



Determinants of Smallholder Farmers' Dependency on Forest Products: the case of PFM at Kaffa Zone, Southwest Ethiopia

Amanuel Afeto^{1*} , Tesfaye Gafaro¹

¹ Southwest Ethiopia Agricultural Research Institute; Bonga Agricultural Research Center, Bonga Ethiopia.

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CORRESPONDING EMAIL

*Corresponding email:
amanyaster@gmail.com

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Abstract

Forest are one of the most essential types of resources for the existence of life which regulates environmental and ecological system, provides environmental services and economically valuable products. Significant percentage of world population relied on forests resources for subsistence, livelihoods, employment and income generation. The objective of this study was to identify and examine factors determining level of households' dependency on forest product income. It is conducted in Gawata and Tello districts of Kaffa zone southwest Ethiopia. Data was collected by household survey, key informant interview and focus group discussion. Multistage sampling method was employed to select sample households. Sample household collect wood from the forest for fire, construction, furniture production, as well as fiber, spices, ferns, stimulants, honey, wild *Rhamnus prinoides* for home consumption and income generation. They generate a mean income of 12,511.32Ethiopian Birr (ETB) from forest products collection and member of Participatory forest management (PFM) generate 13,263.43ETB more income than non-member households. The dependency level of sample households on forest products' income was 25.87% of total annual income. Land size of household, PFM membership of household, availability of forest land and year of residence in the area positively and significantly affect level of household dependency on forest product income. Promoting forest plantation on own land and engaging households on alternative income sources minimize the dependency level of households on PFM forest

1 Introduction

United nation confirmed that significant percentage of world population relied on forests resources for subsistence, livelihoods, employment and income generation. About 60 million indigenous people are almost wholly dependent on forest; some 350 million people who live within or adjacent to dense forests depend on them to a higher degree for subsistence and cash income (UNFF, 2019). An estimated 57 million rural populations in Ethiopia were engaged in the extraction of one or more of the forest products (UNDP, 2017).

Chilimo and Bonga PFM was established in the year 1996 with support of FARM Africa and SOS Sahel Ethiopia as the two pilot area (Temesgen et al., 2007). Chilimo PFM have a total of 785 members with 662 male and 123 female (Mamo et al., 2007). While Bonga PFM have a total of 7948 members with 4,304 male and 3,644 females (Abebe, 2021). Study in Dendi district and Bonga forest showed PFM has had a positive contribution on improving households' livelihoods and sustainability of the forest resource as participants got more annual income than non-participants (Abebe, 2021; Getachew & Jimma, 2012).

Southwest Ethiopia, still its large parts covered with natural veg-

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etation, is rich in Non-timber forest products (NTFPs), which contribute 24 to 30% of the households' annual income (Chilalo & Wiersum, 2011). Kaffa zone were one of the area with large cover of natural vegetation having large contribution for livelihood of local community. The relative contribution of forest varies from place to place, over time, author to author depending on many factors. Available empirical studies from Africa and Asia show that forest income contributes between 10% and 60% of income for households living in forest landscapes (Damte et al., 2019). In rural communities of Cameroon, Ethiopia, Malawi and Zimbabwe, forest-related activities account for 35-39% of average income of households and in Myanmar 38.82% (Htun et al., 2017; UNFF, 2019). The contributions of forest products to communities in southwest Ethiopia are more than other part of Ethiopia. A study in Bonga forest (47%), Yayu forest (44.7%), and Masha (41.17%) of household annual income were generated from forest product collection (Afeto & Tesfaye, 2022; Asfaw & Etefa, 2017; Melaku et al., 2014).

The level of use and degree of reliance on forests and its importance as a source of subsistence and cash income affected by many socio-economic, demographic and institutional factors. The most common determinant of household level of dependency on forest product income identified by many authors are family size, sex of household head, age of household head, size of farmland, distance from market and forest, access to credit, level of education of household head, livestock unit, amount of income other than forest income (Damte et al., 2019; Fikir et al., 2016; Mamo et al., 2007; McElwee, 2008). The main focus of this study was to indicate socio-economic, demographic and institutional factors affecting the level of reliance of households on forest products income from PFM forest in Kaffa zone of southwest Ethiopia. The objective of this study was to identify and examine factors determining level of households' dependency on forest product income.

