyrifera

5.2.1 Taxonomy, Phenology and Geographical Distribution

Boswellia papyrifera (Del.) Hochst. belongs to the family Burseraceae and to the genus Boswellia. The English name is Frankincense tree or Elephant tree. The Arabic name is Gafal and Tarak Tarak. It is a small deciduous tree growing up to 10 m in height. Bark pale yellow-brown, papery, peeling off in wide strips, slash reddish, exuding a fragrant resin. The leaves which are deciduous are 30cm long, consisting of 6-9 pairs of slightly serrated leaflets with an odd leaflet at the end. Inflorescence panicle, clustered at ends of branches, flowers white

creamy, tinged with pink, appearing before the leaves. Fruit brown-pink 3-4 sided, pear-shaped capsules with short vertical wings.

Adam et al. (2004) reported that the general phenologal cycle of B. papyrifera was determined by rainfall. Beginning of rains terminates the leafless period and induces flushing in addition to determination of tapping process. By the end of the rain season leaf shedding commences and floral bud formation starts. This indicates an adaptation of the tree to escape changes of adverse conditions and increases opportunities of pollination by prolonging the reproduction period. The species is perfectly adapted to extreme dry conditions, since it spends the longest period without leaves.

5.2.2 Distribution

In Sudan B. papyrifera covers large areas of hill catenas in different parts of the country south of latitude 14°N i.e. in Blue Nile state, southern and western Kordofan states, Darfur from Jebel marra towards the western boarder with Chad, Southern Darfur along the boarder with Central Africa Republic, Baharelghazal, Upper Nile and Equatorial states in Southern Sudan . According to the National Inventory carried in 1995 the total area covered by the species in Northern states is estimated to be approximately 500 000 ha. There is no data available about the extend and intensity of this species in the Southern Sudan states.

5.2.3 Stands characteristics

Adam et al (2004) in the study of Boswellia papyrifera stands in Jebel Marra, Darfur stated that the mean diameter at breast height (dbh) was 18.9cm while the highest diameter recorded was 50cm. This low dbh is reflected in the small basal area (5.4m^2/ha) and the low wood volume per hectare (20.29/m^3). Table 5.1 shows the stand characteristics of Boswellia papyrifera in Jebel Marra area.

Table 5.1: Stand characteristics of Boswellia papyrifera in Jebel Marra

Character	Value
Mean height	6.3 m
Mean DBH	18.9 cm
Mean basal area per tree	0.33 m^2
Basal area per hectare	5.4 m m^2
Mean volume per tree	0.12 m^3
Volume per hectare	20.29 m^3
Mean crown diameter	3.3 m
% Crown coverage	17.5

5.2.4 Regeneration of Boswellia papyrifera

Natural regeneration of Boswellia is mainly from fallen seeds dispersed by wind which blows the fruits over long distances, however propagation by large cuttings of 90-140 cm long is easy, and more successful.

(1) Planting of cutting should be carried out during April and May with greater success achieved in April.

(2) Preparation of cuttings and planting should be done at the same time
(3) Branch cuttings should be 90-140 cm long and 16-23 cm wide in mid girth
(4) The surface area of the planting pit should be 30 cm^2 and excavated to a depth of 45-60 cm.
(5) The survival rate is about 94% for cuttings planted in April and May.
(6) Seed germination commences in 11 days and may extend up to 18 days.
(7) Overhead and side shade in the nursery is essential.
(8) Under field conditions, the mortality of seedlings is high and growth is encouraged by removal of overhead shade and clean weeding (Khamis, 1997).

5.2.5 Resin structure and uses of Boswellia papyrifera products:

Work of McMahon (2001), mentioned in Ali (2005), described the gum resin as a natural exudate from under the bark or produced from human made incisions, which is composed of 5-9% volatile oils and 60-70% alcohol soluble resins the rest being water soluble gums.

