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ORIGINAL PAPER

Economic contribution of forest products to household income in Metema district, Ethiopia

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Abstract

Dry deciduous woodland is the dominant vegetation type in northwestern Ethiopia. However, the contribution of such forests and their products to local and national communities has not been empirically studied so far, particularly in the study area. This study was carried out to assess the contribution of dry deciduous woodland forest products to households, as well as to identify the determinants of forest income and level of forest dependence in Ethiopia's northwestern lowlands. The data were collected through field observations, key informant interviews, and individual interviews. A total of 120 respondents were chosen using a systematic random sampling technique in three kebeles (villages) that were selected purposively. Combinations of data analysis methods such as descriptive statistics and an econometric model (a seemingly unrelated regression model) were used. The major sources of households' income were crop production (46.91%), forest products (25.32%,) livestock farming (21.42%,) and off/non-farm activities contributed (6.32%) of the households' total income. The major dry forest products include construction materials and farm tools, grass, gum and resin, charcoal, and fuel wood, contributing 23.60%, 22.77%, 17.89%, 16.56%, and 12.83% of the forest income, respectively. In addition, several socioeconomic and cultural factors that affect forest income and dependency have been identified. Therefore, we suggest that sustainable forest management schemes should be adopted to maintain and enhance the flow of economic benefits to the surrounding communities without damaging the natural resource system.

Keywords Forests income · Forest dependency · Woodland · Determinants · Seemingly unrelated regression

JEL Classification Q50

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1 Introduction

Forests are important assets for sustainable rural development, and currently, forestry is an industry wherever production and social goals are handled simultaneously (Bjärstig and Sténs 2017). According to Almstedt et al. (2014), within the pattern of sustainable forestry, the alert management of forest sectors for multiple purposes is being increased. In Africa, there is a good understanding of different stakeholders on the importance of forests and the forestry sector plays in poverty reduction strategies (Oksanen et al. 2003; Yemiru et al. 2010). Rural Africans have used natural forests, and woodlands and planted trees for food, energy, medicine, animal feed, construction, furniture, agricultural implements and utensils to enhance their livelihood diversification (Mamo et al. 2007; Shackleton et al. 2006). Forest uses not only contribute to generating income, but also contribute to the regulation of the environment, the reduction of carbon emissions, global biodiversity, the fertility of agricultural land, and on the well-being of those who depend on them, meaning that forests are immensely valuable to sustainability (Agrawal et al. 2013).

Similarly, the production, collection, and marketing of non-timber forest products play a significant role in meeting the needs of the rural population for food, poverty reduction, sustainable management of forest products, health, and wealth improvement (Marshall et al. 2005; FAO 2006; Ahenkan and Boon 2008). However, the key challenges that farmers faced to enhance the marketing of forest products were lack of marketing information, lack of packaging and labeling requirement, poor harvesting and processing skill, inadequate finance to non-timber forest product farmers, over-harvesting and deforestation, and lack of policy to guide the use, management, and development of non-timber forest products (Ahenkan and Boon 2010).

In the developing world, including Ethiopia, rural communities follow a wide range of livelihood strategies. Some parts of communities diversify their livelihood strategies, while others rely on one or a few activities. Recently, many studies are providing more evidences of the role of forests in rural people's livelihoods. It is indicated that about one billion of the world's poor depend on forest resources to sustain their livelihoods (Scherr et al. 2003; Cao 2012; Melaku et al. 2014; Brobbey et al. 2019). Studies in sub-Saharan Africa (Cavendish 2000; Campbell et al. 2002; Kaimowitz 2003; Fisher 2004; Paumgarten 2005; Mamo et al. 2007; Shackleton et al. 2006; and Babulo et al. 2008) have shown that rural households regularly supplement their income from forest resources. Hence, the forestry sectors provide a substantial contribution to the welfare of many rural households. However, the level of forest use and the degree of dependence on forest products vary across households. The factors that affect a household's socio-economic dependency on forest products vary on the resource endowment, and the demographic, institutional and socio-economic characteristics of households (Babulo et al. 2008).

