Research Article

The Social and Economic Significance of Natural Gum and Resin in the Woodlands of South Omo Zone, Southern Ethiopia

Alemayehu Hido and Asabeneh Alemayehu

1Natural Resources Management, Wolaita Sodo University, Wolaita Sodo, P.O. Box 138, Ethiopia
2Bahir Dar Environment and Forest Research Center, Ethiopian Environment and Forest Research Institute, Bahir Dar, P.O. Box 2128, Ethiopia

Correspondence should be addressed to Alemayehu Hido; gedohirbo03@gmail.com

Received 9 September 2021; Revised 3 December 2021; Accepted 17 December 2021; Published 4 January 2022

Academic Editor: Anna Żróbek-Sokolnik

Copyright © 2022 Alemayehu Hido and Asabeneh Alemayehu. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

The social, economic, and ecological role of woodlands forests in dry and lowland areas are more imperative than anywhere else. Most of the dry lands of Ethiopia host woodlands that produce various commercial gum-resin products. The objective of this study was to investigate the social and economic importance of commercial gum-resin products focusing on their roles in the local livelihoods. Four kebeles, namely, Luka and Enchete from Bena-Tsemay district, and Erbore and Asele from Hamer district of South Omo Zone, were purposively selected for the collection of socioeconomic data. Semistructured questionnaire and checklists were used for households and key informant interviews and focus group discussions, respectively. In addition, market assessments and field observation were conducted to collect the primary data and supplemented with secondary data. A total of 80 households were randomly selected for one-to-one interviews from the total number of 425 households in the selected kebeles. A total of 10 key informant interviews with elders, forestry experts, local merchants, and enterprise members involved in gum-resins marketing and 4 focus group discussions with 12 members including men, women, and youth were conducted. Simple descriptive statistical tools were used for the data analysis. The results of the study showed that the mean annual income earned from the sale of gum-resins was 5670 and 4571 ETB per household at Bena-Tsemay and Hamer study sites, respectively. About 84% of the respondents indicated that gum-resin collection was the simplest and fastest means to earn income for school children and women. Gum and resin collection was the third most important livelihood option in the study area following animal husbandry and crop and honey production. The majority (84%) of respondents recognized the income made from gum-resin products as a safety net during recurring famine eras. Moreover, respondents recognized the benefit of gum arabic as food during famine time, as chewing gum, and as nutritious fodder. It was also used as folk medicine for both human and livestock diseases. Communities used this resource as a constituent to treat eye and skin infections, bleeding, wounds, ulcers, stomachache, gastrointestinal infections, etc. In addition, 88.33% of shrubs/trees were used as source of cash income for local communities and 11.67% as fodder for animal husbandry. Despite this significance, various constraints hindered the utilization of the resource in the study area, and these included lack of appropriate tapping techniques, market access, market information, cooperatives, infrastructure facilities, and appropriate institutions as well as poor local communities’ awareness of land management. The present investigation has provided valuable information for overcoming the major constraints by devising strategies to maximize gum-resin production and commercialization in the study area.

1. Introduction

Woodlands and forest’s social, economic, and biological role in both dry and lowland areas are more imperative than in any rangelands. Agroforestry parklands and trees/shrubs outside forests play decisive roles in the livelihood of societies in Africa’s woodlands [1]. For Ethiopia, there are many social, economic, ecological, and political details to enact sustainable management of its woodland forests. For example, processed and/or value-added commercialization of gum-resins produced from woodland forests would give access to extra income for the arid and/or woodland prone
communities, in addition to the regional and national economy at large [2]. Discussion on the significance of woodlands and dry forests is highly dependent on lessons from the moist tropics, with scanty information on woodlands that cover large areas and host hundreds of millions of Africans [1, 3, 4]. Current studies reveal that development towards combination of woodland forests has been hindered partly by a lack of practically based information on their socioeconomic significance [1, 5].

About 75% of the Ethiopian total land mass was represented by dryland forests [6], which host woodlands that produce various commercial gum-resin products [2]. An annual production potential of 270,000 tons of gum-resins from more than 3.5 million hectares of woodlands and bushlands was estimated in Ethiopia [5]. Gum-resins are the most widely used and traded non-timber forest products (NTFPs) other than items consumed directly as food, fodder, and medicine [7]. They are important for various purposes in consumer goods such as detergents, cosmetics, pharmaceuticals, perfumes, sweet food products, soft drinks, hard drinks, and insecticides [8].

In addition, as stated by [9], gum-resins are used in indigenous medicines for the management of different ailments such as wounds, arthritis, fractures, obesity, parasitic infection, and gastrointestinal diseases. Income at household level is significant. For example, the estimated income from gum-resin business is threefold higher than the contributions of crops [10]. Consequently, the economic importance of these resources as a government source of valuable foreign currency has been widely realized in Ethiopia [11]. Employment opportunities have also been generated throughout the year; for instance, *Boswellia* products subsector recruits several employees for activities such as tapping and collection, transportation, processing, marketing, and guarding of storage facilities [12]. Additionally, production of NTFPs helps to promote a better consolidation of dry woodlands and, thus, improves economic enhancement along with ecological maintenance [2].