Boswellia papyrifera resin was found to contain the following carbohydrates: D-galactose, L-arabinose, L-rhamnose, L-fucose, D-glucuronic acid, and 4-0-methyl-D-glucuronic acid, (Mustafa, 1997). McMahon (2001) described the essential oil components of frankincense as containing more than 200 individual natural chemicals which are considerably variable in their properties depending on the microclimate where the tree grows. Hydrolysis of polysaccharide from the resin yields uronic acid 19% D-galactose 60% L-arabinose 10% and L-rhamnose 5%, plus a trace of L-fucose (Anderson 1965). Mustafa (1997) stated that B. papyrifera resin exists as calcium, magnesium, potassium, and sodium salts of complex polysaccharide with tannin content of 0.17-0.24 % and ash of 1.7-1.65 %, nitrogen of 0.27-0.28 %, and protein content of 1.71-1.75%. Gum olibanum is used locally for incense and chewing and the bark is used for tanning. The uses of Boswellia resins dates back to 2000 BC. It was used as a fumigation agent for religious ceremonies, medicine and virtual use. Presently, it's used in incense, fixatives, perfume industry, tooth paste, plaster and other pharmaceutical products, and as flavours and fragrances in food industry. The wood of Boswellia is light and can be used for ordinary carpentry, plywood, water cooler shreds, match sticks and pencils.

5.3 Production of resin from Boswellia papyrifera

5.3.1 Tapping of B .papyrifera

Production process of frankincense starts by tree tapping. As described by Ali (2004) tapping is the removal of a very thin layer of the tree bark of an area of 2x3 cm. The number of wounds per tree ranges from 6-9. The wounds are made on the sides of the stem that face sunrise and sunset. Resin collection normally starts after 2-3 weeks from each tapping.

Tapping starts after the rainy season, when the trees shed their leaves during September–October. It starts at 50 cm above ground level and end at workers height. The producers believe that the short trees are more productive than the tall trees, and some of the producers describe the big and tall trees as masculine (males). Moreover the producers classify the trees into three categories according to the hardness of the bark (soft, medium, and hard bark). The productivity of the soft bark trees is higher compared to the other categories. The justification of the producer is based on the assumption that softness of the bark is an indication of ample amount of resin (Sangac, 2005).

Khamis (2001) mentioned that the minimum diameter of the trees to be tapped is 12 cm. Tapping of the tree is mostly done from first of October and lasts four months (until January). The starting of the tapping season is determined by the Forest National Corporation (FNC), which issues the license for tapping in September and encourage the producers to commence tapping in early October. After the first tapping the wound becomes red in colour and can be distinguished from a distant as a bloody spot on the bark. The second tapping is usually done 30-45 days after the first tapping. At this stage the wound starts to turn to white color. The third tapping is made at similar intervals between the first and second tapping. Through this tapping small quantity of resin is removed with the bark to widen the scars. The fourth tapping is also made after similar intervals by removing the bark and the small quantities of the resin.

All the producers confirm that the process of tapping requires skilful labourers backed with good experience. The FNC managed to train the local people on the technical know-how by endorsing a condition in the tapping license for the outsider tappers (Beni Amir) to train the local people in 60% of the areas assigned to them for tapping.

Tapping of Boswellia tree for resin production is achieved by using a tool called mengaf which consists of two part, wooden handle and sharp broad metal blade. The sharp blade is used for penetrating the bark of the tree to open the passage for frankincense to come out.
Khamis (2000) also reported that resin production in Western Sudan starts by tapping in mid-August for trees that had not been tapped before and at the end of September for the trees that had been tapped by the same tapping method described above. After collection the resin is dried under shade and then cleaned and graded according to purity and size of nodule following the method that is described in this section.