2 Materials and Methods

2.1 Description of the Study Area

This study was undertaken in southwest Ethiopia region Kaffa zone, Gawata and Tello districts. Gawata district is 86km away from Bonga town and 546km from Addis Ababa. The area lies within 07°25' - 7°50'N Latitude and 35°56' - 35°89'E Longitude. It is bordered in the South by Gimbo and Chena district, in the West by Bitta and Gesha district, in the North by Sayilem and Oromia region and in the north east bordered by Oromia region. The district has a total of 30 kebeles of which 27 are rural based kebele administration areas and 3 are urban kebeles. The total population of the district was 91,645 of which male accounts for 44,906 and female accounts 46,739 of the total. The estimated total area coverage of the district is 91,500 hectares. Gawata district is well known by high vegetation cover and most of the surrounding area is covered by tropical rain forest comprising a rich mixture of woody species arranged in many layers. The area is characterized by a long rainy season that extends from March /April to October. The mean annual rainfall of the study area ranges from 1800 mm to 2200mm. The mean temperature of the district ranges from 160c (lowest) and 220c highest. The district is dominated by midland agro ecology which is favorable for coffee production. The major crops grown in the district include coffee, maize, barley, faba bean, chickpea and teff.

Tello district is one of the districts in Keffa zone; it was about 42 km away from Bonga. Geographically it is located in latitude of 070 00' 00" to 070 28' 34" N and longitude of 220 20' 89" to 360 19' 60" E. Tello district is bordered from the south by Cheta, west by Decha, north by Menjiwo, and from the east by the Konta zone and the district has 24 kebeles. The mean annual temperature of the district ranged from 14°C to 17.5°C. The mean annual rainfall of district ranged from 1400-1900 mm. Tello district has a population of 63,252, of whom 31,387 are men and 31,865 women; 3,509 or 5.55% of its population are urban dwellers. The major crops grown in the district include Enset, maize, barley, faba bean, wheat and cardamom.

2.2 Sampling Techniques and Sample Size Determination

Multiple stage sampling was employed for this study, in the first stage from kaffa zone two districts namely Gawata and Tello were selected purposely based on the natural forest availability and its management practice of community member by PFM. In the second stage from each district, two kebeles were selected based on forest availability. In the third stage, a stratified technique was employed to select member of PFM and non-member PFM households using a sampling frame. Sample size was determined by using the formula which was developed by Yamane (1967):

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

where, n is sample size; N is target population, and e is level of precision. Based on this formula, by assuming level of precision 8%, and given number of households in the study area, sample size was estimated and distributed based on probability proportion to kebele and participant and non-participant households. A total of 185 household were interviewed, 94 households from Gawata district and 91 from Tello district. Out of the sample households, 46.5% were members of participatory forest management and 53.5% were not a members.

2.3 Data Sources and Methods of Collection

Both primary and secondary data sources were used for this study regarding the forest resources, household's participation on participatory forest management, and household's socioeconomic and demographic information. Structured questionnaire were used to generate the primary data from the selected sample households. Focus group discussions (FGDs) was conducted in all four kebeles by participating elders, female, youth and kebele administrators that have better knowledge about the area and forest resources. Key informants' interview was also conducted to gather necessary information to supplement data collected from selected respondents. Secondary data were collected from published and unpublished documents of different organizations and office report.

2.4 Status of PFM at study area

Tello districts have 15 PFM cooperatives, out of which 8 PFM were supported by Climate Resilient Forest Livelihood (CRFL) and 7

PFM were supported by Reduction of Emission from Deforestation and forest Degradation (REDD++). Gawata districts have 12 PFM cooperatives 8 PFM were supported by CRFL and 4 were supported by REDD++ and Nature and Biodiversity conservation Union (NABU). PFMs in Gawata district covers a total area of 37,971.7 ha of forest land and has total member of 10,404 having 6,147 male and 4,257 female members. Two sample PFM were selected from each district; Saja-Bogenda and Chebero PFM were selected from Gawata district and Sharasha and Deccha PFM were selected from Tello district. Saja-Bogenda PFM has a total area of 900 ha forest land having a total member of 323 having 188 male and 135 female members. Chebero PFM has a total area of 556 ha forest land with 80 members and now only 30 active participants. Decha PFM has a total area of 1904 ha of forest land having 126 total members. Sharasha PFM has a total area of 212ha forest land with 86 male and 14 female members of total of 100 members.