Despite the increasing realization of the social, economic, cultural, environmental, and other roles of gum-resin products worldwide, their critical significance has not been yet recognized and acknowledged generally in the country and specifically in South Omo Zone, South Ethiopia. This is due to, as stated by [13], the absence of information on the social, economic, and cultural importance. Communities in the study area pursue a pastoralist style of life strategy, whose sources of income are mainly relying on livestock rearing and crop and natural honey production [14]. Drought is one of the major reasons for natural resource degradation. For example, as stated by [15], compositions of gum-resin bearing species are facing challenges of degradation due to recurrent droughts, thereby leading to a decline in productivity. In addition, fuel wood collection and charcoal making are considered as alternative income sources especially for those who live around rural towns. This action led to minimizing the gum-resin productivity and loss of genetic diversity of the species [16]. Thus, the development of sustainable management options for this dry land resource is required for the benefit of local communities in particular and national and international communities in general.

The socioeconomic significance through value-added commercialization of gum-resins is considered as the basis for sustainable production and marketing of the products. Therefore, this study aims to assess the social and economic role of gum-resin products and identify main constraints on the production, marketing, and/or commercialization of gum-resin products in the woodlands of South Omo Zone, Southern Ethiopia.

### 2. Materials and Methods

#### 2.1. Study Area Description

This study was carried out in semi-arid woodlands of Bena-Tsemay and Hamer districts of South Omo Zone, located in Southwestern parts of Ethiopia. The zone is unique in that it comprises 16 distinct ethnic groups within 8 districts of the zone in the country and is known as the heart of cultural diversity. The study area is geographically located between 36°09′25″E and 37°04′12″E longitude and 4°30′18″N and 5°44′06″N latitude (Figure 1). The total population of the study districts is 62,362 and 59,572, inhabiting 3754 km² and 5742 km² of total area of Bena-Tsemay and Hamer districts, respectively. The elevation of the area ranges between 371 and 2084 m a.s.l in Bena-Tsemay and Hamer districts, respectively [14, 17]. The districts have a bimodal rainfall pattern with an average annual rainfall of 1400 mm and 764 mm in Bena-Tsemay and Hamer districts, respectively [17, 18]. The annual average minimum and maximum temperatures are in the range of 16°C–27°C and 40°C–41°C for Bena-Tsemay and Hamer districts, respectively [19]. Eutric Fluvisol is the dominant soil types in grasslands while Eutric and Chromic Cambisol are dominant in mountains areas [20].

Most of the households in the selected districts depend on livestock rearing, gum-resins collection, and natural honey harvesting for living as well as for generating income. In the study districts, gum-resin bearing tree species are the predominant vegetation types [14, 21].

#### 2.2. Sampling, Data Collection, and Analysis

For this study, both qualitative and quantitative approach were used. Multistage random sampling techniques were used. Firstly, two districts, Bena-Tsemay and Hamer, that are adjacent to the forest resources (i.e., comprising the natural gum-resin bearing tree/shrub species) were purposively identified. Secondly, following the same fashion, four kebeles, namely, Luk’a and Enchete from Bena-Tsemay district, and Erbore and Asele from Hamer district, were purposively selected based on their dependence on gum-resin production and marketing. A total number of 425 household heads, who lived permanently in the selected sample kebeles, were recorded, and from these, 80 households (20 from each kebele) were randomly selected and used for face-to-face interviews.

Semistructured questionnaire was used for household survey and key informant interviews and focus group discussions were conducted using a checklist. A total of 10 key informants including elders, forestry experts, local merchants, and enterprise members involved in gum-resin marketing and 4 focus group discussions (one in each kebele,
containing 12 individuals including men, women, and youth) were conducted. Questions on the socioeconomic characteristics, gum-resin products collection and handling, processing, and marketing practices were the nucleus of the questionnaire. The main challenges for the production and marketing of these products and their main livelihood contributions were also important concerns of this research. The collected primary data was complimented with field observation and secondary data sources.

2.3. Data Analysis. Both qualitative and quantitative data analysis methods were used, summarized, and analyzed through employing statistical package for social science (SPSS version 20). Descriptive statistics was employed to describe the various variables.

3. Results

3.1. Socioeconomic Characteristics and Main Livelihood Options of Local Communities. The majority of the respondents (86%) were male-headed households, and their ages ranged between 16 and 40 years (Table 1). With regard to the level of education, majority of respondents 60% were illiterate, followed by 25% who attended elementary school up to grades between 5 and 8 (Table 1).