5.3.2 Resin collection

Collection of resin starts after 30-35days from the last tapping and extends up to the end of June according to the license provided by the FNC, which emphasizes the evacuation of Boswellia stands by 30th June. The resin collected from the first and second picking is usually sold for local consumption at village market, because at these stages the resin is produced in small quantities and has low quality (black colour). After additional 25-35 days white gum material is collected in commercial quantities. The white colour is an indication of the good quality of Boswellia resin. Starting from this picking, the number and duration of resin collection depends mainly on the weather. When the weather is cool, the collection of resin is made every two weeks, while in summer, the collection is made after 30 to 35 days. Picking of the resin could continue from 4 to 9 pickings per season depending on the start of the rainy season. After rain starts, the quality of resin becomes poor because the colour changes to dark. The resin is collected in special baskets called raika made up of local materials. Sangac (2005) reported that there is a considerable variation in the quantities and quality of the resin at the different pickings, but there is a general consensus that the third and fourth collections have the maximum yield and the higher quality of resin compared to the others. Although the collection of resin depends on the weather conditions (temperature) the eastern producers (Beni Amir) stick to a fixed collection schedule while the western producers collect at random intervals. Beni Amir members believe that the productivity will be higher at one month intervals. It seems that the low standard of living of the local people, forced them to collect resin at shorter intervals to meet their daily requirement.

5.3.3 Yield of Resin

Sangac (2005) reported that good quantities of resin were produced in Rashad province, Kordofan State (Western Sudan). Table 5.2 shows the quantities of resin produced from Rashad province for the period 1988-97. The assessment of these quantities is based on the fees of shipment. These figures are underestimated because the investors deal directly with traditional local leaders without contacting FNC.

For that region the figures reported remain just as estimates. Also, due to the high taxes and different fees imposed on resin; traders do their best to minimize their expenses through smuggling. Huge amounts of the resin are used locally for different traditional uses. Sangac (2005) made an attempt to forecast the productivity of the resin from south Kordofan area. He found that, the mean Boswellia resin production in different localities of Rashad province is about 1.51 Gontar/feddan. Rashad areas have the highest yield of resin production compared to the other localities of the province. He also mentioned that the productivity of resin per tree for the successive pickings began with small quantity of 110gram/tree and increase in the second collection to about 157g/tree. The trend continues to rise in the third collection to about 178 gram/tree. The fourth collections increased dramatically to 210grams/tree. The third and the fourth collections represent the bulk of the production and after the fourth picking the yield starts to decline continuously Fig 5.1. The yield could be estimated as 0.66kilogram/tree/year. Khamis (2001) reported 2.8 kilograms/tree/year in Jebal Marra, Darfur area.

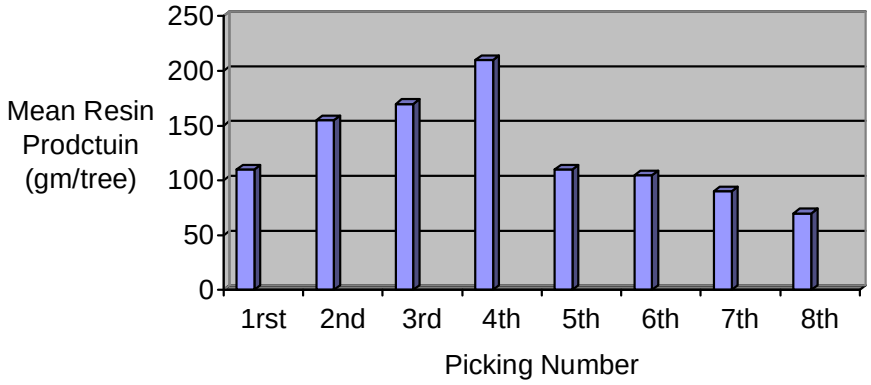
Moreover the average annual yield in Somalia is reported to be 2.3 kilograms/tree/year.

Table 5. 2: Resin Production in Rashad Area

Years	Quantities in Gontar
1988/89	20144
1989/90	17440
1990/91	32723
1991/92	20569
1992/93	11830
1993/94	6570
1994/95	10631
1995/96	7346
1996/97	8412

One Gontar is equivalent to 44.4 Kilograms

Fig. 5.1: Resin Prodution of Boswellia Trees



5.3.4 Resin Storage and Cleaning

The collected resin is usually dried in straw huts of about 3x4m with two doors from the north and south direction to enhance ventilation. The floor of the hut is covered with clean sand. The hut is always constructed from tree branches of other tree species grown in the forest area. The collected resin is spread over the clean sand and protected from direct sunlight and high temperature. Some producers practice the cleaning process during the storage period where the resins are cleaned by hands to remove the bark or any other materials. Some producers claim that they have enough experience to collect the resin in high purity percentage. Generally, the drying and cleaning period of the resin takes about two weeks. Some collectors tend to let the resin dry in the tree and collect it one day before the market day. After drying, the resin is either transported to the local markets or to agencies within the production area.