2.5 Methods of Data Analysis

2.5.1 Descriptive statistics

Descriptive Statistics such as mean, standard deviation, frequency and percentages were used in the process of describing different socioeconomic conditions of the sample households and forest product income. T-test and q-square test were done to analyses the difference between member ad non-members.

Level of household dependency on forest product income or the relative forest product income is share of forest income in total annual income of households. It is calculated by summing total income households generated from collection of forest products and dividing to total annual income and multiplying by 100.

$$DPFP = \frac{FRINC}{TTINC} \times 100 \quad (2)$$

Where:

- DPFP - Dependency on forest product income id indicated by percent
- FRINC - Total forest product income by Ethiopian Birr
- TTINC - Total annual income of households from different sources in Ethiopian Birr

2.5.2 Econometric Model

Determinants of small holder farmers' dependency on forest products' income

The levels of dependency of households on forest products' income are affected by many factors. The dependency level of households or relative forest income are regressed on socio-economic, demographic and other factor variables in order to estimate their effects on the level of dependency of households on forest product income. Hence, the dependent variable is the level of dependency of households on forest products' income which is a continuous variable between 0 and 100, and Ordinary Least Square (OLS) model was used (Gujarat, 2004). The OLS regression is specified as equation (3) and Table 1.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + U_i \quad (3)$$

Where:

- Y = dependency level of households on forest products' income or relative forest income
- β_0 = intercept
- β_i = Vector of estimated coefficient of the explanatory variables
- X_i = Vector of explanatory variables or factor determining households level of dependency on forest products' income
- U_i = disturbance term or other factor that is not included in the regression but has effect on households level of dependency on forest product income

Table 1: Hypothesized factors that affect dependency level on forest income

Variables	Type of variable	Measurement	Expected effect
Dependency level on forest income	Continuous	Percentage	
Sex of household head	Dummy	1=Male, 0=female	-
Age of household head	Continuous	Year	-
Educational status of household head	Continuous	Year	-
Family size	Continuous	Number	+
Land size	Continuous	Hectare	-
Livestock unit	Continuous	Number	-
Distance of PFM forest from home	Continuous	Kilometre	-
Logarism of total non-forest income	Continuous	Percept	-
PFM membership	Dummy	1=member, 0=non member	+
Availability of own wood land	Dummy	1=yes, 0=no	+
Year of residence	Continuous	Years	+
Training access	Dummy	1=yes, 0=no	+/-



3 Results and discussion

3.1 Socio-economic characteristics

Out of the sample households 82.7% were male headed and 17.3% were female headed. The marital status of sample household were 94.1% were married 2.2% were divorced and 3.8% were widowed. The educational level of the sample household head was 42.16% not joined formal education, 44.33% joined primary education, 12.43% joined secondary education and 1.08% joined college. The age of the sample household ranged from 22 to 75years with a mean of 42.57 years.

The sample households' family members ranged from 2 to 16 with a mean of 7 family members. The land holding size of the sample households ranges from 0 to 4.5 hectare with a mean of 1.67 hectare.

There is a significant variation of land holding of PFM member and Non-member with Non-member of PFM have 1.91 ha and higher land holding than member of PFM have 1.43ha of land holding. The pairwise correlation indicates that households with large size of land were not member of PFM. The mean size of sample household wood lots was 0.21 hectare with significant variation between member of PFM and non-member with 1% significance level. The wood lot size of non-member of PFM were 0.31ha, higher than member of PFM 0.1ha, this indicate that PFM members depend on PFM forest for forest product. The correlation between distances of forest demarcated within PFM from home was negatively and significantly correlated with member of PFM. It implies that as distance from PFM forest to home increase households become non-member of PFM. Households around the forest have higher probability of becoming member of PFM. Out of the sample households 46.5% were a member of participatory forest management and 53.5% were not a member.

Table 2: Socio-economic characteristics of sample households

Variable	Total Sample Mean $\pm$ sta dev.	PFM member	Non-member of PFM	F	Sig
age of household head	42.57 $\pm$ 11.86	43.7	41.6	1.44	0.231
family size	6.87 $\pm$ 2.5	6.91	6.84	0.035	0.853
land size in hectare	1.67 $\pm$ 1.16	1.43	1.91	8.017	0.05*
woodlot land size in hectare	0.21 $\pm$ 0.24	0.1	0.31	46.019	0.000***
Livestock owning (TLU)	4.43 $\pm$ 0.24	4.40	4.46	0.023	0.879

*, **, *** indicates significant at 10%, 5% and 1% respectively.