3.2. Household’s Livelihood Options and Their Income Contribution. The main livelihood options for the respondents were livestock production, crop production and natural honey harvesting, gum-resin collection, and collection of wild edible fruits in descending order of importance. In terms of income sources, live animals’ sale accounted for 33.75% of the total household’s income, followed by crop/natural honey production (31.25%) and gum-resin sale (21.25%). The contribution of wild edible fruits to the household’s income was about 13.75% (Table 2).

3.3. Trees and Shrub Species that Bear Gum-Resin Products and Their Use in South Omo Woodlands. Several gum-resin products such as gum, gum gumero, gum arabic, gum talha, incense (produced from B. neglecta and locally named as...
aroma of frankincense from intestinal infections, etc. (Table 3). Infections, bleeding, wounds, ulcers, stomachache, gastrointestinal problems, and myrrh from Commiphora species such as C. myrrha, C. boranensis, C. brucae, and C. schimperi are collected and used in study area, and their products are locally named as “nech etan” (meaning white incense).

Commiphora species are the main tree species for collection of gum. Besides, gum-resins from Commiphora species such as C. africana, C. myrrha, C. boranensis, C. brucae, and C. schimperi are collected and used in study area, and their products are locally named as “tikur etan,” meaning black incense), myrrh, and opoponax (Table 2).

Table 1: Socioeconomic characteristics of the household respondents of the studied districts, South Omo Zone (n = 80).

| Age group (year) | Gender | Level of education |
|-----------------|--------|--------------------|
|                 | Male   | Female  | Total | Illiterate | 1–4 | 5–8 | 9–10 | Total |
| ≤ 15            | 6      | 2       | 8     | 7          | 4   | 0   | 0    | 11   |
| 16–40           | 28     | 5       | 33    | 25         | 8   | 5   | 3    | 40   |
| 41–64           | 19     | 2       | 21    | 12         | 3   | 3   | 1    | 20   |
| ≥ 65            | 16     | 2       | 18    | 13         | 2   | 1   | 2    | 9    |
| Total           | 69 (86%)| 11     | 80    | 48 (60%)   | 17  | 9   | 6    | 80   |

Source: field survey (2018/19).

Table 2: Livelihood options and income sources in study area (respondents = 80) in South Omo Zone.

| Source of income          | Rank of livelihood options | Percent |
|---------------------------|----------------------------|---------|
| Sale of live animals      | 1st                        | 33.75   |
| Sale of crops and honey   | 2nd                        | 31.25   |
| Sale of gum-resins        | 3rd                        | 21.25   |
| Sale of edible fruits     | 4th                        | 13.75   |
| Total                     |                            | 100.00  |

Arranged in descending order of the rank of livelihood options. Source: field survey (2018/19).

“tikur etan,” meaning black incense), myrrh, and opoponax were collected in the study area from different trees/shrubs in South Omo (Figure 2; Table 3). These products were collected for local subsistence use and for income generation. Acacia species such as A. mellifera, A. mubica, A. senegal, A. seyal, and A. sterculia are the main tree species for collection of gum. Besides, gum-resins from Commiphora species such as C. africana, C. myrrha, C. boranensis, C. brucae, and C. schimperi are used as food during famine time, as chewing gum, and as nutritious fodder. Communities have long experience of considering it as folk medicine both for human and livestock diseases. They used this resource as a constituent to treat eye and skin infections, bleeding, wounds, ulcers, stomachache, gastrointestinal infections, etc. (Table 3).

Moreover, pastoralists in both of the districts also used the aroma of frankincense from B. neglecta and myrrh from C. myrrha as fumigants during religious and various cultural occasions. Products such as incense from C. myrrha and C. boranensis were used as candles in holidays and festivals. Colors from the resin of C. africana, C. boranensis, and C. brucae mainly in schools have been prepared by elder people from the services of these gum-resin bearing species; shade for livestock and wind barriers against the blowing storms are invaluable.

In the study districts, 100% of the identified/encountered trees/shrubs species were used as fodder for animal husbandry and 88.33% used as source of cash income for local communities. From the identified tree species, solely one (8.33%) species (Acacia species) was used as food during famine time (Table 4).

3.4 Gum-Resin Collection and Marketing in South Omo Zone.

In the study area, gum-resin products collection was ordinarily performed from communal stands of woodlands, which indicated that the resources are not yet individually owned and domesticated by the local people. Collection of gum-resin products was done by manual labor after oozing naturally, and thus it is a labor-intensive traditional method of tapping (Figure 3) (Table 5).

The majority of the respondents (75%) indicated the absence of any scientific specific tapping technique (Table 6). However, recent specific and improved tapping technologies that help to increase return and productivities of gum-resins were highly appreciated by the society. Harvesting, transporting, and selling of gum-resin products are normally done by women and children. However, during free times, all members of the household were involved in the collection of gum and resin, irrespective of either age or sex, and distributed it to the nearby market. In contrary, gum-resin products collection is considered as a primary occupation, for those who have limited options (i.e., shortage of farmlands and few livestock numbers). These members of the local community bring substantial number of products into local markets and/ or pass them to the intermediaries for earning better prices.

