



The contribution of frankincense to the agro-pastoral household economy and its potential for commercialization - A case from Borana, southern Ethiopia

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ABSTRACT

Frankincense, gum arabic and myrrh are among the most valuable commercial non-timber forest products in the drylands of eastern Africa. This study examines the frankincense value chain and its contribution to the household economy in southern Ethiopia. The study applied a combination of sustainable livelihood and value chain framework to assess the values and the contribution of frankincense to household economies. Data were collected through a household survey, focus group discussions, key informant interviews and field observations. On average, the annual cash income generated from the harvest and sale of frankincense was estimated at 60 USD per adult equivalent unit (AEU) which was 35% of the total household annual cash income. Our analyses reveal that income from frankincense constitutes the second largest share of the total average household cash income after livestock, which accounted for 60%. The poorer households (44% of the sample) have a relatively higher reliance on frankincense income (49.8%), which is almost as much as the contribution from livestock and non-farm income combined (50.2%). Frankincense income functions as a supplementary source of income for the herders. The value chain analysis shows that the price increases from nearly 1 USD per kg at harvest sites to 5.5 USD per kg at the retail level. Nevertheless, despite the abundance of the resource and a growing domestic market demand, the marketed quantities are low, extraction practices are primitive and both local and national markets are poorly developed. Recommendations for researchers and development practitioners include improving harvesting and processing skills through training, introducing harvesting and post-harvest technologies, improving market access, providing credit services, and training to gatherers and local traders on value-adding activities and marketing skills. These measures could improve the economic returns from frankincense extraction and sale and contribute to increased incomes and more sustainable livelihoods.

1. Introduction

Millions of rural dwellers throughout the world depend on non-timber forest products (NTFPs) for household subsistence and cash incomes (FAO, 1996; Kar and Jacobson, 2012; Shackleton, 2011; Sunderlin et al., 2005). Some of these products have important commercial markets and generate substantial revenues (Jensen, 2009; Kusters and Belcher, 2004; Marshall et al., 2006). Collection and marketing of NTFPs offer an easy entry into the market economy for the forest-dependent poor population (Kar and Jacobson, 2012; Shackleton, 2011; Vedeld et al., 2004, 2007). Extraction and trade of NTFPs also provide an economic safety net in times of dire need (Angelsen and Wunder, 2003;

Sunderlin et al., 2005). Despite this, over the past decades, the dominant narrative about NTFPs has swung from optimism to pessimism, and once again more recently back in the international spotlight (Shanley et al., 2016).

Even though the economic importance of NTFPs and their linkage to development has been researched for over three decades (Belcher and Schreckenberg, 2007; Neumann and Hirsch, 2000; Pérez and Arnold, 1996), there has been no general consensus on the subject (Angelsen et al., 2014; Wunder et al., 2014). Consequently, no clear paradigm shift to promote commercialization of NTFPs has occurred in national development approaches in developing countries (Lemenih and Kassa, 2011a; Wunder et al., 2014). In recent years, however, the desire to

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promote the adoption of locally specific development options, along with global concerns over rural poverty and the negative effects of climate change have led to renewed interests in commercial extraction of NTFPs.

In the drylands of Africa, NTFP commercialization has been actively promoted as a strategy for improving rural livelihoods and an approach to foster resilience (De Leeuw et al., 2014; Lemenih and Kassa, 2011a; Wagner et al., 2013). It is argued (Belcher and Schreckenberg, 2007; Jensen and Meilby, 2008; Neumann and Hirsch, 2000) that improved market access and commercialization of NTFP, i.e. increasing the value of NTFP in trade, and enhanced integration of value chain can increase rural incomes and employment opportunities. Under the right conditions, and if managed well, commercialization can also provide incentives for environmental conservation, particularly of valuable tree species (Belcher and Schreckenberg, 2007; Jensen and Meilby, 2008).

Frankincense, gum arabic and myrrh are the most economically valued NTFPs in the dryland areas of Ethiopia. Among these, frankincense is a widely used and traded product, and constitutes an essential part of the livelihoods of the rural communities (Lemenih et al., 2003; Lemenih and Kassa, 2011a). Despite its potential to stimulate local development in parts of Ethiopia where it grows (Lemenih and Kassa, 2011a) and elsewhere in Africa (Abteu et al., 2012), frankincense remains an untapped resource in southern Ethiopia.

This study was conducted to quantify the contribution of frankincense to the rural household economy and analyse its value chain in southern Ethiopia. The results of the study will support the growing national and global initiatives aimed at designing of context-specific livelihood interventions in the drylands (De Leeuw et al., 2014).

2. Conceptual framework and analytical approach

The study applied a combination of sustainable livelihood (Scoones, 1998) and value chain approach to assess the values and the contribution of frankincense to household economies (Gereffi et al., 2001; Kanji et al., 2005; Ribot, 1998). The value chain analysis (VCA), combined with sustainable livelihood approach (SLA), has been widely used in examining the role of NTFPs in generating local livelihoods (Ingram, 2014; Kar, 2010; Neilson and Shonk, 2014).

The SLA approach analyses households' access to assets, the activities they undertake to sustain themselves and the outcomes of these activities. The SLA is also often used to assess aspects of households' vulnerabilities (e.g., to seasonal shifts in prices and production) and their resilience. It is further used to analyse how institutional factors, such as property regimes, markets, and the existence of local institutions affect poor people's access to assets and the benefits they derive from them (through markets) (Scoones, 1998). In our case, SLA was used to study frankincense and show how it contributes to a household's livelihood and economic wellbeing. At the core of the framework are the livelihood capitals or assets that households combine to form livelihood strategies and diversification patterns with particular livelihood outcomes (Challies and Murray, 2014; Scoones, 1998). This scenario building permits a study of the total economic production (i.e. per household) as well as the distributional effects or patterns of production.

Frankincense is freely accessed and harvested from the wild in the open woodlands and is frequently used by agro-pastoralists in southern Ethiopia as a form of natural capital. Thus, in the context of SLA, frankincense extraction is a livelihood strategy in the region. Hence, knowledge on how this natural resource contributes to their livelihoods is essential to be able to understand the links between various elements of household income and dependence on the product. The SLA also seeks to improve development policy and practice by recognizing the seasonal and cyclic complexity of livelihood activities. While the SLA provides sufficient framework for analysing livelihood outcomes of frankincense extraction, it does not sufficiently explain the role of the market and market linkages (Dorward et al., 2003; Kanji et al., 2005). A value chain analysis is therefore used as a complementary framework to better assess

linkages between production and the market for frankincense.

The value chain analysis is both a descriptive and an analytical tool to analyse the activities and processes involved at specific geographical scales from conception of production, through production to harvest, transformation to end users and the final disposal after use (Hoermann et al., 2010; Ingram, 2014; Jensen, 2009; te Velde et al., 2006). The value chain has become a useful analytical tool for understanding markets for commodities, the relationship amongst actors in a chain (te Velde et al., 2006) and considering the potential implications for pro-poor development (UNIDO, 2011; Webber and Labaste, 2006). The VCA is aimed to identify ways to improve the performance of a chain such that all actors are placed in a better position (Lowitt et al., 2015; Riisgaard et al., 2010). The position of actors can be improved through increased rewards and/or reduced exposure to risk, both economically and in terms of outcomes such as poverty, labour, and the environment (Riisgaard et al., 2010). However, there are shortcomings in the existing value chain approach. It provides too much emphasis on the structure and dynamism of marketing networks and the distributional gains along the chain (Lowitt et al., 2015; Rich et al., 2011). Furthermore, it tends to focus on examining the incomes and assets associated with the relevant chain and product, while ignoring other income generating activities of the same households (Bolwig et al., 2010). Rural households in the developing world typically depend on multiple income sources for their survival and livelihood. The VCA also focuses more on economic efficiency and optimization of value chains and less on unequal power and redistribution of costs and benefits along the value chain. A livelihood analysis goes beyond costs and prices, income and consumption, to provide complementary information by which to assess (rather than measure) the choices that people make in particular contexts. Apart from its focus on increased incomes, it recognizes other livelihood outcomes, for example, improved food security or a more sustainable use of natural resources (Kanji et al., 2005). More specifically, it organizes and identifies constraints and opportunities associated with improving household income and displays how they are interlinked.