Globally, empirical evidence has quantified the proportion of forest dependency from the entire household livelihood matrix. The seminal work by Vedeld

et al. (2007) drawing upon 51 case studies across 17 developing countries revealed that the contribution of forests, mainly through forest income accounted for about 22% of the total household income. In North and South America, the contribution of forest income ranged between 14 and 20% of the total household income (Uberhuaga et al. 2012; Cordova et al. 2013). In Asia, forest income varied from 10 to 20% of the total household income (Mukul et al. 2016). While in sub-Saharan Africa, forest income ranged from 30 to 45% of the total household income (Mamo et al. 2007; Appiah et al. 2009; Kalaba et al. 2013).

Moreover, a study conducted by Teshome et al. (2015) showed that major sources of household income are crop production, livestock farming, forest products, off- and non-farm activities, and remittances and aid, contributing respectively to 46.3%, 27.6%, 17.0%, 6.3% and 2.8% of the household income. Similarly the major dry forest products include honey, fuel wood, gum and resin, and crafts and construction materials, contributing 49%, 39%, 6%, and 6% of the forest income, respectively (Dagm et al. 2016). These studies demonstrated the significant contribution of forests toward household economies. Some people depend solely on forests as their only source of subsistence, with its contribution sometimes being found to offset other household livelihood portfolios such as agriculture (McElwee 2010).

In Ethiopia, dry forests are the most significant forest types both in area coverage and their economic contribution to the GDP of the country by exporting non-timber forest products (Lemenih and Kassa 2011). Ethiopian forests generated economic benefits in the form of cash and in-kind income equivalent to 111.2 billion Ethiopian Birr (ETB) (USD16.7 billion) or 12.86% of the Gross Domestic Product (GDP) in 2012–13, considerably larger than previously thought. Of this, 6.09% of GDP is attributed to forest industries. The contribution of forest ecosystems to other sectors, particularly agriculture, is valued at 6.77% of GDP. In addition, 2.4 billion ETB was attributed to non-market benefits based on Ethiopians' willingness to pay to maintain forests (UNEP 2016). Likewise, dry forests provide various goods and services to producers, traders, and consumers such as fodder, fuel, medicine and commercial non-timber forest products (FAO 2010; Abebaw et al 2012). However, knowledge of the faith of Ethiopian communities in woodland forests for fuel wood, construction materials, medicinal plants, and gums and resins and factors affecting this faith on forest income is limited (Teshome et al. 2015)**.** The household forest income level is significantly influenced by family size, producer's cooperative membership of producers in gums and resins, and distance to forest resources (Mamo et al. 2007; Teshome et al. 2015).

There is high coverage of forests in the northwestern lowland of Ethiopia though as far as knowledge of research its economic contribution to the communities and governments is not estimated empirically. Therefore, based on the above statement, the study was intended to empirically answer the following two key questions: (i) what is the economic contribution of northwestern Ethiopian lowland forests to the communities, and (ii) What factors determine the forest income and dependency levels on forest income of households in the Northwest Lowlands from Ethiopia. Following that, the researcher hypothesized that household forest dependency and forest income would differ significantly across a range of socioeconomic factors.

2 Methodology

2.1 Description of the study area

The study was undertaken in a vegetation-dominated woodland area in the Metema district. It is located in the North Gondar Zone, Northwestern lowlands of Ethiopia. Geographically, it is situated between 36°17' E and 12°39' N. The site is characterized by an undulating land configuration. The annual rainfall of the area goes up to 1128 mm and the mean monthly minimum and maximum temperature of the Metema district were 19.31°C and 35.65°C, respectively (Wale et al. 2012). The dominant vegetation type is mixed dry deciduous woodland where Combretum and Terminalia species are abundant (Friis et al. 2010; Eshete et al. 2011; Wale et al. 2012). *Combretumcollinum*, *Combretummolle, Terminalialaxiflora, Anogeissusleiocarpa, Dalbergiamelanoxylon, Combretumharotomannianum, Acacia seyal, Balanitesaegyptiaca, Boswelliapapyrifera, Pterocarpuslucens, Lanchocarpuslaxifiora, Lanneafruticosa, Acacia Polyacantha, Sterculiasetigera, Stereospermumkunthianum,* and *Dichrostachyscinerea* species are found in the study site. In this woodland, 36–39 woody species were existing (Eshete et al. 2011; Wale et al. 2012).