3.5 Contribution of Gum-Resin Production and Marketing to Rural Livelihood.

Gum-resin production has a great contribution to rural livelihood, including income generation; being safety net; use as traditional medicine, food, and fodder; employment opportunities; soil and water conservation; biodiversity conservation; and other cultural contributions. As seen in Table 5, households collect on average annually 360, 380, and 200 kg of gum arabic, frankincense, and myrrh, respectively, in Bena Tsemay and 394, 360, and 197 kg of gum arabic, frankincense, and myrrh, respectively, in Hamer district. It indicates the significant income contribution of gum-resin production in the study area. This study revealed the average annual income of about 5670 and 4571 ETB (Ethiopian Birr) from the sale of gum-resin products at the household level at Bena-Tsemay and Hamer study sites, respectively (Table 7). The result revealed that the household food purchase was mainly fulfilled from the income obtained from the sale of gum-resin products and that 84% of respondents recognized the income made from gum-resin products as a safety net during recurring famine eras (Table 6). In addition, this business creates a peculiar advantage for the household to access cash income following main and short rain seasons. Moreover, majority of respondents (84%) considered gum-resin harvesting as the simplest and fastest means to earn income for school children and women (Table 6). The respondents also believed that there were improved social
Table 3: Summary of gum and resin bearing tree species and their local use for both districts in South Omo Zone.

| Species                  | *Life form | Product name | Local use as medicine                              | GFC | FOD | FU | FFF | SC | S |
|--------------------------|------------|--------------|-----------------------------------------------------|-----|-----|----|-----|----|----|
| Sterculia africana       | T          | Myrrh        | Used as additive                                    | No  | Yes | No | No  | No | No |
| Acacia senegal           | T/S        | Gum arabic   | Used to heal stomach discomfort                      | No  | Yes | No | Yes | Yes| Yes|
| Acacia seyal             | T          | Gum talha    | Gum used to treat dysentery                          | No  | Yes | No | Yes | No | Yes|
| Acacia tortilis          | T          | Gum          | Gum used to increase blood clotting                  | No  | Yes | No | No  | Yes| Yes|
| Boswellia neglecta       | T/S        | Incense      | Incense fumigation healing headache                  | Yes | Yes | No | No  | Yes| Yes|
| Commiphora africana      | T/S        | Hagar        | Used to treat snakebite and skin wound               | Yes | Yes | No | Yes | Yes| Yes|
| Commiphora boranensis    | T/S        | Myrrh        | Used for wound treatment                             | Yes | Yes | No | Yes | Yes| Yes|
| Commiphora breuceae      | T/S        | Opoponax     | Used for folk medicine/perfumery                     | Yes | Yes | No | Yes | Yes| Yes|
| Commiphora myrrh         | T          | Pure Myrrh   | Used to treat stomachache and disinfections of male genital organ | No  | Yes | No | Yes | Yes| Yes|
| Commiphora schimperi     | T/S        | Myrrh        | Used to stop calves and sheep breastfeeding          | No  | Yes | No | Yes | Yes| Yes|
| Sterculia africana       | T          | Myrrh        | Used as additive                                    | No  | Yes | No | No  | No | No |
| Acacia nubica            | T/S        | Gum gumero   | Gum used to treat dysentery                          | No  | Yes | No | No  | No | No |

*Life form: T: tree, S: shrub. *Additional use: GFC: gum for chewing; FOD: fodder; FU: fumigation; FFF: food during famine; SC: source of cash; S: sanitation. Source: field survey (2018/19).

Table 4: Percentage of local use of gum and resin bearing tree species for both districts in South Omo Zone.

| Local use of gum and resin bearing tree species | No. of tree species | Frequency (%) |
|------------------------------------------------|---------------------|---------------|
| Fodder                                        | 12                  | 100.00        |
| Source of cash income                         | 10                  | 83.33         |
| Sanitation                                    | 9                   | 75.00         |
| Fumigation                                    | 5                   | 41.67         |
| Gum for chewing                               | 3                   | 25.00         |
| Food during famine time                       | 1                   | 8.33          |

*Arranged in descending order of frequency. Source: field survey (2018/19).
Table 5: Mean daily and annual harvesting of gum-resin products (in kg) in South Omo Zone woodlands.

| Commodity  | Mean daily harvesting (kg/individual ± SD) | Mean annual harvesting (kg/individual) |
|------------|------------------------------------------|----------------------------------------|
|            | Bena-Tsemay                              | Hamer                                  |
| Gum arabic | 2.56 ± 18                                 | 1.98 ± 13                              | 360 | 394 |
| Frankincense | 3.15 ± 14                               | 2.63 ± 13                             | 380 | 360 |
| Myrrh      | 1.87 ± 23                                | 1.68 ± 35                              | 200 | 197 |

Measurement taken through six months/year harvesting bases. Source: survey data (2018/19).