Combining the two approaches thus yields a more comprehensive understanding of both the market related-aspects of frankincense and the way in which markets for frankincense relate to livelihood strategies (Challies and Murray, 2014; Kanji et al., 2005; Kar, 2010). A key component of such analysis is looking at the relative importance of different activities and income sources at the household level (e.g., the relative contribution of frankincense income to household economy compared to other livelihood sources) (Trædal and Vedeld, 2018). The present study is focused on the upstream/productive end of the supply chain, i.e. the small-scale frankincense extractors (hereafter referred to as "gatherers") in southern Ethiopia. Further links and functions were investigated by moving up the chain as suggested by Marshal et al. (2006).

3. The study area and description of frankincense

3.1. Study area

The study was conducted in Borana, southern Ethiopia (Fig. 1). The study area is characterized by a semi-arid climate and a bimodal rainfall pattern, with the long rainy season from March to May and the short rains from September to October. Diminishing rainfall and climate variability (Niang et al., 2014; USGS, 2012) are the most important physical constraints to agricultural production in Borana. The area is home to the Borana agro-pastoralists whose livelihood is based on livestock keeping and small-scale subsistence farming as well as forest resource utilization. Cattle comprise the largest share of livestock biomass and are the most highly valued animals in the area. They are a symbol of abundance, of social status and of community influence. Land holdings are generally small with an average holding of 2 ha per household (Yonas et al., 2019). The area has a low adult literacy rate (only 13% of households can read and write) (Megersa et al., 2014). This

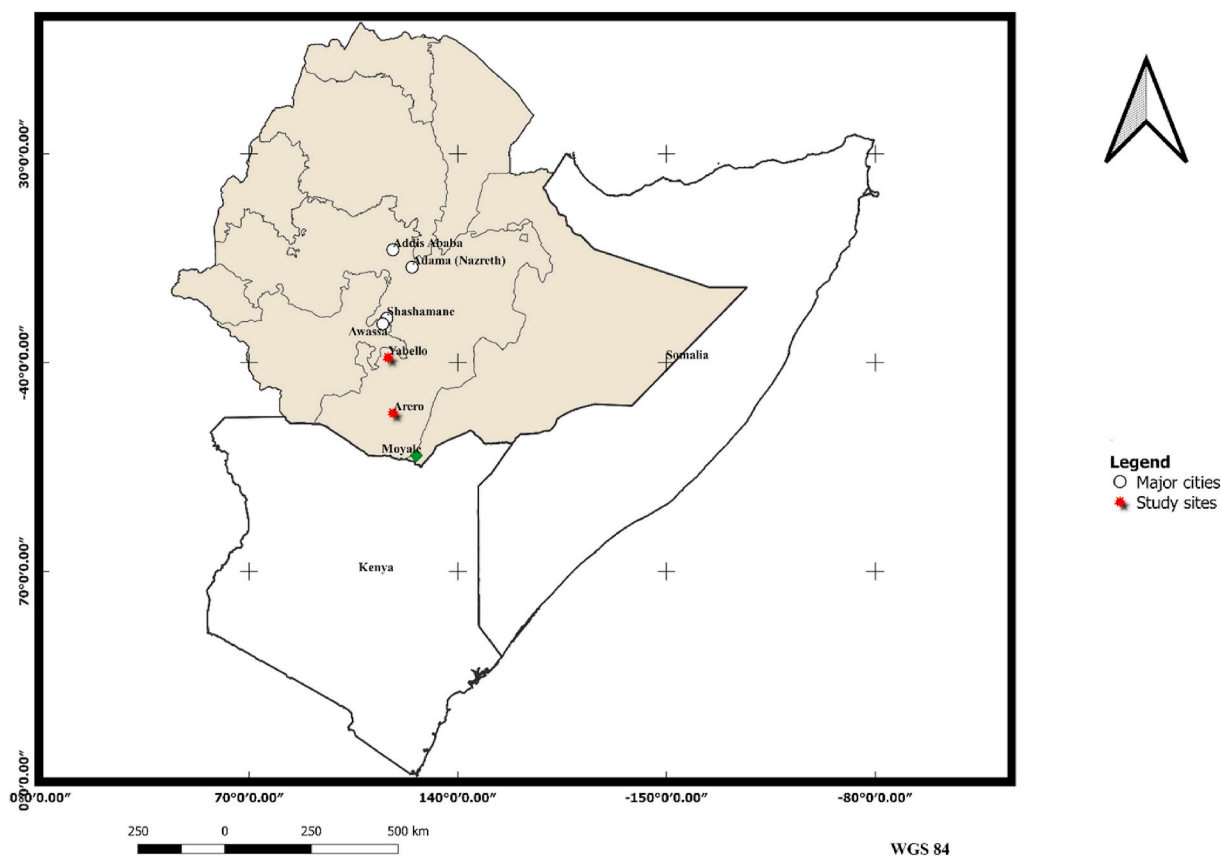


Fig. 1. Map of study sites and frankincense marketing centres (note: apart from harvest sites (Yabello and Arero), marketing takes place in major cities and towns).

study was conducted in two districts (Yabello and Arero) where frankincense is actively collected and marketed (Worku, 2006). These districts are amongst the poorest in Ethiopia. Due to recurrent droughts and erratic rainfall, these areas have experienced severe food insecurity problems, and increasing temperatures and declining spring rainfalls are projected to be major future challenges to agro-pastoralists in these areas (Niang et al., 2014), supporting the importance of alternative cash income generating options. Two villages (one from each district) were selected. The villages are relatively similar in terms of natural habitat, a heavy reliance on the natural resource base, open access to forest resources, similar production systems and ethnicity characteristics (both villages are Borana agro-pastoralists). The Borana dryland area is known for its abundant and diverse species of gum and resin-yielding trees, principally in the genus *Acacia*, *Boswellia* and *Commiphora*, from which local communities actively collect frankincense, gum and myrrh (Worku, 2006).

3.2. Description of frankincense

Frankincense (also called olibanum) is a widely traded aromatic, congealed, resinous exudate derived from species of the genus *Boswellia* (FAO, 1995). There are three types of frankincense found in Ethiopia: the Tigray type, the Ogaden type and the Borana type. The Borana type, which is the focus of this paper, is produced from *Boswellia neglecta* S. Moore and originates in the drylands of Borana (Deffar, 1998; Lemenih et al., 2003b; Tadesse et al., 2007). The Borana type frankincense is a black-coloured, fragrant resin exudate that oozes out from the trunks and branches of *B. neglecta*. In Borana, frankincense is harvested from natural stands through natural exudation.

Frankincense has been used in embalming, cosmetics and as incense in rituals and religious ceremonies in ancient Egypt, Greece, Rome and China for thousands of years (Tucker, 1986). In Ethiopia, frankincense is

used as a fragrance in the home, and in many religious and social rituals such as the coffee ceremonies. The product is also used as a raw material in food, adhesives, cosmetics, paints and pharmaceutical industries in the developed world (FAO, 1995; Tucker, 1986). Frankincense reportedly has health benefits and is used in various traditional medicines in Asia and Africa (e.g., for the treatment of skin ailments, teeth infections, cough and asthma) (Yaniv and Dudai, 2014). The product is believed to have the oldest global supply chain in the world, and Ethiopia is claimed to be one of the main sources of frankincense of antiquity (since the Aksumite period) (Munro-Hay, 1991; Tucker, 1986). The country is also one of the major producers and exporters (the first in Africa) of frankincense in the world (FAO, 1995; Lemenih and Teketay, 2003).

4. Materials and methods

4.1. Research approach and sampling

The present study was conducted as a case study. Due to the semi-nomadic nature of the pastoral populations, it was difficult to find a sensible sampling frame – a list of population members from which a relevant sample can be drawn – and to identify and locate gatherers using conventional household-based sampling strategies. Moreover, frankincense extraction is not a fulltime activity as households collect the product while herding their animals and undertaking other income generating activities. In addition, no data were available on the number of gatherers in the study area and traders along the chain. For such hard-to-reach populations then, constructing the sampling frame using conventional sampling procedures is not easily feasible (in terms of time and cost) since the population is dispersed in time and space and is very mobile (Heckathorn, 2011). It was thus difficult to assess the actual number of household members engaged in frankincense extraction and trade.