5.3.5 Grading and processing

The dried resins is sorted and graded immediately in accordance to size, colour and purity, where, large and whiter nodules are more valued than smaller and darker ones. Changing in nodule colour to black or brown is a result of excessive exposure to heat, dirt, or poor handling. In South Kordofan state the raw resin is usually processed manually by women using different size of sieves to separate eight grades according to purity, brightness and size of nodules as follows:

1. Super
2. Second grade
3. Third grade
4. Fourth grade
5. Suksukania
6. Nagawa
7. Ozzala
8. Gishra
9. Turabia

In Jebel Marra, raw resin produces 10% grade one, (super) and 50% for grades 4-7 (Khamis 2001). Ali (2005) reported in his study eight grades for Boswellia resin with mean percentage as follows:

1. Grade 1 super 8%
2. Grade 25.6%
3. Grade 3 Suksukania 2%
4. Grade 4 Eskarto 68.9%
5. Grade 5 Ozzala 7.6%
6. Grade 6 Sukaria 1.4%
7. Grade 7 Soft gishra 3.1%
8. Grade 8 Hardgishra 3.5%

5.4 Trade and Marketing of Gum Resin

5.4.1 General

Resin production in the Sudan is traditionally practiced by local communities and by tappers from Ben Amir tribes from Eastern Sudan near the borders with Eritrea and Ethiopia. Resin merchants and traders individually make contracts with the tappers for resin production. They finance all the production activities and post harvest handling. They also pay all fees and royalties to the FNC and other taxes for local authorities. After marketing of the resin produced, expenses are divided between the merchants and the resin tappers. Post harvest handling is carried out manually using different sieve sizes to separate fine grades according to the quality and nodule sizes. The first, second and third grades are high quality for export while the rest of the grades are marketed locally.

Resin exporters are the local enterprises. Sometimes they give money in advance to resin merchants to buy resin from them. Resin importers are the foreign buyers who export it to foreign markets. They pay customs to the government. The main importers of resin are Germany, Syria, Lebanon and, Egypt. The Ministry of Finance, representing the government of Sudan regulates the producers and provides licenses, as well as charges the taxes and the key players dealing in resin with the aim of seeking information on the type and quality which modifies with market potential.

The local people usually sell their resin to local markets. Rural markets are operational on weekly basis and organized in such away that people can attend several markets in one week. Prices differ from one market to the other and on different days, in the same market. Prices are set primarily through the market mechanism (bargaining) .The local people have very low purchasing power and have no transport to access markets. Therefore, they rely on the near markets to dispose off their production, and to buy their necessities, and moreover, they never go back with their resin irrespective of the prices imposed by the traders. Local people believe that the merchants exploit them. They do not know the exact price of the resins elsewhere, but the amount of money they receive is very low compared to the efforts they exert in the collection of the resin. The investors of resin never pass through the village markets; they transport their resin directly to the principal cities.

The local traders usually work in groups and they communicate with resin agencies. According to the prices of the agencies, the local traders manage to follow certain strategy through which they can set a price for resin at the local markets. This fact makes it obvious that the prices of resin are fluctuating and determined by the merchants from outside the production area (resin agencies).

5.4.2 Cost of Resin Production

The cost of resin production could be discussed at three levels, namely, the producers, the traders, and investors. For the producers, there is no direct cost imposed on them. They have the ownership of the land as allocated by traditional leaders, and they practice tapping of the trees growing in their land, although this contradicts with the regulations of FNC, since FNC in the production area is always under funded and understated, and so most of Boswellia stands are unreserved forest and without guards, therefore, there is no fee paid by the local producers for the resin. As far as labour is concerned, it is provided by family members.

The cost of production for the traders is represented in the transportation costs, sacks, resins value, and the different fees. Table 5.3 shows the different costs of the local traders per one truck of 100 Gontars (Sangac, 2005).