Table 6: Views of respondents on the future gum-resin resources management and commercialization.

| Items                                                                 | Yes (%) | No (%) |
|----------------------------------------------------------------------|---------|--------|
| Do you know about the abundant existence of gum-resin producing tree/shrubs in your local area? | 97.4    | 2.6    |
| Would you harvest gum-resin for local use?                           | 62.6    | 38.4   |
| Would you harvest for sale?                                          | 91.5    | 8.5    |
| Are there business cooperative associations?                         | 33.0    | 68.0   |
| Do you want to be a member of gum-resin collection?                  | 92.2    | 7.8    |
| Is gum-resin collection the simplest and fastest means to earn income for school children and women? | 84.0    | 16.0   |
| Is income from gum-resin products used as safety net during recurring famine eras? | 84.0    | 16.0   |
| Are there scientific tapping techniques?                             | 75.0    | 25.0   |

Source: survey data (2018/19).

Table 7: Mean annual cash income (in ETB) obtained by household heads from the sale of gum-resin products in South Omo Zone woodlands.

| Commodity  | Unit price (ETB/kg) | Estimated mean annual cash income (ETB) |
|------------|---------------------|----------------------------------------|
|            | Bena-Tsemay         | Hamer                                  |
| Gum arabic | 8.00                | 6.00                                   | 2880.00 | 2360.00 |
| Frankincense | 5.50                | 4.50                                   | 2090.00 | 1620.00 |
| Myrrh      | 3.50                | 3.00                                   | 700.00  | 591.00  |
| Total      | 5670.00             | 4571.00                                |

Source: survey data (2018/19).
interactions due to production and marketing of the resource.

3.6. Respondents’ Perception of Future Gum-Resin Resources Management and Commercialization in the Study Area. About 97.4% of the sample respondents realized the potential of the natural gum-resin bearing tree/shrub species in the study area. The prevailing multiarray contribution of these products induce the majority of respondents (92.2%) to have a growing interest in being actively involved in gum-resin collection practices, while the remaining respondents (7.8%) still showed lack of interest in any of gum-resin collection practices (Table 6). Moreover, the majority of the respondents (62.6%) used gum-resin products for local use, and 91.5% of them collected the product for sale. Some of the respondents (33.0%) tried to establish a cooperative association in order to encourage others to be part of the business; however, they were unsuccessful and disorganized (Table 6).

3.7. Challenges and Constraints Affecting Gum-Resin Production. Several constraints that potentially hinder the possible utilization of these resources have been identified as indicated by key informants and through focus group discussions. These include lack of infrastructure facilities, appropriate institutions, capacity, suitable tapping technologies, and cooperatives and difficulty in accessing market, market information, and fair market prices. The key informants and focus group also asserted that the poor local communities’ awareness of maximizing utilization and marketing of woodlands resources and gum-resin resources in particular, changing the woodlands to farmlands, overgrazing, drought, and bush encroachment are considered as underlying problems.

4. Discussion

4.1. Socioeconomic Characteristics and Main Livelihood Options of Local Communities. Majority of the respondents (60%) of pastoralists were illiterate and unable to read and write, and only 7.5% completed formal education. The result obtained in this study was in line with the previous studies done by [17, 22] in Hamer and Bena-Tsemay, South Omo, respectively, but unlike those in Mexico, Kenya, and Kwara State (Nigeria), as reported by different authors [23–25], where most of the people had elementary education. The high level of illiteracy was attributed to the lack of participation in learning, as most of the time was spent in rearing livestock. However, at present, both governmental and nongovernmental organizations are promoting education, and astonishing change has been seen around the districts. The first livelihood option for the local communities has been animal rearing, and it is also the largest income source (33.75%). The result obtained in the current study validated what has been reported by different authors in different pastoral areas of Ethiopia [26–28]. In addition to animal husbandry, the woodland forests of the districts are the source of several products including gum-resins, honey, fuel wood, hand crafts, and construction materials, which are use for their subsistence and cash income and are imperative for household livelihoods. Hence, sale of gum-resin is the third livelihood option for the households next to sale of crops and honey. The findings obtained from this study on the sale of gum-resin agreed with what [10, 29–31] reported from Liban, Southeast Ethiopia, and Hamer and Bena-Tsemay district, Southwestern Ethiopia, respectively. Similarly, like societies in South Omo, societies living in the lowland parts of Tigray [32] and Amhara, North Gondar Zone [33], produce gum-resins for both home consumption and sale.