We therefore employed a respondent-driven sampling (RDS) approach, which is a network-based method designed to study hard-to-reach populations, in which respondents refer the researcher to other respondents. The method provides a study sample through referrals (i.e. one interviewee providing information about the next points in the chain) made among people who share or know of others who possess some characteristics that are of research interest (Heckathorn, 1997; Wejnert and Heckathorn, 2008). In this study, the participants were encouraged to identify and access a sample of respondents who were as representative as possible. To minimize the risk of not reaching certain subgroups via this insider method (i.e. RDS) (Biernacki and Waldor, 1981), we supplemented with a purposive sampling strategy. Accordingly, frankincense gatherers ($n = 34$) were selected using a combination of RDS and purposive sampling methods whereas RDS was employed to select mobile traders ($n = 5$), collectors ($n = 6$), and microenterprises ($n = 2$). In addition, petty traders at the village level ($n = 7$), and urban petty traders ($n = 7$) were selected using purposive sampling technique. The state-owned Natural Gum Processing and Marketing Enterprise (hereafter called the state-owned enterprise (SOE)) was selected using purposive sampling.

4.2. Methods of data collection

The study was further conducted through a combination of qualitative and quantitative methods, comprising of a questionnaire survey; key informant interviews (KII), focus group discussions (FGD), and review of published literature and secondary data sources. Secondary data were collected from the SOE that dominates the frankincense processing and export market in the country. Semi-structured interviews with the above-mentioned actors ($N = 61$) involved in the gathering, collection, and trading, constituted the primary source of information. Gatherer data were drawn from the household survey; all other participant data came from the value chain survey using KII, FGDs, and direct market observations.

4.2.1. Gatherer data

4.2.1.1. Harvest variables. The key harvest variables were collected based on respondent's recall of average quantity of frankincense sold daily, harvesting days per week and length of harvest season, instead of the preferred but more time consuming and costly method of direct measurement. In order to avoid recall problems and minimize inaccuracies, the data were collected during one of the two production seasons and at harvest sites. The data were cross-checked with *in situ* observations. Moreover, focus group discussions were held (a day after the interviews) in the villages to triangulate data and to clarify points raised during the interviews.

Annual production was calculated as average quantity sold per day of unprocessed frankincense multiplied by the average number of harvest days per week multiplied by the average number of harvest months in the year 2015/16 (two seasons) as recalled by the respondents. For average harvest quantity, respondents were asked to provide estimates of the maximum (high harvest) and minimum (low harvest) harvest data the average of which was used to calculate production per gatherer per day.

4.2.1.2. Household income variables. Valuation and household income accounting methods draw on the commonly used approach (Cavendish, 2002). In this paper, we only considered the cash income generated from different activities. Total net income was calculated as gross value minus the total costs of all inputs. Family labour was not deducted due to difficulties in finding relevant labour shadow prices in the area where formal wage labour markets are absent. In our case study, income sources of the households were disaggregated into livestock production (live animal, milk and butter sales), frankincense extraction and non-

farm activities (income from safety net programme). Income from crop production and poultry was excluded in our analysis. This is because crops are solely produced for subsistence use. Chickens are generally scarce (ref. FGD and observation). Thus, the contribution of these activities to total household cash income was assumed to be negligible.

Calculating the net income from livestock involved multiplying the quantities of products and number of animals sold by the actual price at village markets and deducting the other annual costs incurred. In Ethiopia, the poorer pastoral households without options (i.e. in areas where access to income is rare or absent), critically depend on gifts and remittances from their kin or from wealthier neighbours as the source of cash income (MoRAD, 2010). These households would often sell these animals to purchase food grain and other basic products. Thus, we have included gifts in our livestock income computation. The total net income from livestock production was the sum of the net income from sales of live animals, animals received as gifts, milk and butter sales over a year as a production period.

Annual net income (Wollenberg and Ingles, 1998) from frankincense sale was calculated as the quantities sold multiplied by the actual price at village markets. The analysis did not include any input costs. For reasons discussed above, labour cost was not deducted from gross income. Gatherers do not incur material costs because incense tears are picked by hand and collectors provide empty sacks. Thus, net frankincense income equals the value derived from annual total harvest.

The cash income from non-farm activities (cash-for-work and remittances) is based on the amount earned during the study year. Income analysis, in the present study, aimed at elucidating total household cash income (i.e. the sum of livestock, frankincense and non-farm incomes), per capita income, and the respective shares of frankincense income.

4.2.2. Value chain analysis and mapping

Data from participants through interviews with gatherers, traders, and retailers were supplemented with market reports from SOE and used to conduct the frankincense VCA. This included the following analyses:

- Describing the functions of the different market chain actors
- Value chain mapping, i.e. mapping and description of the chain via graphic presentation of the linkages between chain actors involved in transferring the product from gatherer to consumer (McCormick and Schmitz, 2001)
- Quantifying the volume of product that moves through the different routes of the chain, and the distribution of (net income) profits along the chain.

4.2.2.1. Profits along the chain. Quantitative data on the cost and revenues, value added, and profit distribution were calculated as described in Marshall et al. (2006).

Profit margin at each stage was calculated to evaluate the benefits along the product value chain as:

$$\text{profit margin} = \text{Revenue} - \text{total cost}$$

where Revenue = sale volume x unit price

$$\text{Profit margin \%} = \frac{(\text{Revenue} - \text{total cost})}{\text{Revenue}} \times 100$$

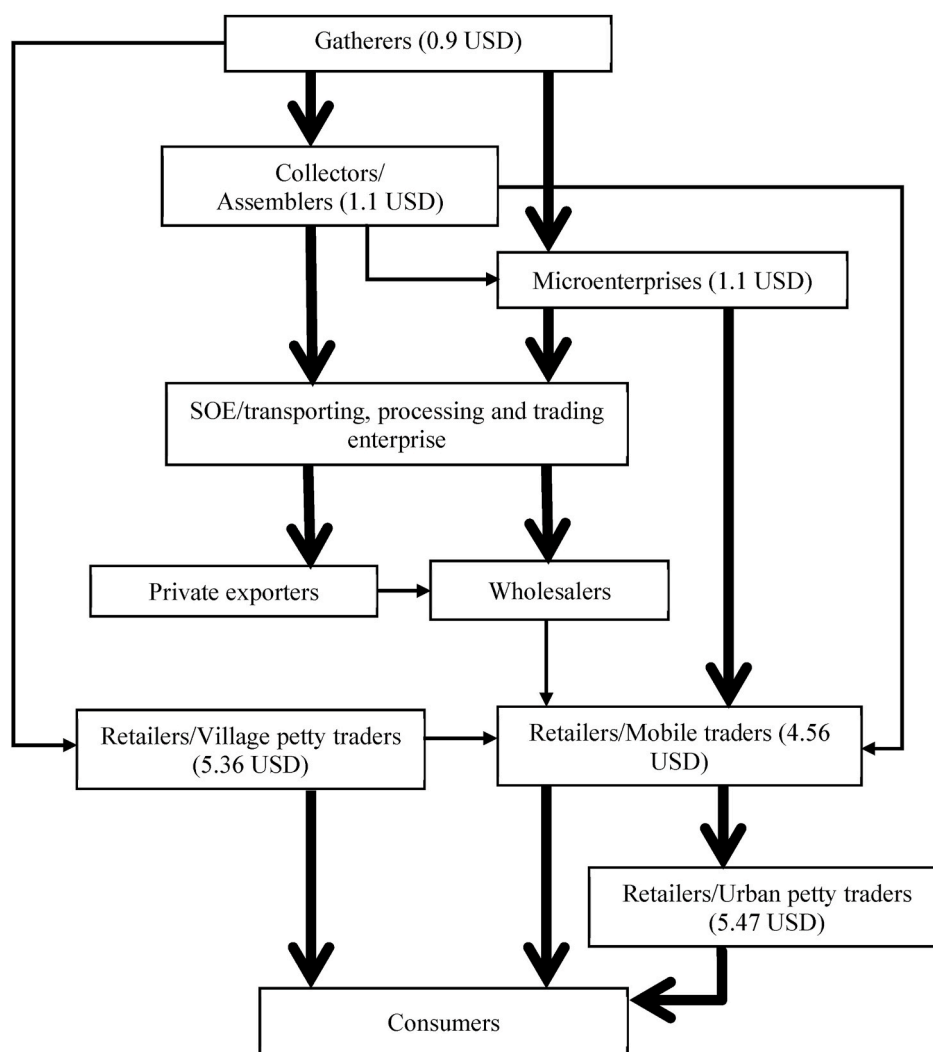
The costs include transportation, labour, material (sacks) and taxes. Furthermore, a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis was used for analysing internal and external factors that influence production and marketing of frankincense. Focus group discussions were the basis of identifying these factors, which were later verified through literature searching and expert consultation.