2.2 Sampling and data collection

Prior to the survey, visits to the district were made, and secondary information relevant to the study was gathered from formal possible sources such as information documented by zonal and district agricultural offices. Then, after a thorough discussion with experts from the agricultural district office, three kebeles (Das Gunido, Kokit, and Metema Yohans) were selected based on forest cover/dry forest, representativeness and accessibility and stratification based on household status (low, medium and rich households).

Field data collection at the selected kebeles was carried out from January 2017 to February 2018 using various methods like household surveys, group discussions, market assessments, and field observation. Finally, using the list of households, the default size obtained was 120 sampled households from each Kebel, which were randomly selected using a systematic sampling technique. The survey was carried out using a household interview aimed at capturing both qualitative and quantitative information. The questionnaire was comprised of such major issues as socio-demographic characteristics (such as sex, age, family size, and literacy status) and major assets such as land and livestock, livelihood activities, and forest product extraction. Local interviewers were recruited from the respective sample kebeles. All interviewers were fluent speakers of the respective local languages. They were trained on data collection procedures, interviewing techniques, and the detailed contents of the questionnaire. The questionnaire was pretested to check its appropriateness for gathering all the required data.

2.3 Method of data analysis

Data from the field were edited, coded, and cleaned to ensure consistency, uniformity, and accuracy. During the data checking, 2 of the 120 questionnaires were found incomplete and removed from data processing and analysis. Data were entered into computer software for analysis. Both SPSS and STATA computer programs were used to process the data. Two types of analysis, namely: descriptive and inferential statistics were used to analyze the data collected. To identify factors influencing household income from the forest and forest income dependence (measured as the relative share of forest income in the total annual household income) estimated by seemingly unrelated regression analysis (SUR) model since the two equations have some correlation between household income from the forest and forest income dependence.

To estimate the interaction effect of the dependent variables and identify the common underlying factors, researchers widely employed seemingly unrelated regression SUR model (Goshu et al. 2012a; Goshu et al. 2012b; Bessie et al. 2014). In this paper, interdependences between income from the forest and forest income dependence were assumed. Theoretical and empirical studies show that such kinds of bivariate correlations between endogamous variables were best estimated by seemingly unrelated regression (SUR) model (Zellner 1962; Greene 2012). Assuming the latent dependent variables were uncorrelated, past research studies used entirely separate multiple regression analysis (Eyduran 2012; Teshome et al. 2015; Dagm et al. 2016; Garekae et al. 2017; Adamu et al. 2019). However, such types of regression equations are not unrelated because they may at least interrelate through their error terms. Moreover, they are not necessarily simultaneous but bear a close conceptual relationship to one another. The thumb of rule states that when the dependent variables are assumed to be correlated, then joint analysis (set of regression equations) are preferred over equation-by-equation analysis in order to obtain precise estimates and prediction that lead to a better solution.

Accordingly, they were estimated by a two-equation SUR model (Zellner 1962; Greene 2012):

$$Y_i = X'\beta + U_i \tag{1}$$

where Yi = amount of income generated from forest and relative share of forest income in the total annual household income. β = a vector of estimated coefficient of the explanatory variables. $X^{'}$ = a vector of explanatory variables. U_i = disturbance term.

The following socioeconomic, demographic, and institutional factors are identified and their relationships hypothesized based on an extensive literature review on the contribution of dry forest products to household income. Each variable's definition, measurement, and expected sign are summarized in Table 1.