4.2. Gum-Resin Products and Their Uses. Collection and selling of tree/shrub-based gum-resin products were the third predominant livelihood activities in the area following animal husbandry and crop production. In majority of areas in Ethiopia, gum-resin collection and selling played an important role in the overall socioeconomic conditions of the local communities [27]. Similarly, [10] stated that collection of gum-resins was the main source of livelihoods at Liben district, Somali region. Gum-resin products were mainly collected by school children followed by women in both study areas. This observation was in line with the reports of [34] that children and women are the main actors for the collection and selling of gum-resin products in Tigray region. Moreover, numerous studies from different parts of Ethiopia [29, 31, 35–37] reported gum-resin production and/or extraction as local income source in woodland forest areas of Ethiopia. The estimated average annual income of gum-resin (5670 and 4571 ETB at Benà-Tsemay and Hamer study sites, respectively) was comparable to that from the natural gum-resin bearing species in Ethiopia [2, 29, 35] with mean annual income of Borana, Metema, and Somali study sites, respectively. In this study, household communities have been highly involved in the harvesting (63%) and sale of gum-resin (92%), and relatively fewer intervention activities have been taken place concerning the initiation and mobilization of societies to start business as cooperative associations (33%) than those reported in most of these previous studies conducted in Borana, Metema, and Somali study sites, respectively.

The societies in South Omo have never been trained in tapping and collection methods and/or techniques and are working with disorganized and fragmented youth associations. Hence, the collection process has been limited to collecting only those natural exudates. Societies that inhabit the study area often utilize this resource for numerous purposes similar to the observation of [10, 33] in eastern and northern parts of Ethiopia, respectively. Fodder, income earning alternative, folk medicine, hygiene, and several cultural practices are considered as primary purposes of the resource in the study area. This may indicate the deep curiosity of the societies about gum-resin bearing tree/shrub species.

Among the local uses of gum-resin bearing tree species, fodder provision was the most important one followed by cash income. Woodland forest and/or gum-resin trees/shrubs species are the only source of forage for animal
husbandry in the area, implying that woodland forests are used as rangelands or forage. Following fodder and cash income generation, the woodland gum-resin bearing trees/shrubs are used for fumigation and chewing gum and as food during famine periods with descending order of importance. The current results from this study on local use of woodland gum-resin trees/shrubs are comparable with the previous studies [2, 30, 38] reporting on selected district, zone, and regions and national economy of Ethiopia, respectively.

The majority of the respondents adopt the attitude of keeping the woodlands as rangelands through skillfully exploiting and installing integrated and organized gum-resin production system. With the worldwide growing demand for gum-resin products as imperative business commodities, vast not yet exploited tree/shrub gum-resin species found in the study area ensure the potential income alternatives particularly for the local community and generally to the country’s export potential.

5. Conclusions

This study assessed the economic and social significance of gum-resin bearing tree species in the woodlands of South Omo Zone. Gum and resin collection was the third most important livelihood option for the local communities in the study area following livestock rearing and crop production. It is also the third most important income source for the communities. These findings have highlighted the vital importance of gum-resin for livelihoods improvement of local pastoral societies. A mean income of 5670 and 4571 ETB was gained annually per household at Bena-Tsemay and Hamer study sites, respectively. Moreover, gum-resin has high social and cultural value for the society. Its contributions include income generation; being safety net; use as traditional medicine, food, and fodder; employment opportunities; soil and water conservation; biodiversity conservation; and other cultural contributions. Besides the economic and social significance, gum-resin producing tree/shrub species contribute to the sustainability of dryland ecosystems. Despite these benefits, various constraints such as lack of appropriate tapping techniques, market access, cooperatives, infrastructure facilities, and appropriate institutions as well as poor local communities’ awareness of land management hindered the utilization of gum-resin products in the area, while such significant role of gum-resin has to be given proper consideration during policy making of land use and policy implementations. Thus, this study recommends sustainable planning and management strategies for maximizing gum-resin utilization and marketing by overcoming the identified challenges. In addition, further study on supportable preservation and wise utilization of woodlands for potential production of gum-resin resources from bearing species is recommended.

Data Availability

The data used to support the findings of this study are available in the tables of this article as well as in supplementary materials.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this work.

Acknowledgments

This study was sponsored by the Pastoral, Agro-pastoral, and Emerging Regions Directorate of Ethiopian Institute of Agricultural Research (EIAR). The authors are grateful to both districts’ experts for their unreserved support during data collection and fieldwork. The authors are grateful to the local community for their willingness to directly involve themselves and provide invaluable information during data collection period.