4.3. Data analysis

Both quantitative and qualitative analysis methods were employed to analyse and present the data. The main statistical analysis applied are descriptive statistics, analysis of variance (ANOVA) and regression. The regression is employed to analyse relationships between the relative frankincense income and households' total income. Descriptive statistics were used to describe the demographic profile of gatherers and levels of income, quantities and values of frankincense marketed. Data from the gatherers from the two villages (one from each district) were pooled (therefore, $n = 34$) because the sample size was too small to analyse each village individually once disaggregated into wealth categories. Household wealth in this dryland area is closely connected to livestock and, since it reflects common access to livelihood capital, we categorized households into three wealth groups based on the size of cattle holdings: poor (0–14 tropical livestock units, TLUs), medium (14–21 TLUs) and better-off (above 21 TLUs). As observed in many NTFP studies (Godoy and Bawa 1993; Kar and Jacobson, 2012; Quang and Anh, 2006), we also expect a negative relationship between dependence on frankincense income and household wealth. Our interest in this paper is not only to examine the relationship between livestock holdings and frankincense income, but also to examine to what extent households differ in their

reliance on frankincense income. The evidence of different groups may provide suggestive insights about the degree of dependence of different groups of the population on the studied product, which may be of relevance for policies aimed at improving the livelihoods of vulnerable groups in the area.

For inter-household comparisons, we do not use the total cash income per household, but we adjust it according to the size of the household. The adult equivalent unit (AEU) scales the consumption level of household members of different ages to the equivalent consumption level of an adult (Deaton, 2003). Adults (above 18) were given a weight of 1 while children (below 18) were given a weight of 0.3 as recommended by Deaton (2003). A one-way ANOVA was carried out to test the differences in the frankincense income and mean income per AEU among the wealth groups. The means were separated using the least significant different (LSD) test. A probability of 0.05 was used in both the tests. Information collected using KII, FGDs, and observations were summarized and narrated. All income figures are reported in purchasing power parity (PPP) adjusted 2016 USD using a conversion figure of 21.94 Ethiopian birr (ETB) per 1 USD. In this study, we included only households engaged in frankincense extraction so as to enable us to compare and contrast incomes obtained from different household economic activities.



(Numbers in brackets are approximate mean prices per kg received by various types of actors. Data on price received by SOE, exporters and wholesalers not available.)

Fig. 2. Market actors and their relationships in the frankincense value chain, Borana, southern Ethiopia, 2016.

5. Results

5.1. The frankincense value chain

The frankincense value chain analysis for southern Ethiopia divided activities down into four functional segments: extraction and collection (product assembly); handling and processing (storage, transportation and processing); commercialization which involves price establishment, marketing (buying and selling); and facilitating functions such as regulatory support. Fig. 2 describes the value chain map (a conceptual model) of frankincense in southern Ethiopia. The chart shows the structure of the frankincense value chain from harvest to end users and the role that the different actors play at the different stages. The arrows in the value chain map represent transitions of the product between actors in different segments of the value chain. The bold lines show the most important channel of the product flow.

The transfer of frankincense from the production area to end users is carried out by a set of specialized economic actors, and the commodity is traded through the formal and informal markets at harvest sites, village, urban and central (national) markets. The major actors are gatherers, collectors and microenterprises, retailers, the SOE, wholesalers and private exporters and consumers (Fig. 2).

Formal regulatory, supporting, and/or controlling actors are largely absent in the frankincense production sites. In this study, no formal interviews were made with private exporters, wholesalers, consumers and support institutions. Thus, results are presented based on observations, from key informant interviews at the SOE and informal discussions with various government officials.

5.2. Chain actors, stakeholders and activities

5.2.1. Socioeconomic characteristics of the gatherers

We start with an overview of the households' socioeconomic characteristics and income levels before turning to a description of gatherers as the first actors in the market value chain.

All the surveyed households were engaged in a diversified set of livelihood activities. On average, the households in the study area

Table 1

Socioeconomic characteristics of households engaged in frankincense extraction (harvesting) in Borana, southern Ethiopia, 2016.

Attributes		Better-off (n = 8) ^a	Medium (n = 11)	Poor (n = 15)	Sample mean (n = 34)
Age (in years) ^b		39.8 (11.2)	33.82 (7.5)	29.53 (4.41)	33.32 (8.26)
HH size (AEU)		5.2 (2.44)	3.97 (1.91)	3.45 (1.01)	4.03 (1.81)
Resident status (%)	Local villagers	8.82	20.56	29.4	58.8
	Non- residents (migrants)	14.71	11.8	14.71	41.2
Education of HH head (%)	None	17.7	23.53	14.71	55.9
	Read and write	5.9	8.82	14.71	29.4
	Primary school	0	0	14.71	14.7
Cattle TLU		35.53 (16)	17.69 (2.15)	8.49 (2.2)	17.83 (13.2)
Cattle per AEU		7.16 (3.63)	4.23 (2.2)	3.75 (2.44)	4.71 (2.95)
TI per AEU in USD		262.04 (162.11)	256.14 (147.5)	156.62 (69.73)	213.62 (129.9)

^a Households were categorized based on the level of cattle holdings per HH.

^b Age of the household head; HH: household; AEU: adult equivalent unit; TLU: tropical livestock unit, equivalent to an animal of 250 kg weight (Cattle: 0.7); TI: total income (i.e. the sum of livestock, frankincense and non-farm income) (see Table 4). Values are averages with standard deviation in parentheses.

earned an annual cash net income of 213 USD per AEU (Table 1). The livestock incomes provide on average close to 60% and frankincense close to 35% of the total cash income (Table 4). Incomes from non-farm sources, which were mainly from remittances and cash-for-work schemes, represented 5% of the total household cash income. The average household size (adult equivalent) was 4 while the average age of the respondents was 33 years old. Cattle are the most highly valued animals in the area. The average cattle holding, measured in TLU, was 17.8, ranging from 5.6 to 70 per household. Based on the wealth categories, 44% of the households were poor while 32% and 24% were in the medium and better-off categories, respectively. Of the household sample, only 14.7% had some form of formal education and none had received any form of agricultural extension and/or NTFPs production training. Due to the relative undercapitalization (small livestock holding) the young-aged households are more educated and dependent on frankincense harvesting. Other socioeconomic characteristics of households engaged in frankincense extraction are shown in Table 1.

5.2.1.1. Harvest variables and functions of the gatherers. There is a long tradition of frankincense harvesting and trade in Borana and other parts of Ethiopia. Gatherers were the first actors in the chain. In all sampled households, members involved in frankincense gathering were male. Fifty-nine percent of gatherers were local villagers who lived and harvested the product in their home village (village of origin). Key informants reported that frankincense harvesting was mainly a dry-season activity coinciding with pastoral mobility during the low cropping season and low levels of milk production. Tapping (incisions made into the bark of the tree to collect the exudate) is not a common practice in the study area. All frankincense is harvested by gathering exudate that naturally seeps through the bark. The average amount of frankincense collected per gatherer was 5 kg per day and the average number of days one was engaged in gathering were about 3 days per week. The average annual production was an estimated 219 ± 74 kg per household (Table 2). It was stated (ref. KII) that the gatherers often deliver frankincense to the market immediately (and paid immediately) after collection (fresh, unsorted and uncleaned). Depending on the quantity of frankincense collected per day, the gatherers deliver the product either to camps set up by the collectors at the harvest sites (often close to water points) or to microenterprises at village markets, or to village-level petty traders (Fig. 3). This was mainly the case when they had small quantities - often less than 1 kg. Transactions in the village were largely done in exchange for cash, or in a few cases for commodities (exchanging with frankincense equivalent) for daily consumption. The analysis in this study was done based on trading in cash. Gatherers earned on average 205 USD annually (ETB 4489) from frankincense collection and sales (Table 3).

