Potential, Distribution, Ethno-botany and Tapping Procedures of Gum Producing *Acacia* Species in the Somali Region, Southeastern Ethiopia

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Abstract: A survey study was undertaken in eight districts of the Somali Region, southeastern Ethiopia to identify gum producing species; their distribution and abundance; gum-tapping practices; and local uses. Nine gum producing *Acacia* species; widely known by pastoralists and agro-pastoralists in the Region were identified. Dihun and Gerbo Districts in Fik Zone were the high potential areas for gum arabic *(Acacia Senegal(L.) wild.)* and gum talh *(Acacia seyal Del.)* production based on the abundance of the source species. Degahamedow District in Degahabur Zone was another promising gum production area following the Districts in Fik Zone. However, both *A. senegal* and *A. seyal* were abundantly found in all study Districts, with the former being the most abundant and widely distributed throughout the study Zones. The gum resource in the Somali Region appeared under-exploited due to lack of proper tapping and extraction skills in the area. Apart from gum tapping, the woody vegetation of the Region supports livestock production, mitigates desertification, ensures biodiversity maintenance, and provides immense non-wood forest products. Therefore, promotion of gum extraction in the Somali Region both for economic benefit of the community and sustainable management of the fragile ecosystem is recommended.

Key words: *Acacia*, Bushland; Gum Arabic; Gum Talh; Somali Region

1. Introduction

Gum has been used by man for millennia and remains to be an important article of commerce to the present day. Natural gums obtained from incisions of stems and branches of several *Acacia* species growing in arid and semi arid agroecologies are used for making different beverages, medicines, and water-soluble glues (EFAP, 1994; FAO, 1995a). In food industry, gum is used as thickening, stabilizing, emulsifying and suspending agent, besides their applications in making foods and drinks. In pharmaceutical industry, gum is used as a binding agent in tablets and as a suspending and emulsifying agent in creams and lotions (FAO, 1995b). Some of the technical applications of gums are in the printing and textile industries where advantage is taken of their filming and sizing properties, respectively (Cossalter, 1991). Local medicinal uses have been claimed to serve as smoothening and softening agent, taken internally for cough, diarrhea, dysentery, hemorrhage; and externally in the treatment of local inflammations and nodular leprosy (FAO, 1995a, 1995b).

Africa is the world's leading producer and exporter of gum arabic from *A. senegal*. Sudan accounts for 80% of the world's gum arabic production, followed by Senegal, Nigeria, Mauritania, Mali, Ethiopia, Chad, Tanzania and Niger, according to their importance (Seif el Din and Zarroung, 1996). Total gum production in Ethiopia is approximately 3000 tones per annum and only an estimated 50% of the produce is exported through formal trading channels (EFAP,1994).

Gum represents a group of non-wood forest products, which have played and continue to play a significant role in the economies of the Somali people in Ethiopia. Though the Somali Region is one of the major gum-producing regions of Ethiopia, the actual production and trade data on gum from this region is hard to come by. Information on the production and marketing of these products is inadequately documented.

Furthermore, the extent of variations in the nature, quality, characteristics and use of the products compounds the situation. Nevertheless, gum collection plays an important role in the livelihood of the rural communities of Somali Region (Mulugeta *et al*., 2003). The degradation and loss of ecosystem and the gradual destruction of natural resources, on which the collection of gum depends, appear to be among the biggest threats to the development of this sector in the Somali Region. The major problems affecting production and trade of gum in Somali Region are related to inadequate knowledge of botanical sources, lack of proper market information, poor infrastructural development, and poor production and handling of the products. The information on the ecology and distribution of the species is scanty. Sound and sustainable management of this natural resource is required to ensure socio-economic benefits, processing and product development of gum arabic (Mulugeta *et al*., 2003). This can be achieved by undertaking investigations targeted at understanding of the ecology of the species, the socio-economic impacts of the products as well as their potentials for investment,

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employment and income opportunities for the rural population in Somali Region. The data generated from such study should enable to create awareness of issues on the part of policy-makers, to gain policy and legislative support in the development, management and conservation of this natural resource to ensure sustainability of gum production, trade and marketing in the Somali Region. Therefore, the objectives of this study were to identify gum producing species and their distribution in the Somali Region; assess the ethno-botanical and cultural values of the gum producing species; and assess gum tapping procedures used by the local community.

2. Material and Methods

2.1. Description of the study area

The study was conducted in three Zones of the Somali National Regional State (SNRS), namely, Gode, Fik and Degahabur. Potential Districts within each Zone were identified based on the available information from the regional agricultural bureau. Accordingly, Gode, Kelafo and Mustahil Districts of Gode Zone; Segeg, Dihun and Gerbo Districts of Fik Zone; and Degahamedow and Aware Districts of Degahabur Zone were selected for the study (Figure 1).