Supplementary Materials

There is respondent background data based on sample size \( n = 80 \) (Supplementary Table 8) and research questions depending on respondent answers \( n = 80 \) (Supplementary Table 9). Hence, data for monthly income from sale of gum-resin includes only 21.25% of respondents/households (HHs), i.e., \( n = 17 \) out of 80 HHs in the study area (field survey 2018/19)). Moreover, the summary of data on gum-resin bearing tree species and their local use according to the respondent answers (Supplementary Table 10) used to support the findings of this study is available in editable version table files. (Supplementary Materials)

References

[1] FAO, “Guidelines on sustainable forest management in drylands of sub-Saharan Africa. Arid Zone,” Forests and Forest Working Paper, vol. 1, Rome, Italy, 2010.
[2] A. Worku, M. Leminih, M. Fetene, and D. Teketay, “Socio-economic importance of gum and resin resources in the dry woodlands of Borana, Southern Ethiopia,” Forests, Trees and Livelihoods, vol. 20, no. 2-3, pp. 137–155, 2011.
[3] C. M. Shackleton, S. E. Shackleton, E. Buiten, and N. Bird, “The importance of dry woodlands and forests in rural livelihoods and poverty alleviation in South Africa,” Forest Policy and Economics, vol. 9, no. 5, pp. 558–577, 2007.
[4] A. Asfaw, M. Leminih, H. Kassa, and Z. Ewnetu, “Importance, determinants and gender dimensions of forest income in eastern highlands of Ethiopia: the case of communities around Jelo Afronymontane forest,” Forest Policy and Economics, vol. 28, pp. 1–7, 2013.
[5] M. Leminih and H. Kassa, Eds., Opportunities and Challenges for Sustainable Production and Marketing of Gums and Resins in Ethiopia, CIFOR, Bogor, Indonesia, 2011, http://www.cifor.cgiar.org/.
[6] M. Leminih, “Production and marketing of gums and gum resins in Ethiopia,” Production and Marketing of Gum Resins: Frankincense, Myrrh and Opoponax, pp. 55–70, FAO, Rome, Italy, 2005.
[7] M. Leminih and D. Teketay, “Frankincense and myrrh resources of Ethiopia: I distribution, production, opportunities for dryland development and research needs,” SINET: Ethiopian Journal of Science, vol. 26, no. 1, pp. 63–72, 2003.
[8] A. C. Atti-Santos, M. Rossato, G. F. Pauletti et al., “Physico-chemical evaluation of Rosmarinus officinalis L. essential
D. Hidosa, W. Bedeke, and M. Mengistu, "Participatory on-farm evaluation and demonstration of improved forage species under rain fed condition in Hamer woreda of South Omo zone," *Journal of Arid Environments*, vol. 55, no. 3, pp. 465–482, 2003.

G. Desalegn and R. Alia, "Especies productores de resina y gomas naturales en Etiopía y la aplicación potencial de sus productos," *Forest Systems*, vol. 16, no. 3, pp. 211–221, 2007.

W. Tadesse, D. Teketay, M. Lemenih, and G. Fitwi, "*Boswellia* country report for Ethiopia," in *Review and Synthesis on the State of Knowledge of Boswellia Species and Commercialization of Frankincense in the Dry Land of Eastern Africa*, B. Chikamai, Ed., FAO/EU/FORNESSA Publication, Rome, Italy, 2002.

M. Lemenih, S. Feleke, and W. Tadesse, "Constraints to smallholders production of frankincense in Metema district. North-western Ethiopia," *Journal of Arid Environments*, vol. 71, no. 4, pp. 393–403, 2007.

T. Admasu, E. Abule, and Z. K. Tessema, "Livestock-range management practices and community perceptions towards rangeland degradation in South Omo zone of Southern Ethiopia," *Livestock Research for Rural Development*, vol. 22, no. 1, 2010.

T. Mengistu, D. Teketay, H. Hulten, and Y. Yemshaw, "The role of enclosures in the recovery of woody vegetation in degraded dryland hillsides of central and northern Ethiopia," *Journal of Arid Environments*, vol. 60, no. 2, pp. 259–281, 2005.

K. Hundera, R. Aerts, A. Fontaine et al., "Effects of coffee management intensity on composition, structure, and regeneration status of Ethiopian moist evergreen afro-montane forests," *Environmental Management*, vol. 51, no. 3, pp. 801–809, 2013.

D. Hidosa and B. Ayele, "Assessment on dairy production, post-harvest handling and marketing systems in hamer woreda of South omo zone," *Assessment*, vol. 5, no. 23, 2015.

D. Hidosa and D. Gemiyo, "Replacement of commercial concentrate with *Acacia nilotica* pod meal on feed intake, digestibility and weight gain of boer x woyto-guji crossbred goats," *American Journal of Agriculture and Forestry*, vol. 5, no. 6, pp. 192–197, 2017.

D. Hidosa, W. Bedeke, and M. Mengistu, "Participatory on-farm evaluation and demonstration of improved forage species under rain fed condition in Hamer woreda of South Omo zone," *Global Journal of Science Frontier Research, vol. 16*, no. 4, 2016.

T. Soromessa, D. Teketay, and S. Demissew, "Ecological study of the vegetation in Gamo Gofa zone, Southern Ethiopia," *Tropical Ecology*, vol. 45, no. 2, pp. 209–222, 2004.