5.2.2. Collectors and microenterprises

Collectors and microenterprises report buying, storing and supplying frankincense largely to the SOE. Both actors largely vend unprocessed products. Collectors are mainly local operators living in frankincense-

Table 2

Frankincense harvest and sales prices, Borana, southern Ethiopia, 2016.

Variables	Mean	Std.dev.	Min	Max
Harvest trips per week	2.71	0.76	1	4
Harvest quantity per day (in kg)	5.12	1.25	2.5	8.5
Quantity produced per year (in kg)	218.59	74.39	80	408
Price per kg at formal market (USD)	0.9	–	–	–
Price per kg at informal market (USD) ^a	1.05	–	1	1.1

^a Markets operating fully outside of government regulation and observation. Traders in such markets participate in the illegal (unrecorded by the official custom system) small-scale frankincense trade across the border (through border towns such as Moyale) to Kenya. In Ethiopia, individuals or groups engaged (interested to take part) in NTFP trading must have a license (granted by the Ministry of Trade or branch offices at the district level).



Fig. 3. Left: A village-based petty trader. Right: Partly processed (dried, cleaned and sorted) frankincense packed for sale by a microenterprise (top) and woman selling packed frankincense (bottom) (at Yabello town). (Photograph credit: Yonas Berhanu).

Table 3

Mean annual frankincense quantities turned over along different value chain actors, Borana, southern Ethiopia, 2016.

Category	Gatherers (n = 34)	Collectors (n = 6)	ME (n = 2)	MT (n = 5)	VPT (n = 7)	UPT (n = 7)
Quantity gathered/bought (tonne)	0.22	5.33	10.5	0.54	0.04	0.19
Purchase price (USD/kg)	0	0.9	0.9	2.07	1.0	4.56
Quantity sold (tonne)	0.22	5.30	10.4	0.53	0.038	0.18
Sale price (USD/kg)	0.93	1.1	1.1	4.56	5.36	5.47
Total cost per year	0	4913	9966.4	1138.9	42.20	857.86
Total revenue ^a	204.59	5775.75	11371.01	2406.56	174.64	1015.76
Profit (Revenue less total cost)	204.59	862.70	1404.63	1267.7	132.45	157.90
Profit margin (%)		14.58	12.39	52.68	73.47	15.44
Added value		0.2	0.2	2.49	4.36	0.91

ME: Microenterprises; MT: Mobile traders; VPT: Village petty traders; UPT: Urban petty traders.

^a Price x Average production.

producing villages. They buy from gatherers at harvest sites or weekly rural markets near the production sites. They are commonly organized at a central place in the village or in the district centre. Collectors have established trading relationships with the SOE and sometimes receive advances from the company. These actors also trade basic commodities (sugar, tea, tobacco, maize flour, etc.). They bring goods to the harvest sites and exchange them with gatherers for cash or frankincense equivalent.

Microenterprises are small-scale cooperatives established by youth groups and are mainly local actors at the district or village level. Microenterprises collect and accumulate frankincense from gatherers and, to a lesser extent, from collectors at village markets. They sell partially dried frankincense largely to the SOE and occasionally to mobile traders (often less than 0.1 tonne per transaction) as well as directly to consumers. They usually own collection sites and smaller storehouses. Microenterprises process (dry, clean and sort) and pack part of the product in smaller quantities (often 250 g) for selling to mobile traders and consumers (Fig. 3, right). These actors are found to be weak in terms of operating and fixed capital. They have few capital costs and capital assets such as warehouses and processing facilities.

5.2.3. State-owned processing and trading enterprise

The SOE is the dominant market operator in the frankincense value chain in Ethiopia (35% of the export trade volume) (Kassa et al., 2011) and also in the study area. Processing, marketing (domestic and export) and facilitation are the major functions of the company. The company functions through its branch offices established in towns such as Yabello near the producing areas. The company sets prices and sometimes

pre-finances the collectors through contractual agreements. The company works in rural weekly markets and offer free transport services to the collectors as an incentive. To this end, the company fetches and transports goods to the collection points (harvest sites/village markets) and transports frankincense on their return. The company procures frankincense in bulk from microenterprises and collectors and transports the unprocessed frankincense to the main depot located at Adama (Nazareth) town where the processing unit is located. Following this, it delivers the product to the exporters and domestic wholesalers. The company has storage facilities in towns close to the production sites. The company also processes and sorts the product into different grades according to size, colour and state of cleanliness before packing it for export or for the domestic market. Processing activities consist of drying, cleaning, sorting and grading. These activities are performed manually by hired female labourers.

5.2.4. Private exporters and wholesalers

Apart from the SOE, there are also private companies involved in frankincense export from Ethiopia. Exporters procure processed frankincense from the SOE. They also sell the low-grade frankincense to domestic wholesalers. Wholesalers source frankincense largely from the SOE, and occasionally from other wholesalers and exporters. These actors often supply larger urban markets and sell to other wholesalers or urban-based retailers in the towns. Both private exporters and wholesalers are situated in Addis Ababa. There are no exporters or wholesalers in smaller villages/towns.

5.2.5. Retailers

In the present study, two types of retailers were observed: mobile traders and small-scale retailers; hereafter-called petty traders. The mobile traders purchase produce either directly from microenterprises or from village petty traders and resell to their customers in major cities such as Hawassa and Shashamane. They do not have a permanent trading station but are street vendors who sell along roadsides. They mostly move door-to-door selling frankincense to urban petty traders (described below) and end users such as street coffee vendors, individual households and cultural restaurants. The amount sold per transaction was around 0.5 kg. The second group of retailers (i.e. petty traders) sell small quantities of frankincense (up to 5 kg per transaction (market observation)) to mobile traders and less than 0.5 kg per transaction to consumers. They could be sub-categorized into village-level petty traders and urban petty traders. The former are small shop owners operating near frankincense producing villages and often buy one plastic bag (equivalent to 0.55 kg) per transaction from gatherers (Fig. 3, left). They sell largely to consumers and, to a lesser degree, to mobile traders. These groups of actors are not specialized but trade a wide range of other products and commodities.

Urban petty traders are street vendors selling at the roadsides, and in small trading squares called *Gulit*, established in urban areas, villages or along roadsides. These market squares are open for a few hours every day for the people to buy vegetables and other household consumer goods. Village-level petty traders normally perform simple processing activities limited to air-drying and cleaning. Although required to have a license, the retailers in our case study did not have a retail license and thus paid no fees related to frankincense trading. All retailers are female vendors.

5.2.6. Consumers

Street coffee vendors, individual households, religious institutions, particularly the Ethiopian Orthodox Church, and cultural restaurants are the main consumers of frankincense in Ethiopia. Research indicates that large volumes of frankincense produced in the country are consumed locally (about two-thirds of the total marketed volume) (Lemenih and Kassa, 2011a).

5.2.7. Support institutions

Support stakeholders include government institutions such as the district revenue office, the district cooperative agency and district office of climate change, forestry and environment, and NGOs and transporters. In our case study, we defined support institutions as stakeholders or indirect actors with a right, mandate and/or interest in the product's value chain. Their role and functions are to facilitate and influence activities of the core value chain actors in the marketing chain. The government institutions issue production and marketing permits, establish cooperatives at the local level, collect taxes, commission and fees including royalty fees from traders at the local, regional (sub-national) and national levels. NGOs are mandated to facilitate and support establishment of cooperatives. However, among the main value chain actors there was no mention of banks and micro-financial institutions providing financial support to the sector. Moreover, stakeholders providing development, technical harvesting, or processing support were not observed.