For the investor, the cost is almost similar to the cost of the local trader with some changes in the items, as the investors are direct producers and they don't buy ready resin product from any local market. Table 5.4 shows the different costs of investors for resin production.

Table 5.3: Resin cost for the local traders per one truck (100Gontars)

Item	Cost to El Rashad or Um Rawaba	Cost to UM Durman
Value of resins	750000	750000
Transportation	100000	140000
Loading and downloading	10000	10000
Sacks	5000	5000
Zakat	500/Gontar	500/Gontar
Market services	15000(10% of the shipment)	15000(10% of the shipment)
Locality support	1000	1000
Tax	500	500
Wounded stamp	500	500
Redemption stamp	3000	3000
	1000	1000
	886000 SD	926000 SD

* (1US$is equivalent to 250 SD)

Table 5.4: Resin cost for the investors per one trunk (100 Gontar)

Item	Cost to Um Durman
Hired labour(4laborers)	200000
Transportation of labour	20000
Cost of food and water	75000
Transportation	140000
Loading and downloading	30000
Cleaning and grading	50000
Sacks	5000
FNC fees	500/Gontar
Zakat	15000
Market services	1000
Locality support	500
Tax	500
Wounded stamp	3000
Redemption stamp	1000
Total	541000 SD

The investors usually get four labourers per Taya (450-500feddan). Every worker receives loan in advance from the investor for his transport accommodation and food expenses before leaving his home for the whole season as credit. When the investor sells his resin the net revenue is divided equally between the investor and the labourers. Then the labourers have to pay back to the investor the loan. The distribution of the net revenue then is as follows:

- The investor takes $3/8^{th}$ of the final revenue
- The head of the labourers (who supervises the work in the absence of the investor) takes $2/8^{th}$ of the final revenue.
- The other three labourers get $3/8^{th}$ of the final revenue.

Therefore, the net revenue of the investor is equal to the net revenue of three labourers.
According to the financial capability of the investor, he can bring more groups of labourers to maximizing his net revenue.

5.4.3 Profitability from investment in resin production

As mentioned before, it is difficult to collect reliable data on incomes of local producers for resin production. However a study by Sangac (2005) confirms that the resin contributes significantly to their livelihood.

For the local traders the activity is profitable for them, but still they feel they could earn more, (Sangac, 2005). According to the current prices (7000SD/Gontar) at the principal cities the gross revenue of local traders is 1050 000 SD/shipment. From the net revenue for the local traders it is about 164000SD/shipment when they dispose their resin at the near cities and 124000SD/shipment when they dispose it at the capital.

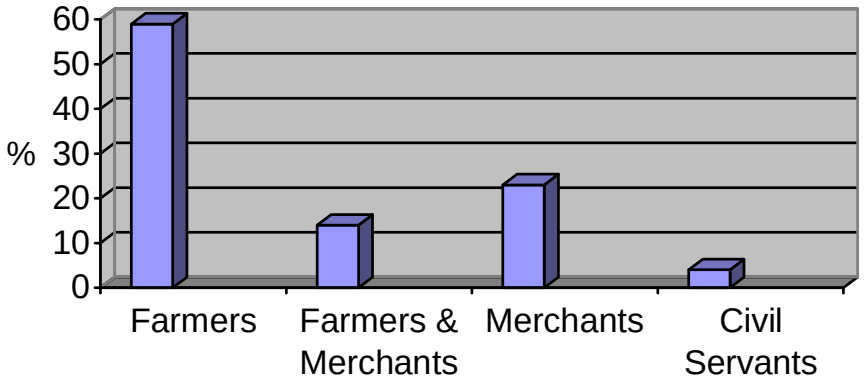
The total cost of the investors as shown in Table 5.4 is about 541000SD/shipment, while the total revenue is 1050 000SD/shipment and the net revenue is about 509000SD/shipment. From this data it is clear that the revenue of the investors is almost four times that of the local traders in each shipment.