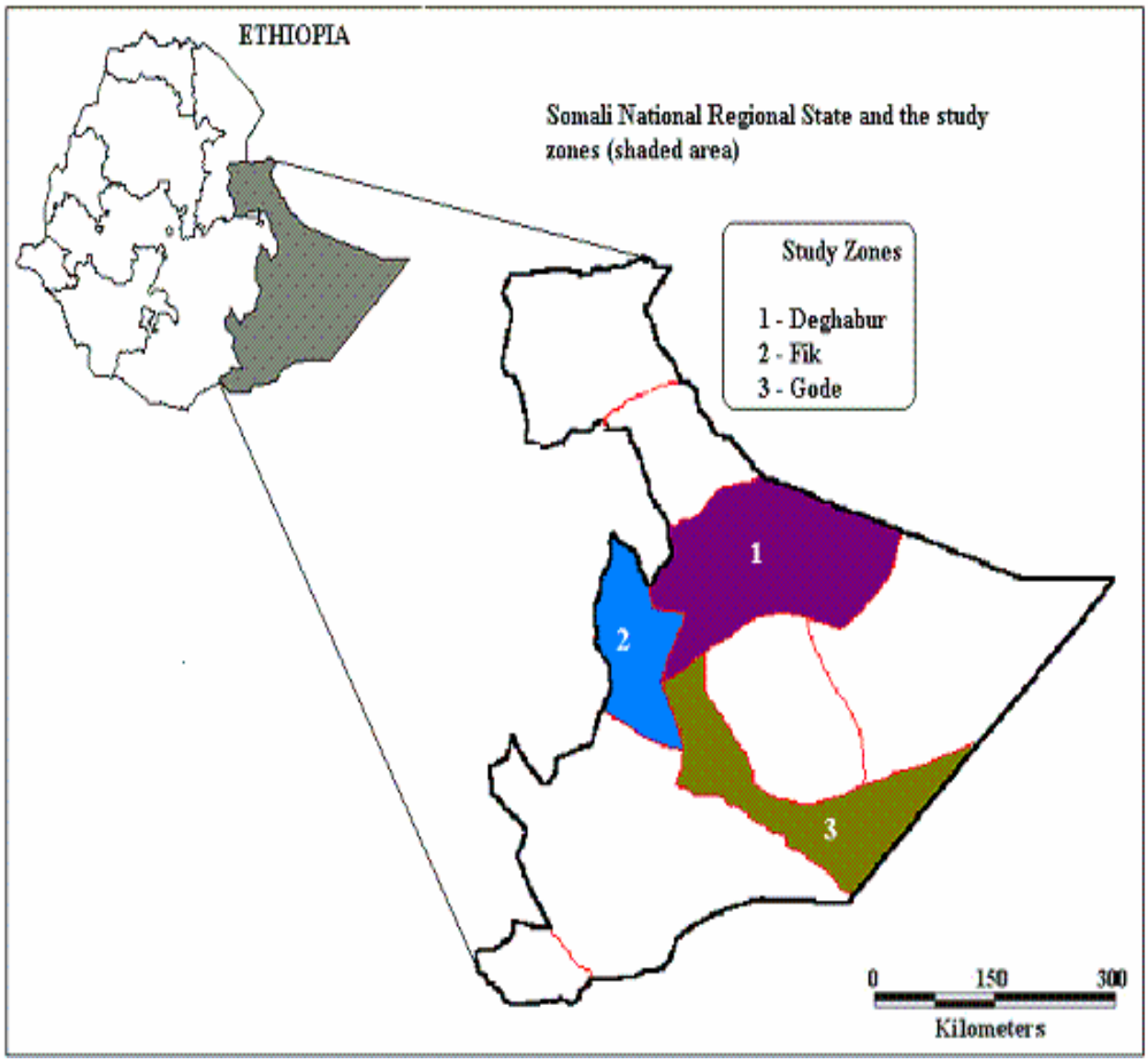

Figure 1. Map of Ethiopia showing the Somali Region and the study zones of the Region

The altitudes of the study districts range from 250 – 560 m in Gode, 600 – 1370 m in Fik and 900 – 1200 m in Degahabur. The climate is arid to semi arid with mean annual rainfall ranging from 190 mm at Kelafo to 700 mm at Jijiga (Ethiopian Meteorological Agency, 2002). According to the Ethiopian Meteorological Agency (2002), the mean annual rainfall at the Gode, Degahabur and Fik weather stations are 252.0, 328.5 and 458.7 mm, respectively. The soils of the Somali Region can broadly be described as loose red sands, dark brown, reddish brown to yellowish brown and gray soils varying from very coarse (sandy) to heavy clay soils in texture (Murphy, 1968; UNDP/RRC, 1984; Mohamed and Mishra, 2005). The majority of the population is pastoralist, and sedentary to settled agriculture is practiced near or around major towns and villages. Livestock includes cattle, camels, black-headed sheep and goats. Extensive livestock grazing and browsing is a major environmental threat in the study districts of the Somali Region.