5.3. Price, marketed volume and profit distribution along the chain

5.3.1. Value of marketed frankincense

Due to the lack of reliably recorded data from official statistics and other sources it was difficult to collect data on revenues and quantities from wholesalers, exporters and the SOE. In addition, these groups of actors were not willing to give information on their business. This in turn made it problematic to analyse the benefits to these participants. Thus, the present analysis considers merely their roles in physical functions and commercialization of the commodity. Based on the interviews with

the key-informants, the results of estimated quantities of frankincense traded and price realized by the different actors are shown in Table 3.

The prices obtained at the different stages at the value chain are: gatherers (0.9 USD/kg), collectors/microenterprise (1.1 USD/kg), mobile traders (4.56 USD/kg), village (5.36 USD/kg) and urban (5.47 USD/kg) retailers (Table 3). The price differences stem from costs and value added including the transfer or relocation benefits of the product.

The price is usually fixed by the SOE at the beginning of each collection season, and fixed prices remain unchanged for the rest of the year. The SOE, for instance, fixes the price at the head office, and branch offices would undertake the purchases. Subsequently the traders set a price at which they buy from gatherers (ref, KII). However, the traders in the informal markets offer higher prices that ranged in this study from 1 to 1.1 USD (22–24 ETB) (Table 2). Due to their strong market linkages with the traders, the limited capacity of the traders in the informal markets and the lack of alternative marketing outlets, the gatherers were still forced to sell through the formal markets.

5.3.2. Profit gained at different levels

The main costs for collectors, microenterprises and mobile traders were transportation costs, purchasing the product and various material costs. The average annual net income of gatherers, collectors, microenterprises, mobile traders, village-level and urban petty traders was estimated to be 205, 863, 1405, 1268, 132 and 158 USD, respectively. The profit margins made were 15, 12, 53, 73 and 15% for the collectors, microenterprises, mobile retailers, village-level and urban-level petty traders, respectively. The results clearly demonstrate that benefits are unevenly distributed among the value chain actors.

5.4. The contribution of frankincense production to the household economy: a case of gatherers in Borana, southern Ethiopia

Frankincense extraction was the second most important livelihood activity among the studied households (i.e. gatherers) in the area (Table 4). The income of agro-pastoralists derived from livestock and the sale of livestock products contributes 60% of the average total household cash incomes. All the wealth groups acquired substantial frankincense incomes. The average annual income generated from frankincense sale was estimated to be 59 USD per AEU. The income was estimated to contribute on average 35% (ranging from 4% to 77%) of the total household annual income. This shows the scope to devise an alternative livelihood activity through frankincense production in the region, where agricultural production is marginal. However, as can be seen in Table 5, the contribution of frankincense to household income (per AEU by wealth group) varied from 16% to 50%, which was significant ($P < 0.05$). Income from non-farm sources, which were mainly from remittances and cash-for-work schemes, represented by comparison some

Table 4

Reported annual cash income (in USD) per household and per AEU by source, Borana, Ethiopia, 2016.

Income source	Average income per HH ^a per year		Average income per AEU per year		Income shares (%)	
	Mean income	Max (min) values	Mean income	Max (min) values	Mean	Max (min) values
Livestock income	505.48	1640.84 (30.08)	146.05	565.81 (7.01)	59.37	94.49 (9.42)
Frankincense income	204.59	371.92 (72.93)	59.70	143.05 (10.81)	35.22	76.1 (4.2)
Non-farm income ^b	29.40	101.19 (0)	7.87	31.62 (0)	5.40	22.11 (0)
Total income	739.47	1736.55 (291.02)	213.62	598.81 (42.79)		

^a HH = household.

^b Includes incomes from remittance and cash-for-work.

Table 5

Mean total and relative annual frankincense income per AEU by wealth groups, Borana, Ethiopia, 2016.

Variable	Better-off (n = 8)	Medium (n = 11)	Poor (n = 15)	Sample mean (n = 34)
TI (USD/AEU/year)	262.04 (43.51)	256.14 (37.12)	156.62 (31.78)	213.62 (22.3)
FI (USD/AEU/year)	34.48 (9.65) ^a	57.62 (8.23) ^{ab}	74.70 (7.04) ^b	59.70 (5.3)
FIS (%)	16.16 (3.14) ^a	29.20 (5.62) ^a	49.81 (3.13)	35.22 (3.35)

TI: total income; FI: income from frankincense; FIS=Frankincense income share (as share of total income). Standard errors in parentheses: ^{a,ab,b}Groups with different or no letters are significantly different from each other (Fisher's LSD test, $P < 0.05$).

5% of the total income. This type of non-farm income is common in most chronically food insecure districts of the country.

5.5. The contribution of frankincense income by wealth groups

As shown earlier, frankincense contributes more than one-third of household's annual cash income. However, the poorest households obtained a significantly larger amount of frankincense income compared to the medium and better-off wealth groups ($P < 0.05$) (Table 5). We found no significant difference in mean annual frankincense income (per AEU) between medium and better-off groups. The frankincense harvest was thus found to be particularly important for the poorer households. The income from frankincense is almost as important as livestock production and non-farm income combined among the poor households, amounting to half (49.81%) of their mean annual income (Table 5). Better-off households had lower income from frankincense extraction. No significant difference was observed in the share of frankincense income between better-off and medium groups ($P > 0.05$) (Table 5).

An ordinary least square linear regression was carried out to investigate the relationship between the relative frankincense income and households' total income. We found that the relative frankincense income was negatively correlated with the total household income ($R^2 = 0.398$; $P < 0.001$; $n = 34$) (Fig. 4). This indicates that frankincense income decreases with increasing household total income. This regression analysis also confirms that the poorer households generate a larger share of their total income from frankincense income compared to the medium and better-off households.

5.6. Analysis of factors influencing frankincense production and commercialization (SWOT analysis)

The possible **strengths** of the frankincense value chain revealed by

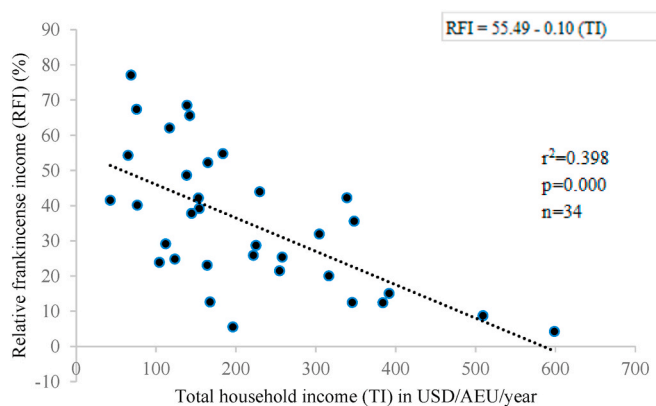


Fig. 4. Relationship between relative frankincense income and total annual household income, Borana, Ethiopia, 2016.

the SWOT analysis were abundance of the resource, accessibility, good demand at domestic/national markets and availability during the dry seasons. The resource is found abundantly in forests and is freely accessible to the agro-pastoralists for gathering, without any restrictions. An additional suggested strength in the value chain is the gathering technique, which involves collecting natural frankincense exudates from tears in the bark. This technique is considered potentially less destructive as minor damage is caused during the gathering practice. The **opportunities** that were identified are favourable marketing locations, absence of substitutes, increased domestic markets and possibilities for expansion into export market. Moreover, there were no externally imposed regulations that control the amount of frankincense harvested and supplied to the markets in the area. These could be positive factors to support the commercialization of the product. Furthermore, the frankincense production can be integrated with livestock husbandry. However, the production and marketing of frankincense in the study area is under **threats** such as labour competition with herding, high dependence on a single company, lack of official recognition and policy support. Moreover, markets, transportation links and other conditions favouring trade are poorly developed. If introduced, improper tapping methods such as intensive tapping regime may also be an additional threat. Studies have shown that excessive tapping practice can cause damage to the trees (Lemenih and Kassa, 2011a). The **weaknesses** found were low and unpredictable prices, lack of marketing skills and extension services, lack of skills and the necessary tools for tapping and processing, lack of associations of gatherers and collectors, lack of government support, and inadequate research and development on processing technologies and value creation. Another important weakness of the frankincense value chain is that gatherers and local traders have limited access to cash or credit and thus capital. Table 6 summarizes the results of the SWOT analysis.