5.4.4 Contribution of resin to sustainable livelihood of the local communities

Resin production is a secondary occupation for nearly all the producers in the resin production area. Figure 5.2 shows the main sources of income of resin producers in south Kordofan area beside resin production. The main occupation of the resin producers is farming. Agriculture in the resin production area is for self-sufficiency where small pieces of land are cultivated with subsistent crops. Little amount of the crop production goes to the market and the rest is stored in traditional stores (Sweeba and Matmura). There is task force for agricultural purposes; consisting of family members (man and his wife and their unmarried children). Savings from crop sales is not enough to meet the daily requirement of the producers, because Boswellia tapping represents the main source of additional income during the dry season in the production area. The fact that the activity of resin coincides with the dry season in which there is no available source of income generation encourages the local people to adopt resin production. Resin picking ceases with the onset of the first rain and the local people start the preparation for the agricultural season. The tapping of Boswellia usually starts in October; by the time the farmers harvest their crops.

The local people are not used to collect the resin in big quantities because they believe that if they got the returns from the resin once, the money will be spend in different issues which are not a priority, but if they dispose off the resin in small quantities they are sure they can finance themselves until the agricultural season. Therefore resin is a continuous asset, where small quantities are collected one day before the village market to provide cash (Sangac, 2005).

Fig 5.2 Sources of income in the B. papyrifera production



5.4.5 Production and Price Trend for the Period 1995-2005

Table 5.5 furnishes the results about the quantities of resin production in the Sudan, but the figures in the table remain more or less as estimates. Several factors support this assumption. Due to the high taxes and different fees imposed on resin; traders do their best to minimize their expenses through smuggling. Moreover, even for those which pass through the FNC offices are not realistic about the actual weight of their load. Traders tend to underestimate their load to escape more expenses. Furthermore, it is worth mentioning that a huge amount of the resin is used locally for different uses (Sangac 2005)

Table 5.5: Resin production and prices for the period 1993-2005

Year	Quantities/tones	Prices/ton in SD
1995	472	219.640
1996	326	170.000
1997	374	288.320
1998	029	229.840
1999	996	214.200
2000	519	192.780
2001	401	180.880
2002	428	182.580
2003	464	174.000
2004	113	162.000
2005	086	158.000

One dollar equal 250 SD

The assessment of these quantities is based on the fees of the shipments. A truck is assumed to load hundred Gontar (4.5 tons) but the traders are used to load up to 150-200 Gontar in the truck for the reason of reducing the fees and expenses collected by FNC.

The production trend during the period 1995-2005 tends to decrease up to the year 1998 when it reaches the lowest level 29 tons/year only. The reason for this decrease is due to the conflict raised between the local people (the producers) and the Beni Amir (the outsides tappers) for the reason of production share of each of them. The production in 1999 increased again and reached a very high level due to the price increase in that year while gum arabic price dropped between the years 2000 and 2003, the production stayed in the same level and it expressed some sort of the stability before it dropped again in 2004 and 2005.

Gum olibanum production decreased during the year 2004 and 2005 is due to increase of gum arabic price from 675 000-780 000 SD/tone instead of 25 000SD/tone in the year before. The high increase of gum arabic price led the tappers to shift from gum resin to gum Arabic.

5.5 Key Players Dealing in Gum Resins

5.5.1 Forest National Corporation (FNC)

Forest National Corporation is a legal body that is responsible for protection, conservation and sustainable management of the forest of the Sudan according to the Forest National Corporation Act of 1989. Some of the Boswellia papyrifera stands are reserved and gazetted forests which are under the responsibility of FNC. At present the management is only protection through guarding, which is not effective to prevent the impacts of interventions by man on the Boswellia papyrifera stands. FNC extension sections in the resin producing states adopts programs and training to motivate the direct users who actually cause some damage to the Boswellia papyrifera stands through their wrong practices.

FNC carried out an inventory and mapping of the Boswellia papyrifera stands for management and planning (National inventory 1995 and SRRAD inventory in Western Sudan 1997). FNC still has a lot to do for improvement of gum olibanum production and management. To achieve these goals the following should be given great consideration:

1. Updating of the already prepared maps and aerial photographs for all the locations of Boswellia papyrifera in the Sudan.
2. Effective protective measures should be worked out against forest fire, grazing, browsing, illicit felling of trees and other intervention factors.
3. Training the foresters and the villagers on tapping of the Boswellia resin.