Floristically, *Acacia-Commiphora* deciduous bushland and thickets form the dominant vegetation cover in the study areas (Friis, 1992). In the southern and southeastern Ethiopia this vegetation type constitutes dense bushes of up to 7 m high with scattered trees of up to ten meters high. The flora is dominated by species of *Acacia*, *Commiphora*, *Grewia* and *Capparidaceae*, although considerable variation occurs from place to place (Friis and Mesfin, 1991; WCMC, 1991).

2.2. Survey and Data Collection

The study was conducted in eight Districts of the SNRS: Aware, Dihun, Degahamedow, Gerbo, Gode, Kelafo, Mustahil and Segeg, from July 1999 to June 2000. In each of the selected District, 20 sample plots of 20 x 20 m (400 m^2) were laid in a systematic sampling procedure. Topographic maps of 1:50,000 scales were used as references for sampling. The boundaries of the study area were first marked and accessible roads were identified on the maps. Parallel transect lines, 8 to 15 km away from each other depending on the size of the district, were laid along a south to north direction starting from the south west border of each study district. Sample plots were laid down on the transects at intervals of five kilometers distance. In each sample plot, vernacular names of species and number of mature trees of each gum producing acacia species were recorded. Since species identification at seedling and sapling stages on the field were not possible, all seedlings and saplings of acacias in the plot were counted and considered together. The height, diameter at breast height (DBH) and crown diameter of all mature trees of the different species were measured. Voucher specimens of the gum producing acacia species collected from each sample plot were identified and the corresponding scientific names were assigned. The nomenclature followed the Flora of Ethiopia and the Flora of Tropical East Africa (e.g. Hedberg and Edwards, 1989; Thulin, 1989; Friis, 1992; FAO, 1995b; Demel, 1996). Since the districts were newly demarcated and it was not possible to get the exact area of each district, plant density was presented on hectare basis.

An open-ended questionnaire was prepared to interview gum collectors nearby each sampling plot regarding propagation of the plants, gum tapping and collection techniques, gum processing, gum grading and storage, estimate of gum production per tree, local uses of gums and gum producing trees, gum quality affecting factors, and trends in the vegetation cover. For this purpose a total of 160 informants, that is, twenty persons per district were interviewed.

2.3. Methods of Data Analysis

Tools of descriptive statistics such as mean, percentage, standard deviation, standard error and coefficient of variability were used to analyze, organize and describe the different data sets collected from the field and questionnaire survey studies of the study areas. The statistical packages of Microsoft Excel and SPSS for Windows were employed to undertake the descriptive analysis.

3. Results

3.1. Distribution, Density, Diameter and Height of Gum Producing *Acacia* Species

The scientific and local Somali names of the identified gum producing *Acacia* species are given in Table 1 while their distribution in Ethiopia and elsewhere are presented in Table 2. Plant nomenclature in the Somali Region is very local. A species may have several local names. For instance, *A. senegal* and *A. seyal* are known by six and four different names, respectively, in different localities. There are also cases where two or more species are called by same local name. Therefore, reference to specimens may be required when local names are used. Most of the gum producing *Acacia* species identified in the Somali Region are also common in East and Northeast Africa.

Table 1. Scientific and local Somali names of gum producing *Acacia* species in eight districts of the Somali Region, southeastern Ethiopia

Scientific name	Somali name
Acacia etbaica Schweinf.	Qansax, Qudhac
Acacia horrida (L.) Willd.	Sarmaan
Acacia mellifera (Vahl.) Benth.	Bilcil
Acacia oerfota (Forssk.) Schweinf.	Gumar, Gumaro, Quule
Acacia senegal (L.) Willd.	Marah, Cadad, Cadaad-dhaadheer, Cadaad-madow, Jaleefan, Waylo-Qonjida
Acacia seyal Del.	Galool, Qaydar, Waadhi, Jiiq
Acacia sieberiana DC.	Jeerin
Other Acacia sp.	Gabro
Acacia stuhlmannii Taub.	Gahaydher

Table 2. Distribution of the gum producing *Acacia* species identified from eight districts of the Somali Region, Ethiopia. Distribution in Ethiopia follows the description used in the flora of Ethiopia, viz., AF = Afar, AR = Arsi, BA = Bale, GD = Gondar, GG = Gamo Gofa, GJ = Gojam, HA = Hararghe, IL = Illubabor, KF = Kefa, SD = Sidamo, SU = Shewa, TU = Tigray, WG = Welega, WU = Welo region.