6. Discussion

Despite the abundance of the resource and the age-old traditions of trading, in-depth field studies in southern Ethiopia are rare, and to our knowledge, this study is the first of its kind to characterize the frankincense value chain including the prices and income generated at the different steps in the value chain. The paper also examined the product's contribution to the household's economy among small-scale agro-pastoralists in southern Ethiopia.

Table 6

SWOT analysis of the Frankincense market chain in Borana, southern Ethiopia.

Strength	Weakness
Resource endowments	Lack of knowledge of harvesting techniques and post-harvest handling
Free access/available nearby the village	Lack of access to credits/financial support
Good demand in the domestic/national market	Absence of production and marketing facilities
Available in the dry seasons	Lack of marketing skills and marketing extension services
Extraction is less destructive	Inadequate research and development on processing technologies and value-addition
	Lack of associations of gatherers and collectors
	Low and unpredictable prices
Opportunities	Threats
Growing domestic markets	Underdeveloped market: lack of buyers/market outlets and marketing facilities
Export potential	Higher dependence on a single company
Absence of substitutes	Low unpredictable prices to gatherers and collectors/microenterprises
Favourable location of marketing sites to the gatherers	Damage to the trees if improper tapping method is introduced
No regulations exist regarding the quantity of produce harvested and sold	Labour competition with herding

6.1. Frankincense production and the value chain

Currently the present value chain is entirely dependent on naturally exuding trees unlike the northern parts of Ethiopia (Lemenih and Kassa, 2011b) and other parts of Africa (Abteu et al., 2012) where tapping of trees is commonly practised.

It is easier to harvest from naturally exuding trees because it is less labour intensive and there is less of a need for control and monitoring of land and tree resources. This may also be because gatherers do not have the knowledge and skills about tapping techniques and post-harvest handling.

The low marketed quantities in our case study may also be due to smaller harvest volumes (Table 3). However, the resource is considered to be abundant by most authors (e.g., Lemenih and Kassa, 2001a; Worku, 2006). More income from harvesting frankincense could likely be generated by increasing the number of harvesting days, but there might be some trade-offs between harvesting frankincense and herding. With increasing emphasis on frankincense harvesting, the amount of a household's labour-days spent on herding and watering (and hence livestock production) could likely be diverted. Improved collection techniques such as tapping could most likely increase quantities collected per day, but it comes at a cost of higher labour input at the household level. As observed in the northern parts of Ethiopia (Eshete et al., 2012), without well enforced management regimes and adequate support, intensive tapping may also cause damages to the resource base. From our market observations and key informant interviews, marketing took place at production sites, in the village and in other rural markets, rural and urban retail markets and wholesale markets. The mapping of value chains in actor networks: from gatherers to actors in retail, and in the stages: from extraction to retail and consumer, we find results comparable with general descriptions of NTFPs trade features found in the literature (Abteu et al., 2012; De Caluwé 2011; Jensen, 2009). It characterizes key routes of frankincense trade, value actors, profits, activities and relations associated with production, exchange and distribution of the commodity. The transfer of frankincense from the harvest sites to end users is carried out by a set of specialized actors, and the product is sold in local, regional and national markets. The VCA reveals that collectors, microenterprises and retailers play a key role both in providing markets outlets for gatherers and in distributing the product to consumers. The value chain has four functional segments: extraction and product assembly; transportation and processing; commercialization that includes marketing and price setting; and facilitating functions. These are analogous to stages reported in the NTFP value chain literature (Abteu et al., 2012; Belcher and Schreckenberger, 2007).

6.2. Value-added and profit margins

As stated earlier, gatherers constitute the base of the frankincense value chain. They deliver fresh and unprocessed frankincense to the market. As expected, these actors received the lowest price in the chain (Sec 5.3). Corresponding to the NTFP literature (De Caluwé, 2011; Mujawamariya et al., 2013), the gatherers are disadvantaged by their weak bargaining power, and typically accept low prices for their product.

In general, the value share of an agent or actor will depend on the role, position or function in the value chain (Bolwig et al., 2010; Riisgaard et al., 2010). The upgrading potential of an agent or actor will also depend on their ability to acquire new and more remunerative functions in the value chain (Mitchell and Coles, 2011). Rather than selling the raw frankincense, for example, gatherers could acquire new functions such as drying, cleaning, sorting and packaging before selling to increase the farm-gate value. Gatherers could also establish cooperative marketing groups to increase their share of the market prices as marketing groups can increase bargaining power and their marketing performance (Aoudji et al., 2012; Devaux et al., 2009; Mitchell et al., 2009).

As is to be expected, collectors and microenterprises are the second

group of actors, who achieve higher than farm gate prices, but still lower than retail prices. This is in part because they are often tied to monopsonic relationships with the SOE. Poor market access often makes it difficult for this group of traders to bargain for better prices with the SOE, which normally provides transport, and sometimes gives advance to these traders. Lack of good market access (Jensen and Meilby, 2010) and inadequate information are commonly cited as the most important problems in NTFP trade (De Caluwé, 2011; Meinhold and Darr, 2019). These constraints weaken the bargaining position of the gatherers/producers, and local traders and exposes them to considerable price uncertainty (De Caluwé, 2011; Marshall et al., 2006).

Our analysis reveals that the value-added tend to be the highest for village petty traders and mobile traders. However, value-addition was limited to the transfer of frankincense to the retail outlet; no transformation of the raw material occurred apart from minor processing limited to drying and cleaning, i.e. the removal of bark and tree debris. However, frankincense destined for export or wholesale market is cleaned and sorted into different grades. This takes place in processing plants owned by the SOE.

The distribution of profits of actors in the chain is often used as the primary indicator of income shares in VCA (Gereffi et al., 2001; te Velde et al., 2006). The study revealed that frankincense marketing (production and trade) is profitable for many actors, a finding that is in line with other NTFP literature (Abteu et al., 2012; Jensen, 2009). Gatherers do report a higher profit margin than other actors along the value chain because they incur no cash cost and the alternative value of family labour is arguably often extremely low (Table 3). Moreover, gatherers sell the produce directly to collectors and microenterprises at harvest sites, thus they have less expenditures, and they make considerable returns. Several studies have shown that short trade chains, through reducing costs, provide benefits for producers/gatherers, and they could also create incentives for increasing their harvest and income (De Caluwé, 2011; Maisharou and Larwanou, 2015; Marshall et al., 2006). The group with the second highest profit margin (73.5%) was village-level petty traders. This group obtained increased profits in part because they add value to the product through primary processing thereby selling at higher prices. However, due to limited financing and low capacity, the quantity and value of frankincense traded by these actors is very small (Table 3). Most NTFP traders in Africa generally exchange small quantities of modest value, due to a variety of constraints including limited financing, low capacity, and lack of access to capital, among others (De Caluwé, 2011; Ingram, 2014).

There exists a rather good domestic market demand for frankincense in Ethiopia (Lemenih and Kassa, 2011a). Moreover, owing to both population and economic growth, the demand for frankincense is likely to grow in the country, providing an incentive for increased production. Therefore, there is a possibility for increased incomes along the value chain.

Policy recommendations to develop the sector include improved harvesting and processing skills through training, developing or introducing harvesting and processing equipment, improving market access for gatherers, providing credit service, training and skills development in trade, especially in quality grading for gatherers and local traders. As reported earlier, gatherers have no access to credit, nor is there any government support for frankincense production and trade in the area (Table 6). Farmers in other parts of the country, particularly in the highland regions, often receive credit in cash or as inputs direct from a credit unit, which they repay in cash after the harvest. Such service is not common in the agro-pastoralist areas of southern Ethiopia. Facilitating access to credit is an essential requirement for successful NTFPs commercialization (Marshall et al., 2006). Provision of credit in equipment could enable gatherers to increase output and income. However, significant scaling up of production through introduction of improper tapping method may cause damage to frankincense-producing trees. Development of community-based organizations and/or strengthening customary resource management institutions could effectively minimize

or eliminate unsustainable extraction of the resource (Ingram, 2014).