3.2 Forest product income and level of dependency

Households in the study area collect diversified forest products from PFM forests of Kaffa zone. The major forest product collected by the sample households include construction material, wild food, spice biomass energy, household utensil and farm implement. All of the sample households collect at least fire wood for energy source but the variation was on other type of forest product. This study agree with finding in Masha district, found that diversified forest product collected from forest of Sheka for home consumption and cash income generation (Afeto & Tesfaye, 2022).

Households in the study area generate a mean income of 12,511.32ETB from forest product collection. There is a significant variation of income from forest product collection between member of PFM and non-member at 10% significance level. Member of PFM generate an annual income of 13,263.43ETB per year from forest product collection and non-member of PFM generate 11,857.98 ETB per year from forest product collection from their own wood lot and communal forest. The finding was similar with finding of Abebe (2021) and Girma et al. (2023), those members of PFM secure more income from forest than non-member of PFM.

The dependency level of the sample households on forest product income were 25.87% of total annual income. The sample households generate quarter of their annual income from forest product collection, which was less than the finding in Masha district, household gain 41.17% of total annual income from forest product (Afeto & Tesfaye, 2022). The finding were less than the finding of Melaku et al. (2014) said that communities around natural forest generate 47% of their total annual income from forest. This find-

ing indicates that the dependency level of households around Kaffa forest decrease time to time by diversifying their income sources. The members of participatory forest management generate 28.35% of their total annual income and non-member of PFM generates 23.84% from forest product collection. The finding of this study agrees with earlier finding in the study are by Abebe (2021), who stated that member of PFM generate higher share of their annual income than non-member of PFM.

3.3 Determinants of household dependency on forest product Income

The results of multiple linear regressions indicate that the model best fit the regression analysis and it was significant at 1% and F-value was 22.176. The R-square value indicated that, independent variables explained 66.4% of the variation of the level of dependency of households on forest product income. From a total of twelve explanatory variables seven variables significantly affected dependency level of households on forest product income. Land size of household, PFM membership of household, availability of forest land and year of residence in the area positively and significantly affect level of household dependency on forest product income, while age of household head, family size and logarithm of total non-forest income negatively and significantly affect level of household dependency on forest product income (Table 3).

Age of household head affected the dependency of households on forest product income negatively and significantly at 1% significance level. The dependency level of households on forest product income decreased by 0.307% when the age of household increase



by one year. The finding indicate that younger household head are more dependent on forest product income than older due to labor intensive of forest product collection and limited availability of livelihood income sources for younger households. The finding were in line with Garekae et al. (2017), who indicated that, younger households were more likely to gather more forest products compared to the middle aged and the elderly.

Family size of households negatively affect the level of dependency on forest product income and are statistically significant at $p < 0.05$. The dependency level of households on forest product income de-

crease by 0.662%, when the family member increases by one person holding other factor constant. Household with large family member are less dependent on forest product income than household with small family member. It is in line with the finding of Vihi et al. (2024) denoted that as household size increase they have opportunity to many livelihood activities that decrease their reliance on forest product income. It contradicts with studies finding in Hammar and northwestern and southern lowlands of Ethiopia, household with large family size depend more on forest income than households with small family member due to labor intensive of forest product collection (Fikir et al., 2016; Teshome et al., 2016).

Table 3: Result of Multiple linear regression model of factor determining household dependency on forest income

R – Square 0.664	F-value 28.302	Sig. 0.000			
Variable	Coefficients	Std. Error	t-value	Sig.	
Constant	209.778***	14.713	14.258	0.000	
Sex of household head	-1.024	1.663	-0.616	0.539	
Age of household head	-0.307***	0.097	-3.171	0.002	
Educational status	0.211	0.192	1.103	0.272	
Family size	-0.662**	0.274	-2.418	0.017	
Land size in hectare	3.596***	0.867	4.149	0.000	
Total livestock owning	-0.099	0.383	-0.258	0.797	
Distance of PFM from home	0.189	0.561	0.337	0.736	
Logarithm of total non-forest income	-42.437***	3.637	-11.668	0.000	
PFM membership	6.872***	1.594	4.311	0.000	
Availability of wood land	5.266***	1.651	3.189	0.002	
Year of residence	0.358***	0.082	4.339	0.000	
Training access	1.256	1.718	0.731	0.466	

*, **, *** indicates significant at 10%, 5% and 1% respectively.