Species	Altitude (m)	Distribution in Ethiopia	Distribution elsewhere
A. etbaica	500-2300	AR, HA, WU, SD	Eritrea, Somalia, Kenya, Sudan, Uganda, Tanzania and Saudi Arabia
A. horrida	500-1700	HA, BA, KF, SD, GG	Somalia, Kenya, Sudan, Uganda
A. mellifera	400-2500	WU, SD, SU, HA, BA, KF, GG	Africa and Arabia
A. oerfota	100-1600	WU, SD, SU, HA, BA, AF, TU	Eritrea, Somali, Kenya, Sudan, Uganda, Tanzania, Egypt, Arabia
A. senegal	600-1700	AF, WU, SU, AR, BA, SD, HA, GG	Africa, Arabia, India and Pakistan
A. seyal	500-2300	TU, WU, GD, GG, SU, AR, HA, IL, KF, SD	Tropical Africa
A. sieberiana	500-2200	WU, SU, WG, IL, KF, SD, TU, GD, AR, HA	Tropical Africa
A. stuhlmannii	-	HA	Somalia, Kenya, Tanzania Zambia, Botswana, Transvaal

Sources: von Breitenbach (1963), White (1983), Kuchar (1988), Thulin (1989), Friis (1992), FAO (1995b) and Demel (1996).

Higher stockings of mature gum-yielding *Acacia* species were found in Gerbo and Segeg as well as in Dihun Districts of Fik Zone (Figure 2).

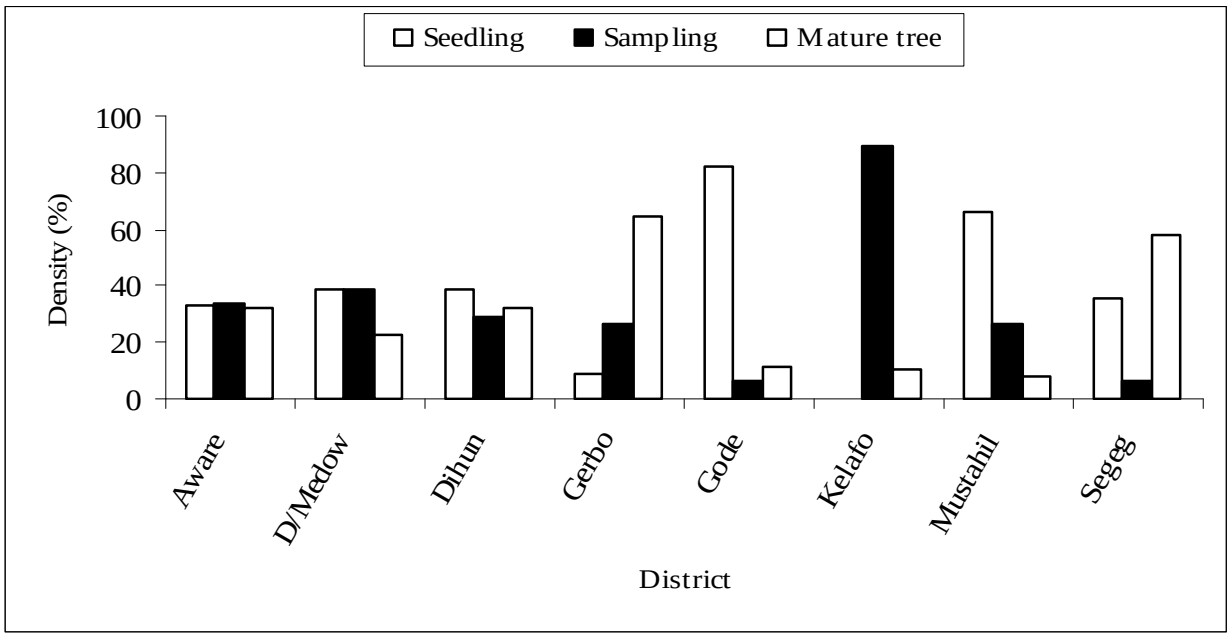

Figure 2. Mean seedling, sapling and mature plant densities of gum producing acacia species in the eight districts of the Somali Region, southeastern Ethiopia. From left to right, at each district, the bars stand for seedling, sampling and mature tree, respectively.

Based on seedling and sapling densities, the natural regeneration of the gum-yielding species were higher at Mustahil followed by Kelafo and Gode of Gode Zone. Among the nine gum producing acacias identified, *A. senegal* and *A. seyal* were widely distributed in all of the study districts and scored higher mean stocking tree densities compared to all the other species (Figure 3).