The SWOT analysis suggests that there is a possibility to enhance commercialization of frankincense in southern Ethiopia. However, frankincense production and marketing in the study area is characterized by the following major weaknesses: weak integration, lack of associations/organization, little value-adding activities, whereas gatherers and traders (notably at the local level) have underdeveloped marketing skills, lack of access to extension services. In addition, although there exists a number of studies on the abundance of *B. neglecta* from which the product is derived (Lemenih and Kassa, 2011a; Worku, 2006), research on value-addition processes and on developing technologies is virtually absent. Moreover, unlike northern Ethiopia (Lemenih and Kassa, 2011a), research on regeneration status/tree recruitment rate and domestication potential of the tree species is limited. The major threats influencing frankincense production and trade in the area are higher dependence on a single company and labour competition with herding.

To develop and expand commercialization of frankincense in the study area it is essential to mitigate the above-mentioned threats and weakness. This could be achieved by the following interventions:

- Advocacy that encourage policy-makers and government institutions to recognize the economic contribution and commercialization potential of frankincense
- Training gatherers (small-scale agro-pastoral households) on improved tapping and handling techniques to increase production and produce higher quality products
- Developing or introducing improved tapping techniques to increase production and avoid damages to the forest resource
- Training gatherers on value-adding processes and marketing skills to upgrade their function in the value chain
- Supporting gatherers and collectors to organize and collaborate, thus strengthen their access to resources and market. It is widely acknowledged that collective action plays a key role in creating market access for gatherers/producers, strengthening their capacity for producing more and better quality product, to add value to raw product, and to increase their bargaining power, improving their access to credits, technical support and market information (De Caluwé, 2011; Ingram, 2014; Marshall et al., 2006; Seville et al., 2011)
- Create business linkages between gatherers and local traders (collectors and microenterprises)
- Strengthening market institutions and establish marketing facilities
- Establishing community-based organizations and/or strengthening existing customary resources management institutions, with proper support and regulations. This could enable to minimize or mitigate the likely degradation of the tree species caused by unsustainable extraction. Research and development on regeneration capacity of the frankincense-producing trees and options for domestication could have a positive impact in maintaining the resource base, product sustainability and continued trade.

6.3. The economic contribution of frankincense production in Borana: implications for agro-pastoralists adaptation and resource sustainability

The harvest of wild NTFPs represents an important source of income to millions of people worldwide (Shackleton, 2011). Vedeld et al. (2007) estimate in a meta-study that as much as 20–25% of rural households' income is derived from forest environmental resources. In Northern Benin for instance, income from NTFPs accounted for about 39% of the total household income (Heubach et al., 2011). In Sudan, gum and resins were found to contribute 14–21% of the household income (Abteu et al., 2014). In the present study, frankincense alone was an important income source for pastoral households, representing from 4 to 77% of the total household cash income. The annual income from frankincense extraction and sale averages 59 USD per AEU in our sample and this

income was estimated, on average, to contribute 35% of the total household's annual income. The result supports the notion that many rural populations are highly dependent upon forest resources for their livelihoods.

Frankincense production and sales diversify the economic activities and reduce the risks associated with frequent crop and pasture failures in the drylands of Ethiopia (Lemenih et al., 2003b; Wagner et al., 2013); hence, the trade increases the adaptive capacity of the agro-pastoralist communities. Due to their low adaptive capacity and risk-prone production environments, these communities are vulnerable to the effects of drought and climate variability and are severely exposed to food and feed insecurity. Crop failure in such areas can lead to a 'price scissors', where livestock values plummet just as cereal costs surge, leading to a large shift in the terms of trade (IUCN, 2011). One advantage for the gatherers is that marketing of frankincense occurs during the dry season when other agricultural products are becoming scarce and thus more expensive (Lemenih et al., 2003b). This implies that commercialization of the product may provide cash income complementary to other sources of income, and thus serving as a financial buffer. In addition, the seasonality of frankincense harvesting and selling make the activity compatible with pastoral mobility and with farming in the rainy season.

Although frankincense constitutes an important income source, with the existing patterns of production, there is little evidence to suggest that frankincense income has a substantial role as a pathway out of poverty or poverty mitigation for any group of households in this sample. Overall annual income of gatherers is still low, i.e. USD 213 per AEU. These households are among the poorest in the country with an average income of less than 1 USD per capita per day, which reflects a high incidence of poverty in the study area. Frankincense income therefore functions as an economic *safety net* and a supplementary source of income for the households. However, since the resource is abundant and freely accessed combined with the lack of wage job opportunities, frankincense production could be used to create an alternative job and more income. More importantly, the forest resource is vital; even for the medium wealth groups, relative frankincense income reaches nearly 30%, well above the previous high forest (timber and NTFPs) income shares (22%) found for all groups in an early synthesis of 51 cases studies from developing countries (Vedeld et al., 2007). Our findings emphasize the huge importance of frankincense to rural households in the study area.

Besides its economic contribution, the use of dry woodlands for extraction of frankincense could have ecological significance in the study area. Drylands are especially prone to degradation as a result of scarce, variable rainfall and low soil fertility (Bainbridge, 2007). Conservation of the vegetation cover is thus seen as an appropriate strategy to ensure long-term viability of dryland areas (Cortina et al., 2011) such as in Borana. More efficient governance of the value chains and better organization among the gatherers can lead to more efficient frankincense production and ensure better returns for the actors upstream along the value chain (te Velde et al., 2006). Overall, the present study shows scope for high-income generation through frankincense harvesting that can be realized by the rural poor in the region. Abundance of the resource, homogeneity of the gatherers (i.e. gatherers involved are the Borana agro-pastoralists), low human population density and compatibility of frankincense harvesting with livestock production might provide an opportunity to consider this livelihood strategy to help improve the households economy in this dryland region, where agricultural production is marginal. The study further shows that there are possibilities for scaling-up the frankincense trade and developing the sector in southern Ethiopia. Given the present population increase and national economic growth, production of frankincense is expected to intensify in the county putting increased pressure on the natural resource base for intensive exploitation. Designing and implementing sustainable production systems is necessary not only to conserve the resource but also to enhance its sustainable socio-economic and ecological significance.

7. Limitations and recommendations for future research

In this study, we measured, through a case study from southern Ethiopia, the value of frankincense at the upstream end of the supply chain. As the wholesalers and exporters engaged in multiple products marketing, it was difficult to obtain data on volumes and incomes from these actors. Another limitation in this study is that the data were collected from a limited number of gatherers and market actors. The data presented should thus be considered as a pilot case study in obtaining insights in the commercialization of frankincense that originates from the southern Ethiopia and therefore cannot be generalizable to other parts of Ethiopia. Future applied research on frankincense resources (including the regeneration capacity, domestication potential of frankincense yielding trees, and management of natural stands) and analysis of overall livelihoods of the agro-pastoral population would allow for a more complete and accurate assessment of the product and its values (economic, environmental and social), and thus increase the external validity of the results. In addition, value chain analysis that considers the national harvest and trade, and international markets could enhance the wider validity of conclusions.

8. Conclusion

This article has estimated the contribution of frankincense to involved households' economy and the product's value chain in southern Ethiopia. The annual income generated from frankincense harvest and sale was estimated to be 60 USD per AEU contributing to 35% of the total household's annual income and almost 50% of the poorest people. Frankincense is thus shown to be of particular importance for poorer households.

While frankincense harvest is only one activity within a household livelihood strategy, the cash it generates can play an important role in sustaining and improving households' economy in the study area, where the dominant economic activities are often threatened by frequent droughts. The value chain analysis revealed that frankincense production and trade is profitable for many actors. Nevertheless, despite the resource's abundance and a growing domestic market demand, the marketed quantities are low, extractions practices are traditional and both local and national markets are poorly developed. The SWOT analysis suggests that there is substantial scope to develop and expand commercialization of frankincense in southern Ethiopia, bearing in mind to mitigate weaknesses and threats to production and marketing of the product.

CRedit authorship contribution statement

Yonas Berhanu: Data curation, Writing - original draft, Writing - original draft, conceived the work, collected and processed the data, wrote and revised the manuscript. **Pål Vedeld:** Writing - review & editing, Writing - review & editing, provided commentary and a critical review of the manuscript. **Ayana Angassa:** Writing - review & editing, Writing - review & editing, provided commentary and a critical review of the manuscript. **Jens B. Aune:** Writing - review & editing, Writing - review & editing, provided commentary and a critical review of the manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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