Land size households have positive and significant effect on household's dependency on forest product income at 1% significance level. The dependency level of households on forest product income increase by 3.596% when the size of land holding of household increase by one hectare holding other factor constant. The finding indicates that households with large size of land holding are more dependent on forest product than households with small size of land holding. It might be due to household with large size of land be able to allocate land for forest to collect and produce diversified forest products. The finding contradict with Htun et al. (2017), said that household with small land holding are more dependent on forest income.

Logarithms of total non-forest income have negative and significant effect on household's dependency level on forest product income at 1% significance level. The results of analysis indicate that, the natural logarithm of total non-forest income increase by 1%, the dependency of households on forest product income decrease by 42.437% holding other factor constant. The finding shows that household who generate much income from other livelihood income sources are less dependent on forest product income than households with limited income sources. The result agrees with finding in Myanmar that indicated the negative relation of household income with forest income (McElwee, 2008). An increase in non-forest income decreases forest dependency of households (Mendako et al., 2022).

A member of Participatory Forest Management has a positive and significant effect on household's level of dependency on forest product income at 1% significance level. When a households become a member of PFM its dependency level on forest product income increase by 6.872% compared to non-member of PFM holding

other factor constant. The finding indicates that member of PFM are more dependent on forest product income than non-member of PFM. This result is in line with Girma et al. (2023), said that member of PFM generate higher significant income over non-member of PFM and has impact on livelihood improvement of PFM member.

Availability of wood land for household has positive and significant effect on household's dependency on forest product income at 1% significance level. When households have its own woodlot its dependency on forest product income increase by 5.266% compared to household who don't have their own forest land holding other factor constant. The finding implies that households who have wood land are more dependent on forest product income; it may be due to production and collection of diversified forest product from their own forest.

Year of residence of households on specific area have positive and significant effect on households dependency on forest product income. When the year of residence of households on specific area increase by one year its dependency on forest product income increase by 0.358%. The finding indicates that households who stayed long time on specific area are more dependent on forest product income than new comer to the area, it might be due sharing of communal resource and knowledge on available resources in the area. Long-term residents were likely to learn more about the ecological structure, composition, and seasonal patterns of forests and were therefore more skillful at collecting forest products (Birben, 2022).



4 Conclusion and Recommendation

References

4.1 Conclusion

Forest of Kaffa was mainly managed by the active participation of community member through PFM. Larger area of forest land delineated to forest user groups community members living around forest land. The forest of Kaffa has an importance to the livelihood of local community by providing forest product including construction material, wild food, spice biomass energy, household utensil and farm implement for household consumption and cash income generation. All households in the study area collect at least fire wood for energy source due to unavailability of alternative source of energy. Households in the study area generate a significant share of their annual income from collection of forest product. Being a member of PFM, households' income from forest products will increase by 4.51% compared to non-members. Land size of household, PFM membership of household, availability of forest land and year of residence in the area positively and significantly affect level of household dependency on forest product income, while age of household head, family size and logarithm of total non-forest income negatively and significantly affect level of household dependency on forest product income.

4.2 Recommendation

Local government and supporting NGOs should give much focus for livelihood of forest managing communities and forest bordering households. As their livelihoods are not improved their dependencies on forest increases and negatively affect forest resources. The sample households generate quarter of their annual income from forest product collection and still their dependency on forest income were higher. The availability of alternative income sources and livelihood activities minimize households' dependency on forest product income. Therefore finding other livelihood activities that minimize their dependency on forest resources were needed.

Households with larger forest land on their holding are more dependent on forest product income than with small forest land. Promoting farmers to have forest on their land holding minimize the forest product they collect from PFM forest, so local government should work on planting forests on their land holding. Over exploitation forest product allowed for member of PFM are promoting deforestation, so limiting the type and quantity of forest product collected from PFM forest are beneficial for the existence of forest. Further to know the trend of biodiversity change in the forest under PFM plant biodiversity assessment is needed.

Conflict of interest

The authors declare that they have no conflict of interest.

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Data availability Statement

Data can be made available on the behave of the request

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