Table 1 Variables used in the estimation, their definitions, and measurements

Variables	Notations	Measurements	Expected effect		Sources
			Forest income	Forest income dependence	
Sex of Household	Sex	1 for male, 0 otherwise	±	±	Teshome et al. (2015), Dagm et al. (2016), Hesekia et al. (2017)
Age of H	Age	years	±	±	Teshome et al. (2015), Dagm et al. (2016), Hesekia et al. (2017)
Family size	Fsize	Adult equivalent	+	+	Teshome et al. (2015), Dagm et al. (2016), Hesekia et al. (2017)
Literacy status	Literacy	1 literacy, 0 otherwise	±	±	Teshome et al. (2015), Dagm et al. (2016) Hesekia et al. (2017)
Distance to nearest forest	DNF	In km	−	−	Teshome et al. (2015), Dagm et al. (2016), Hesekia et al. (2017)
Distance to urban market	DUM	In km	−	−	Teshome et al. (2015), Dagm et al. (2016), Hesekia et al. (2017)
Gum and resin Cooperative membership	Coop	1 if HH member, 0 Otherwise	+	+	Teshome et al. (2015), Dagm et al. (2016), Hesekia et al. (2017)
Tropical livestock unit	Livestock	Measured in TLU	±	±	Teshome et al. (2015), Dagm et al. (2016), Hesekia et al. (2017)
Access to credit	credit	1 credit user, 0 otherwise	±	±	Teshome et al. (2015), Dagm et al. (2016), Hesekia et al. (2017)
Participation in Off/Non-farm activities	Off/nonincome	1 participant, 0 otherwise	±	±	Teshome et al. (2015), Dagm et al. (2016), Hesekia et al. (2017)
Land covered by forest	Land	Measured in ha	+	+	Teshome et al. (2015), Dagm et al. (2016), Hesekia et al. (2017)
Household wealth status	Wealth	Household head wealth status (1 = poor, 2 = medium, 3 = rich)	±	±	Semeneh et al.(2014), Dagm et al.(2016), Teshome et al. (2015), Hesekia et al. (2017)

3 Results and discussion

3.1 Relative contribution of different livelihood options

Figure 1 illustrates the relative contribution of livelihood options to households. Crop production is still the main source of income (22,770.8 ETB, or 46.9% of total income) for local people in the study area, and this is in line with several similar studies. For instance, Mamo et al. (2007) at Chilimo Forest reported that while agriculture contributed 40% and livestock 27.6% to household income, the average contribution of forest products was 17%. The overall average income of respondent households derived from the forests was estimated to be 25.32% of the total household income. This finding is in line with Teshome et al. (2015), who reported that NTFPs contributed 17% to household income in the Northwestern and Southern Lowlands of Ethiopia. Likewise, in Chiradzulu District, Malawi, forest income constituted around 15% of the total income. Income from off- and non-farm activities accounted for 6.3% of the total household income, and petty trade and working as a daily laborer were the most common off-farm activities in the study area. Income from livestock accounted for 21.4% of the total household income.

Table 2 depicts household activities and cash contributions by income category. The annual income of forest income for different wealth groups at the study sites amounted to Birr 14,091.2 for the rich, Birr 12,089 for the medium, and Birr 1171.8% for the poor. For the study site, the relative percentage contribution of forest income for rich households was 21.4%, while the contribution for medium and poor households was 23.4% and 33.2%, respectively. Low-income households usually own less agricultural land and livestock, which makes them more dependent on forest products. In terms of magnitude, forest income differed significantly