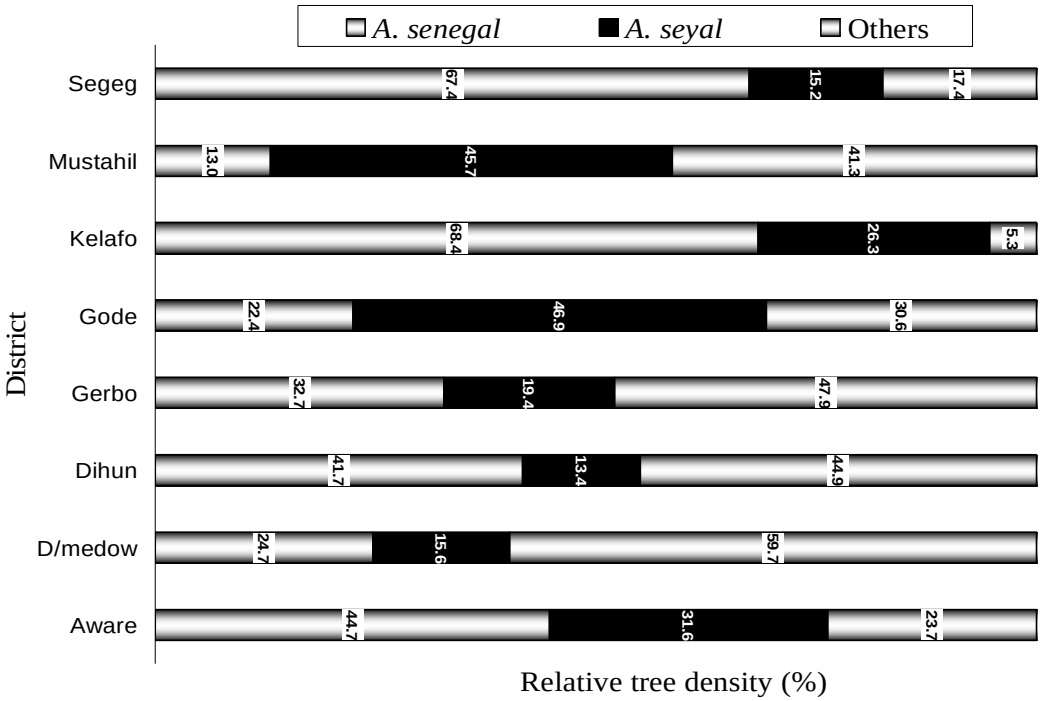

Figure 3. The relative abundance/density of the two major and other gum producing Acacia species in eight districts of the Somali Region, southeastern Ethiopia. The bar representing each district has three sections: bottom, middle and top, representing *A.sengaal*, *A.seyal* and others, respectively.

On the other hand, *A. etbaica* and *A. seyal* were larger both in terms of diameter at breast height (DBH) and height among the gum producing acacias (Table 3). These two species and *A. senegal* form large and umbrella-like crowns. The crown diameter of the acacias in the study areas at least equals the height of the tree (Tables 3 and 4). The other species with rather shrubby habits are short-stemmed, multi-branched and, in most cases, the main stem is established from branches. The highest diameter (at breast height) was recorded in Kelafo for *A. senegal* and in Segeg for *A. seyal* (Table 4).

Table 3. Mean (± SE) diameter at breast height (DBH), height, crown diameter and abundance of gum producing acacia species observed in eight districts of the Somali Region

Species	DBH (cm)	Height (m)	Crown diameter (m)
A. etbaica	11.1 ± 0.78	5.4 ± 0.24	5.7 ± 0.26
A. horrida	7.5 ± 0.82	2.8 ± 0.69	4.3 ± 0.44
A. mellifera	8.9 ± 0.76	3.7 ± 0.36	3.8 ± 0.21
A. oerfota	5.9 ± 0.82	3.5 ± 0.27	3.4 ± 0.20
A. Senegal	10.2 ± 0.67	4.2 ± 0.15	4.2 ± 0.20
A. seyal	11.8 ± 0.78	5.0 ± 0.27	4.4 ± 0.22
A. sieberiana	7.2 ± 1.86	4.3 ± 0.55	3.7 ± 0.30
A. stuhlmannii	4.8 ± 1.29	2.5 ± 0.57	2.5 ± 0.32
Other Acacia sp.	12.7 ± 1.13	5.2 ± 1.22	4.2 ± 0.73

Table 4. Mean (± SE) diameter at breast height (DBH), height and crown diameter of *A. senegal* and *A. seyal* in eight districts of the Somali Region, Ethiopia