5.5.2 Forest Research Center (FRC)

FRC at the end of the last year prepared a research project on Boswellia papyrifera. This project is considered as on of the Trans National Research Projects to be coordinated by the Association for Forest Research Institutions in Eastern Africa (AFREA). This project has the following objectives;

1. Determine the resource status of the species in the Sudan.
2. Review and develop the appropriate husbandry and management techniques building on the indigenous technical knowledge.

3. Determine economic potential and contribution to the livelihood of the communities and improve processing, marketing and pricing of the gum olibanum through quality control and standardization
4. Improve production and quality

5.5.3 Faculties of forestry (Universities)

The Faculty of forestry University of Khartoum has been involved in the natural forest resource survey conducted in the year 1995 by the Forest National Corporation and FAO which elaborate programs on resource mapping (inventory) including Boswellia forests in different areas and States. Very few studies have been made on Boswellia and Commiphora sp. as resin producing species and their valuable products economically and socially studied by the Faculties of Forestry. As a result, very few documented information is available which indicate:

- Study on the ecology and management of Boswellia papyrifera in Jebal Marra Western Sudan.
- The economics of Boswellia papyrifera in Southern Kordofan.
- Management of B. papyrifera stands for resin production in Jebel marra W. Sudan present situation and future prospects.
- Yield of gum oilbanum (B. papyrifera) (Del) Hoschs) in relation to methods of tapping in South Kordofan.
- Yield of gum resin from Commiphora sp. in South Kordofan.

- Phenology of Boswellia papyrifera (Del.) Hochst (olibanum gum tree in Jebel Marra, Darfur Sudan.

5.5.4 Gum Arabic Company

Gum Arabic Company is registered to trade in all gums and gum resins commodities but at present is mostly specialized in gum arabic. The Gum Arabic Company in fact, at a present, is still leading the export of gum arabic in the country and it doesn't give any special interest to trade in resins. Resin exporters and importers are the internal and foreign buyers and sellers of the resin from different production places in Sudan and sell it in the foreign markets.

5.6 Constraints in utilization and commercialization of resin

5.6.1 Topography

- The remoteness as well as the rugged and undulating topography of the habitat where the Boswellia resin tree grows, lack of accessible roads and infrastructure /facilities such as residential quarters and inadequate transport facilities to the potential production areas have made mobilization of labour force, equipment and supplies collection and transportation of harvested resins very difficult.
- Lack of insufficient trained manpower in tapping Boswellia trees reduces resin production.
- Interference from human, domestic animals, wind, insect attack and fires have in one way or another contributed to reduced regeneration of Boswellia trees.

- The areas where gum resin trees grow are hot and evapotranspiration rate tends to be very high. Hence water requirement of the labourers, particularly for drinking, is very high.
- The prevalence of diseases such as malaria, which affect the tappers frequently, is common in the areas where natural Boswellia stands grow.
- The inadequate /insufficient research undertaken is one of the gaps due to the prevalent shortage of trained researchers, physical facilities and funds hinders Boswellia resin production and management. Inadequate market information which affect market access requirements, price trends and market improvement in general.
- Lack of credit accessibility. The cost of resin production is relatively high and the local people are not financially capable to do the resin production activities.
- Absence of extension services towards improvement and reservation of the resource.
- Some areas of production are inaccessible, because of the security problems (Darfur and Blue Nile State).

5.6.2 Opportunities towards Commercial Development of the Resin

Sudan has a vast resource of Boswellia stands, which cover about 500 000 hectares. There is high potential for increased production from the existing resources. Estimates have shown that the annual production volume of Boswellia resins is about 75000 tons. In addition Boswellia papyrifera species is easy to propagate from cuttings. Studies of resources management and development of this stands towards resin production using sound production practices started through national and international conventions. The community members where the resource is grown are poor and willing to participate in resin collection as an income generation activity.

Current international market trend favouring natural products for health reasons has increased consumption of natural gums and resins, which brings about high demand for resin at local and international markets.

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