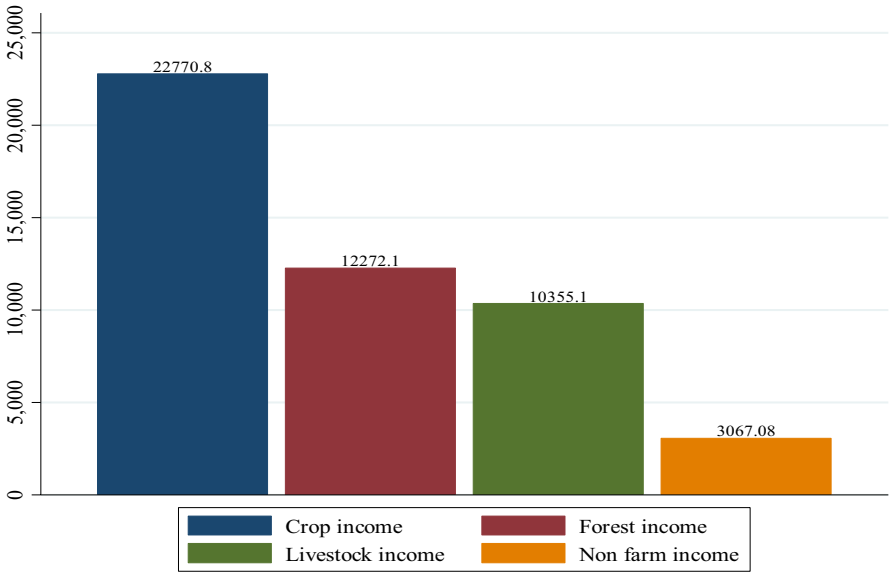

Fig. 1 Major source of annual household income and their contribution in Birr

Table 2 Average annual total household cash income contribution by household activities

	Rich households (n1 = 18)	Shared %	Medium Households (n2 = 61)	Shared %	Poor households (n3 = 39)	Shared %	Total (N = 118)	F-value
Income from Crop farming	30,697.2 (25,539)	46.54	24,277.54 (15,021.4)	46.95	16,755.6 (13,700)	47.42	22,770.7 (17,157)	4.85***
Income from Livestock production	12,811.1 (2218.4)	19.42	12,981.9 (20,570)	25.11	5112.8 (6068)	14.47	10,355.1 (16,258.3)	3.14**
Income from off / nonfarm	8361.1 (22,813.6)	12.67	2351.5 (6239.3)	4.54	1742.82 (4635.7)	4.93	3067.1 (10,379)	2.89*
Income from forest	14,091.2 (11,772)	21.36	12,089 (10,795)	23.38	11,718.7 (9985.2)	33.16	2272.1 (10,626)	0.32
Total	65,960.6 (36,457)		51,700.1 (26,814.9)		35,330 (21,589.9)		48,464.9 (28,693.3)	8.87***

Source: computed from survey data, 2018

***Significant at 1%, ** at 5% and * at 10% Parenthesis shows standard error

Fig. 2 The contribution of different forest products to total forest income in Birr

($P < 0.05$) with the wealth category of the households; the households in the poor category benefited more than the rich. Similarly, Shackleton (2006) showed that rich households extracted a smaller amount of forest products. Shackleton (2004) found that poor households extracted greater income from NTFPs than rich households.

Arnold and Perez (2011) showed that it was generally the poorest households who relied more heavily on forests for a portion of their overall means of subsistence. Similar findings were reported in the Chilimo Forest in Ethiopia (Teshome et al. 2015) and in a communal area of Zimbabwe (Cavendish 2000). Additionally, there were significant differences ($P < 0.001$) in the income from agriculture, livestock, and other activities among the income groups (poor, middle, and rich), with local people being more reliant on these activities for generating income. Out of all the income sources, it was discovered that forest income contributed the second-highest amount to household income.

3.2 Contribution of various forest products to forest income

Figure 2 illustrates, the forest provides various products for livelihood. The major products include construction materials and farm tools, grass, gum and resin, charcoal, fuel wood, fence, honey and medicinal plants and the first five were the top five important products in terms of their contribution to household income.

The forest provides a variety of products for livelihood. The major products include construction materials and farm tools; grass, gum, and resin; charcoal; fuel wood; fences; honey; and medicinal plants. Of these, the first five were the most significant in terms of their contribution to household income.

3.2.1 Construction materials and farm tools

Timber, thatch, and bamboo are used as different building materials components. These products were used for the floor, walls, poles, rafters, beams, roofs, and other parts of the houses. Bamboo was collected not only as a building material but also for cash generation. Small wood is collected for making or repairing cattle/ buffalo carts and agricultural cultivation tools such as plows, harrows, yokes, and spade handles. The most frequently collected tree species were Yemane (Gmelinaarborea), Thitnet, and Yant-kaw (local names). Some collected small wood was also used as building material (timber) (Fig. 2).