District	DBH (cm)		Height (m)		Crown diameter (m)	
	A. senegal	*A. seyal*	*A. senegal*	*A. seyal*	*A. senegal*	*A. seyal*
Aware	9.5 ± 0.71	9.2 ± 0.60	3.1 ± 0.10	3.4 ± 0.89	3.1 ± 0.19	3.2 ± 0.24
D/Medow	10.8 ± .86	15.8 ± 0.94	3.9 ± 0.35	6.0 ± 0.30	4.1 ± 0.28	4.7 ± 0.52
Dihun	6.2 ± 0.79	8.1 ± 1.30	4.4 ± 0.32	4.9 ± 0.88	4.7 ± 0.57	5.5 ± 1.04
Gerbo	6.9 ± 1.00	9.9 ± 1.12	3.6 ± 0.31	4.4 ± 0.28	3.8 ± 0.10	4.4 ± 0.62
Gode	6.2 ± 0.77	6.1 ± 0.74	3.6 ± 0.34	3.7 ± 0.78	2.7 ± 0.29	2.5 ± 0.15
Kelafo	24.6 ± 1.60	25.5 ± 1.97	5.5 ± 0.27	5.3 ± 1.20	6.1 ± 0.38	6.2 ± 0.65
Mustahil	3.9 ± 0.86	8.0 ± 0.77	5.8 ± 0.23	6.3 ± 0.22	6.6 ± 1.37	6.0 ± 0.17
Segeg	12.7 ± 1.58	18.3 ± 1.63	4.5 ± 0.65	6.5 ± 0.34	3.5 ± 0.30	4.2 ± 0.87

3.2. Local Uses of the Gum Producing Tree Species

Unlike gums from *A. senegal* and *A. seyal* that were widely traded, the uses of gums from the other species were, however, limited to local consumption: chewing, and the trees are used for construction, fuel wood, animal browse and traditional medicine (Table 5). Discussion with collectors and traders of gum in the study area indicated a possibility of mixing products from different species. Gum arabic (from *A. senegal*) might be contaminated with gum talh (from *A. seyal*) or others at least in the initial stages of collection and processing which may result in adulteration.

Table 5. Local uses of gum producing *Acacia* species in eight districts of the Somali Region

Species	Chewing	Construction	Fuel wood	Animal browse	Medicine
A. etbaica	X	X		X	X
A. horrida	X			X	
A. mellifera	X	X	X	X	X
A. oerfota		X	X	X	
A. senegal	X	X	X	X	X
A. seyal	X	X	X	X	X
A. sieberiana	X	X	X	X	
A. stuhlmannii	X			X	

The interview with the farmers revealed that in addition to gum production, acacias have multiple local uses (Table 5) that can be categorized either as wood or non-wood products. The Somali in the study area have developed a wealthy of ethno-botanical knowledge, of which traditional medicine is one. Wood from acacias is highly valued for construction and fuel. Although charcoal extraction from various acacia species is widely practiced in the upper catchments of the region, mainly around Jijiga and along the main road to Harar, the practice was not developed in Gode Zone. However, acacias were the major sources of firewood in the zones of all studied districts. Although acacias are crooked and their woods are not suitable for timber, they are the main sources of construction wood in the Somali Region. All of the farmers interviewed preferred wood of acacias to any other species due to their strength and durability. Furthermore, most of the respondent farmers considered acacias to form excellent cover of palatable browse for their livestock and some believed that life would not be possible in the area without the acacias.

3.3. Regeneration, Tree Planting Culture and Status of the Natural Vegetation

Respondent farmers in all study districts of Somali Region indicated that all the gum producing species could be propagated by seeds. In all the study districts, none of the interviewed farmers practiced tree planting at all indicating that all the gum producing acacia trees of the region were components of the natural vegetation established naturally.

Over two-third of the farmers interviewed were aware of the declining of the natural regeneration capacity and vegetation cover of their surrounding. Frequent drought, increasing human and livestock populations, poor management and absence of proper ecosystem conservation policies and practices have been identified as the major causes of the deterioration of the vegetation cover and biodiversity in the region.

3.4. Tapping, Quantity and Quality of Gum

Depending on the type of species and altitude, gum producing acacia trees reach productive age (i.e., the beginning of tapping) from 6 to 10 years. In the lower altitude areas: Gode, Mustahil and Kelafo, trees reach productive age slower compared to the districts of higher altitudes. Furthermore, collectors estimated gum yield to range from 1 to 3 kg per tree per annum. Estimates of production per tree were higher in the lower altitude areas compared to higher altitude areas.

Tapping, which is the practice of wounding/incision of trees to facilitate the flow of exudes from the trees, is a very important operation in harvesting gum. Usually, only the bark of the gum producing trees is wounded and the exudates which start oozing just after each wounding dries within two to three weeks and become ready for collection. Tapping and gum collection takes place during the dry season and the wounds are healed when vegetative growth is initiated during the rainy season. Tapping heights on the tree range from 30 cm to 4 m depending on the locality and tree species. Tapping directly affects both quality and quantity of the products, and without proper tapping maximum potential of the tree may not be exploited.