T. A. Belay, Ø. Totland, and S. R. Moe, "Woody vegetation dynamics in the rangelands of lower Omo region, south-western Ethiopia," *Journal of Arid Environments*, vol. 89, pp. 94–102, 2013.

A. Adicha, D. Segaw, A. Tesfaye, and S. Tesema, "Value chain analysis of frankincense in hammer and benna-tsemay districts of the South Omo zone, south Western Ethiopia," *International Journal of Environmental Sciences and Natural Resources*, vol. 7, no. 3, pp. 68–73, 2017.

A. López-Feldman, "Shocks, income and wealth: do they affect the extraction of natural resources by rural households," *World Development*, vol. 64, pp. S91–S100, 2014.

M. Muyanga, T. S. Jayne, and W. J. Burke, "Pathways into and out of poverty: a study of rural household wealth dynamics in Kenya," *Journal of Development Studies*, vol. 49, no. 10, pp. 1358–1374, 2013.

A. Tunde, E. Adeleke, and E. Adeniyi, "Impact of charcoal production on the sustainable development of asa local government area, Kwara state, Nigeria," *African Research Review*, vol. 7, no. 2, pp. 1–15, 2013.

A. E. Gedda, "Rangeland evaluation in relation to pastoralists perceptions in the Middle Awash Valley of Ethiopia," https://hdl.handle.net/11660/6302 Doctoral dissertation, University of the Free State, Bloemfontein, South Africa, 2003, https://hdl.handle.net/11660/6302 Doctoral dissertation.

T. Gemedo-Dalle, B. L. Maass, and J. Isselstein, "Plant biodiversity and ethnobotany of Borana pastoralists in southern Oromia, Ethiopia," *Economic Botany*, vol. 59, no. 1, pp. 43–65, 2005.

T. Admasu, "Pastoralist's perceptions on range-livestock management practices and rangeland assessment in Hamer and Benna-Tsemay districts of South Omo Zone," MSc thesis, AmMSc Thesis Presented to the School of Graduate Studies of Alemaya University, Ethiopia, 2006.

D. Abebaw, H. Kassa, G. T. Kassie, M. Lemenih, B. Campbell, and W. Teka, "Dry Forest based livelihoods in resettlement areas of Northwestern Ethiopia," *Forest Policy and Economics*, vol. 20, pp. 72–77, 2012.

D. Fikir, W. Tadesse, and A. Gure, "Economic contribution to local livelihoods and households dependency on dry land forest products in Hammer District, Southeastern Ethiopia," *International Journal of Forestry Research*, vol. 2016, Article ID 5474680, 11 pages, 2016.

A. Hido, M. Tolera, B. Lemma, and P. H. Evangelista, "Population status and resin quality of frankincense *Boswellia neglecta* (burseraceae) growing in South omo, southwestern Ethiopia," *Journal of Sustainable Forestry*, vol. 39, no. 6, pp. 620–634, 2020.

W. Tadesse, D. Teketay, M. Lemenih, and G. Fitwi, "Country report for Ethiopia," in *Review and Synthesis on the State of Knowledge of Boswellia Species and Commercialization of Frankincense in the Drylands of Eastern Africa*, B. N. Chikamai, Ed., Association of Forestry Research Institutions in Eastern Africa, Nairobi, Kenya, 2003.

A. Eshte, D. Teketay, and H. Hulten, "The socio-economic importance and status of populations of boswellia Papyrifera (del.) Hochst. in Northern Ethiopia: the case of North Gonder zone," *Forests, Trees and Livelihoods*, vol. 15, no. 1, pp. 55–74, 2005.

N. Chikamai, *Review and Synthesis on the State of Knowledge of Boswellia Species and Commercialization of Frankincense in the Drylands of Eastern Africa*, Association of Forestry Research Institutions in Eastern Africa, Nairobi, Kenya, 2003.

A. Worku, J. Pretzsch, H. Kassa, and E. Auch, "The significance of dry forest income for livelihood resilience: the case of the pastoralists and agro-pastoralists in the drylands of southeastern Ethiopia," *Forest Policy and Economics*, vol. 41, pp. 51–59, 2014.

D. Begna, "Assessment of the effect of ant (Dorylus fulvus) on honeybee colony (*A. mellifera*) and their products in West and South-West Shewa zones, Ethiopia," *Ethiopian Journal of Animal Production*, vol. 7, no. 1, pp. 12–26, 2007.
[37] M. Tilahun, L. Vranken, B. Muys et al., “Rural households’ demand for frankincense forest conservation in Tigray, Ethiopia: a contingent valuation analysis,” *Land Degradation and Development*, vol. 26, no. 7, pp. 642–653, 2015.

[38] Z. Mekonnen, A. Worku, T. Yohannes, T. Bahru, T. Mebratu, and D. Teketay, “Economic contribution of gum and resin resources to household livelihoods in selected regions and the national economy of Ethiopia,” *Ethnobotany Research and Applications*, vol. 11, pp. 273–288, 2013.