3.2.2 Firewood

Income from firewood collection was the fourth most important forest income; it accounted for 12.8% of the annual forest income (Fig. 2). Given that firewood has remained the major energy source for most rural as well as urban households, coupled with the relentless population growth and the subsequent increase in wood demand, it might not be uncommon to find firewood harvesting as a major forest-based livelihood activity. For rural communities in many regions of Ethiopia, the extraction of fuel wood from the forest has been noted as a significant source of revenue related to the forest (Abebaw et al. 2012; Teshome et al. 2015).

3.2.3 Gums and resins (GR)

Gums and resins (GR) are one of the most economically valuable products of dry forests of several regions. In the current study, the collection and sale of GR products as a source of income were observed at the study site. In this study site, households extracted GR from different species. The most commonly known GR product was frankincense collected from Boswellianeglecta, which is locally named as "*Tikur etan*" (meaning: black incense). Income from gums and resin collection was the third most important forest income; it accounted for 17.9% of the annual forest income (Fig. 2). The average annual income from GR was estimated to be 2196.5 ETB.

3.2.4 Fodder (grass)

Some types of foods collected and consumed in each studied household were observed and their quantities were recorded as long as the household could recall. Households collect forest products to use as fodder for their livestock. These were used f**o**r both consumption and cash generation. Fodder products were mostly collected during the rainy season (from May to October). Fodder from the forest forms

an important source for cattle and other grazing animals in hilly and arid regions and during a drought. It was the second most important forest income; it accounted for 22.7% of the annual forest income (Fig. 2).

3.2.5 Charcoal

Income from the charcoal collection was the fourth most important forest income; it accounted for 16.5% of the annual forest income (Fig. 2). For the rural and urban population charcoal is an important source of energy for cooking and heating.

3.2.6 Honey

In the current study, about 36.44% of sample households in the study area indicated the production of honey as one of their forest-based livelihood activities. According to the household survey, honey production in the study areas was mainly carried out by placing hives hang in a forest. Honey from the forest is produced/harvested three to five times annually; three to five kg of honey can be produced in one bee hive in one harvest. As reported during the survey, households delivered the raw honey to the nearby market, without product processing or any other value adding-activity. The raw honey was reported to be sold at an average price of ETB 40 per kg. Income from honey contributed a less significant proportion of the annual forest income of households in the study area: of the total forest income 126 ETB was accounted which is the least contribution next to medicinal plants.

3.3 Determinants of forest income levels and forest income dependence

The SUR model estimation results of households' annual forest income and level of dependency on forest income are reported in Table 3. As expected the residuals from the two equations were strongly and positively correlated and the SUR model explained about 37% and 39% of the variation in annual forest income and level of dependency on forest income, respectively. The result of regression models is presented in Table 3. The forest income and forest income dependence of a household are regressed against some household characteristics that may influence income levels. The results of this study reveal that family size has been positively related to both forest income ($P<0.05$) and the level of dependency on forest income. The result indicates that households that have larger family sizes engage more in forest products and dependence. The work of Hegde and Enters (2000) also showed that families with more labor tended to extract more forest resources. This was because they were either able to mobilize part of their families to undertake forest-dependent activities. Furthermore, larger families had higher subsistence needs, and that may be another reason to depend more on forest resources.

The results indicate that distance from the forest and nearest market are the other factors, which are positively related to forest income and level of forest dependence. This implies that, as the distance from the forest and nearest market increases, the income generated by households from the forest and forest

Table 3 SUR regression of household forest income

Variables	Coefficient equations	
	Forest income	Forest income dependence
Sex of Household	0.04 (0.267)	−5.13 (5.612)
Age of H	0.01 (0.009)	0.008 (0.199)
Family size	0.11** (0.043)	1.81* (0.924)
Literacy status	0.16 (0.191)	−5.15 (4.016)
Distance to nearest forest	0.08** (0.038)	0.84 (0.802)
Distance to urban market	0.14** (0.067)	2.75* (1.413)
Gum and resin Cooperative membership	0.75*** (0.209)	18.61*** (4.408)
Tropical livestock unit	0.002 (0.011)	−0.67*** (0.242)
Access to credit	−0.36*** (0.165)	−9.95** (3.486)
Participation in Off/Non-farm activities	−0.30 (0.186)	−3.94 (3.917)
Land covered by forest	0.08* (0.046)	1.17 (0.967)
Rich household	−0.09 (0.275)	−8.09 (5.783)
Medium household	−0.02 (0.194)	−2.16 (4.072)
Constant	7.58*** (0.458)	26.11*** (9.643)
Observation	118	118
Chi-value	70.53***	75.63***
R-square	0.37	0.39
Correlation matrix of residuals	0.53	
Breusch-Pagan test of independence: chi^2 (1) = 33.898, Pr = 0.0000		