However, unlike in other parts of the country and elsewhere from which gum is collected, farmers in the SNRS do not practice proper tapping with the exception of few collectors. In most of the areas, exudes are simply collected when the tree trunk naturally oozes. In the areas where collectors practiced wounding of the trees, only very poor and traditional tapping techniques are followed. In such areas, trees that are mature for extraction are wounded either by cutting or piercing by local hand tools such as scissors, peelers, knives, axes, sickles, stones, metal or any sharpened material. In most cases, tapping is done twice a year although a tree might be tapped up to five times a year depending on localities and tree species .

In all the study areas, no attention has been given to the direction of tapping and the trees are wounded in all directions. However, there were some exceptional

respondents in Aware and Segeg Districts who preferred tapping to be made against wind direction.

Since exudation takes place slowly, granules are collected from two to three weeks after wounding. Local household utensils or materials such as clothes, plastic sacks, barks, bowls, cups and plates were used to collect and transport the produce. The collector farmers practiced some traditional post-harvest processing and storage involving removal of impurities by hand or sieving, grading the produce by color and size of granules and short-term storage in cool places either in the house or under trees. Although color of exudes vary from species to species, high quality gums, according to the respondents, are usually transparent and sticky and any deviation from this, especially darkness, is an indication of poor quality. Impurities at collection, adulteration and long storage were some of the factors identified by majority of the respondents to alter the color and reduce the quality of gums. As a result, collectors seldom store gum for long time. Most collectors transport the products to local market soon after collection. The large majority of the rural community in the Somali Region considered the material and economic benefits from gum collection as secondary to livestock herding and growing crops.

4. Discussion

4.1. Gum Resource Potential

Although about 40% of the 58 species of *Acacia* known to grow in Ethiopia were reported from the Somali Region (Thulin, 1989), only nine were identified as gum producing species in the current study area (Table 1). More than 20 species of acacias were reported to produce edible gums and/or have some medicinal uses in Africa (White, 1983; FAO, 1995b). Among the gum products, the most important are gum arabic from *A. senegal* and gum talh from *A. seyal* (Seif el Din and Zarroung, 1996). Although gum production by *A. etbaica, A. horrida, A. mellifera, A. oerfota, A. sieberiana* and *A. stuhlmannii* had also been reported from elsewhere in tropical Africa (FAO, 1995b), gums produced from these species is limited to local uses in the SNRS.

Unlike in many African countries (Pandey and Chadha, 1996), gum-bearing plants found in the SNRS regenerate naturally and extraction of gums solely depends on the conditions of the natural stock. The fairly good distribution and abundance of gum producing species in the Region (Figures 2 and 3) suggest a considerable potential for sustained production and utilization of gum products. Former studies also indicate that acacias and commiphoras are the dominant species of bushlands and tickets over a vast area of semi arid and arid east and northeast tropical Africa (von Brietenbach, 1963; Friis, 1992; Millington *et al*., 1994).

The quantity and quality of gums that may be obtained from a particular species depend on a number of factors. The most important of these include ambient temperature, rainfall, tree diameter and crown size, method of tapping and length of tapping seasons (FAO, 1995c). The gum producing acacia species in the SNRS State grow in a climate of high diurnal mean temperature, low mean annual rainfall and rapid evaporation (Kuchar, 1988; Millington *et al*., 1994) that strongly favor gum exudation.

The crown size and DBH of a tree are indicatives of site productivity. Crown size represents the assimilatory surface area of the plant. High crown size is usually associated with high leaf area. Photosynthesis, the process for accumulation of carbon compounds including resins, is directly proportional to leaf area if the leaves in the canopy do not shade each other heavily. Under same set of environmental conditions, therefore, a plant with wider canopy produces more resin compared to one with narrower canopy. Within a species, a plant with wider canopy usually has larger diameter compared to one with narrow canopy. Thus, it can be safely stated that the greater the diameter of the tree tapped and the bigger the proportion of live crown size, the greater the gum yield.

4.2. Local Uses of The Gum Producing Tree Species

Wood from acacias is highly valued for construction and fuel among the pastoralists and agro-pastoralists of the SNRS. The gum producing acacias identified in the current study are reported to meet the desirable criteria for firewood (FAO, 1995b). The acacias are the main sources of wood for construction in the Region. The Somali in the study area have developed a wealthy knowledge of traditional medicine which may be promoted for the well-being and economic benefits of the local communities in the region.

According to Newman (1970), bushlands and thickets are generally considered as hindrances to cattle production, and this is true for dry *Acacia* - *Commiphora* bushlands, which sometimes can hinder stock movement and, due to their density, have only a sparse grass layer. However, under heavy range use, these bushlands tend to be decimated and eliminated rather than stimulated by intensive pastoral activities. This is because most of the important acacias are sources of browse for livestock, especially camel and goat (Table 5). Similar to the Somali Region, the foliages and pods of *A. senegal, A. seyal, A. etbaica, A. mellifera, A sieberian, A. oerfota* and *A. stuhlmannii* are widely used for animal browse in various countries of Sahelian Africa (Skerman *et al*., 1988; Seif el Din, 1991; FAO, 1995b).

Owing to their N-fixing and soil stabilizing abilities and provision of browse (Rocheleau *et al*., 1988; FAO, 1995b) the *Acacia* species identified in this study can be managed under agroforestry land use and management practices (Mulugeta *et al*., 2003). In the

Sudan, *A. senegal* is incorporated in an agroforestry practice called bush fallow system (Seif el Din and Zarroung, 1996). In this system, the gum producing acacia trees are allowed to grow on farm plots during a fallow period, during which they improve soil fertility to ensure adequate crop production. Thus, the trees protect the soil from erosion, improve its fertility and provide the farmer with cash from the sell of gum during the dry season.

4.3. Regeneration, Tree Planting Culture and Status of the Natural Vegetation

Under natural conditions of the Somali Region, natural regeneration from seeds does not appear satisfactory except in three of the study Districts: Dihun, Gode and Mustahil. The less abundance of seedlings and saplings may either be due to poor germination of seeds or dieback of seedlings and saplings due to moisture stress or animal browsing and trampling. According to Demel (1996), in areas with very variable rainfall, like in arid and semi-arid areas, there is a high level of seed dormancy. As a result, plants of dry regions do not germinate uniformly and rapidly. His study on *A. senegal*, *A. seyal*, *A. oerfota* and *A. sieberiana* indicate that mechanical scarification and acid treatment greatly improve seed germination rate. Soaking seeds of *A. sieberiana* in boiling water also increased germination from less than 10 to 80%. Additional sources (Azene *et al*., 1993) also indicate that most of the acacias adapted to the lowlands require pre-treatment to enhance germination.

4.4. Tapping, Quantity and Quality of Gum

Tapping is a very important operation in the harvesting of gum. It directly affects both quality and quantity of the product. Without proper tapping maximum potential of the tree may not be exploited. Studies carried out in the Sudan (Seif el Din and Zarroung, 1996) indicated that tapping facilitates exudation in *A. senegal*. In addition to facilitating the flow of exudes, tapping creates accumulation site on the tree, which would avoid the contamination of the gum with bark of the tree. Collection of the exudates is also easier from tapped trees. Under the current traditional practice, the average gum yield in the Somali Region ranges from 1-3 kg per tree per annum, which is higher compared to gum arabic production from the Sudan (Seif el Din and Zarroung, 1996). On the other hand, it is relatively lower than the gum yields of 3.4±2.6 and 4.4 ±1.3 kg per tree per year reported by Mulugeta *et al.* (2003) for *A. senegal* and *A. seyal*, respectively, in Liban Zone of the Somali Region. With proper tapping and handling procedures to improve quality and yield, future exploitation of gum resource in the SNRS could be improved enormously.

5. Conclusion

The Somali Region has been known for its production of several non-wood forest products exploited from extensive cover of the *Acacia-Commiphora* dominated vegetation. The present study has identified nine potential gum producing *Acacia* species in the arid and semi arid lands of the Region. Besides of being paramount national and international commodity, these species render multiple local uses such as food, dry season fodder, local construction timber, fuel wood, medicine and maintenance of the environment. Under the existing situation carefully planned and managed exploitation of gum in the Somali Region not only generates local, national and foreign incomes but also ensures a sustainable system of production. Apart from natural regeneration of the gum-yielding species, development of plantation of these species is imperative to ensure the sustainable production and utilization of the gum to benefit the region economically.

Disregarding gum extraction, which would cause almost no damage to the tree, the vegetation is important for livestock production, combating desertification, biodiversity maintenance and provision of the immense non-wood forest products and services. However, the increasing livestock population may cause severe interference to the rather fragile dry bushland and thicket ecosystem. Therefore, integration of gum extraction with other production and conservation programs should also be considered for sustainable production and utilization.

Any damage to the vegetation of the Somali region could be exacerbated by the high temperature, moisture stress as well as the degraded soil. Once damaged, the reclamation of such fragile ecosystem is almost impossible or at least very costly. Thus, the extraction of gum could be a very good option to promote local level accountability for the management of the resources. The lack of basic infrastructure, such as road and other communication facilities, at least for the moment, are the bottlenecks to attract investors from outside of the local community. Therefore, the communities of the study areas seem to be the potential group to develop, manage and conserve or sustainably utilize the vegetation resource. Proper management system that promotes the extraction of gums to meet the short-term needs of the local people and the long-term sustainability of the resource base must be designed to ensure a healthy co-existence of the vegetation, livestock and people in the ecologically fragile Somali Region of Ethiopia.

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