Source: computed from survey data, 2018

***Significant at 1%, ** at 5% and * at 10%

dependence increases (unexpected sign). This is in line with the report of Mamo et al. (2007) for Chilimo. Being a member of a cooperative of gums and resins producers and traders has been positively related to forest income and forest dependence at one percent. This shows that those households who are members of cooperatives get income from gums and resin as a result they get better income and depend on forest products than non-member households. This is in line with the report of Teshome et al. (2015) on Ethiopia.

The two important household assets, land covered by forest and livestock size, were found to influence forest income and dependency both positively and negatively. According to the regression result, larger livestock assets significantly decreased the level of dependency on forest income at 1% level of significance. Given that larger livestock resources may reflect higher total income and thereby less dependence on forest income. This is in line with the report of Fisher (2004), Teshome et al. (2015), Fikir et al. (2016).

On the other hand, the regression result for access to credit supported the hypothesis that availability of credit access reduces the need for environmental income: households with access to credit were found to earn lower forest income at 1% and to be less dependent on forest income at 5% than those without. This

could be households who have access to credit could be engaged in other income-generating activities like nonfarm may reduce the quantity of extraction and hence income, by competing for and taking over labor as well as time that would otherwise be invested for forest related- activities.

4 Conclusion and policy implication

The results of the study have shown that the natural forest in the Metema district plays a significant role in rural people's livelihood, serving as the main source of primary and secondary income for rural households. The livelihood of the households in the study area depends on livestock rearing, crop production, forest product collection and off-farm activities our findings highlight the relative importance of income from forest environmental sources in overall household income. Construction and farm tools, fodder, gum and resins, firewood, charcoal, fence, honey, and medicinal plant are the six major forest income sources. Forest income and dependency vary with household characteristics. The determinant of household forest income and forest income level dependence are influenced by family size, distance to the forest and nearest market, cooperative membership, tropical livestock and access to credit positively and negatively. The study findings contribute to local management and conservation strategies in the following ways: the key factors causing variation in household forest income and forest income level dependence can be considered and factored into program and activity planning, design, and implementation for forest sustainability. On the other hand, policies should encourage the active participation of local communities in forest management and conservation. Furthermore, the local and regional governments should educate households on how to maximize financial resource productivity while also strengthening the existing crop-livestock production system and gum- resin cooperatives. Finally, future attempts should be made to estimate and value the contribution of other non-marketable products that have not been included in the current study (such as food like vegetables, fiber and fruits, etc.) to enhance the economic contributions of dry forests to the local livelihoods and the national economy at large.

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Availability of data and materials The authors want to declare that they can submit the data at any time based on the publisher's request. The dataset used and/or analyzed during the current study is available from the authors on reasonable request.

Declarations

Conflict of interest All authors have received research grant from University of Gondar to accomplish this research for collecting research data. The authors declare that they have no competing interests.

Consent for publication Not applicable.

Ethical approval and consent to participate Ethical clearance letters were collected from the University of Gondar research and community service directorate and Central Gondar zone of face to care for both the study participants and the researchers. During survey, letters were written for each kebele /village/ informed verbal permission was obtained from each client, and confidentiality was maintained by giving codes for each respondent rather than recording their name. Study participants were informed that clients have a full right to discontinue or refuse to participate in the study. Hence, all participants throughout the research, including survey households, enumerators, the supervisors and key informants were fully informed of the objectives of the study. They were approached friendly in free moods until then do this research.

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