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THE ROLE OF PARTICIPATORY FOREST MANAGEMENT IN SUSTAINING RURAL LIVELIHOOD AND FOREST CONDITIONS IN SHEKO FOREST, SOUTHWESTERN ETHIOPIA

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Abstract

Different arrangements of decentralized forest management highlighting the inclusion of communities have been promoted to halt deforestation and environmental degradation. The participatory Forest Management (PFM) scheme was introduced as an alternative tool to enhance sustainable forest management through community participation during the early 1990s. This study was conducted in the Sheko forest to examine the role of PFM on the livelihoods of rural community and forest conditions. Forest inventory and socioeconomic surveys were conducted to collect data through involving 95 households and 27 sample plots. The data were analyzed by descriptive and inferential statistical tools. The result indicated that PFM has positive impacts on both forest conditions and rural livelihoods. Income derived from forest products was 89.06%. Of this71.76% was obtained from forest coffee collection while the remaining was shared between honey production and wild spice collections. A total of 55 woody plant species belonging to 34 families were recorded from the three forest zones. Of this, 45 were found within unmanaged dense forest zone, 41 in semi-forest coffee-based agroforestry zone and, 21 in the open zone agroforestry. Overall Shannon diversity index was 3.25 in unmanaged dense forest, 2.89 in semi-forest coffee-based agroforestry and, 1.9 in open zone agroforestry. Higher seedling and sapling densities were recorded under unmanaged forest followed by open zone agroforestry and semi-forest coffee-based agroforestry. The lower number of seedling and sapling under semi-forest coffee-based agroforestry could be attributed to frequent weeding and thinning activities. Concerning the diameter distribution, the unmanaged forest zone displayed uniform distribution and semi-forest coffee-based agroforestry zones displayed a J shaped distribution while the open zone displayed an inverted J shaped distribution suggesting a better regeneration of tree in the unmanaged forest and open zone agroforestry while in semi-forest coffee-based agroforestry zones intervention was required to improve poor regeneration of tree species.

Keywords: Forest income, forest status, forest products, Livelihoods, Participatory Forest Management

1 Introduction

Forests constitute about 90% of terrestrial biodiversity and play a critical role in supporting the livelihoods of over 1.2 billion people worldwide (World Bank, 2002).In developing countries, forest-based enterprises provide about 13–35% of all rural non-farm employment, equivalent to 17 million formal sectors and 30 million informal sector jobs (Angelsen and Wunder, 2003). Ethiopia possesses a wide variety of forest resources such as high forests, woodlands, bushlands, plantations, and trees outside forests with varying ecological and livelihood significance (Aklilu *et al*., 2016; Gashu and Aminu, 2019; Limenih and Temesgen 2011; Tesfaye *et al*., 2012;). Sustainable forest management can contribute to economic development by providing income, employment, food security, and shelter where it is most urgently needed (Agrawal and Chhatre, 2006; Chirenje *et al*., 2013).

The livelihoods of rural and even of some urban people in Ethiopia are closely linked to the forests that provide a range of benefits from energy and construction materials, to grazing, medicinal plants, ritual, and spiritual activities and sources of foods (Ameha *et al*., 2014; Tadesse *et al*., 2017). Forested landscapes also provide a range of environmental services, including watershed protection, biodiversity conservation, carbon sequestration, and landscape preservation. These services are highly valuable to both forest dependent households and off-site beneficiaries whose activities depend on the continued production of these services (Amanda *et al*., 2017; Temesgen and Wu, 2018). Despite these multiple benefits, Ethiopian forests have been considerably declining both in size and quality (Dessie and Christiansson, 2008; FAO, 2011). For example, the deforestation rate in the highlands of Ethiopia is estimated to be 14,000 million hectares per year (FAO, 2010). The decline is mainly due to the massive removal of forest or vegetation cover to meet the fast-growing population and their increasing demand (Getacher and Tafere, 2013; Kassa *et al*., 2009; UNDP, 2012). Given the continued population growth and declining agricultural productivity, the pressure on forests will continue unabated. Hence, managing forest resources is essential to ensure forest-based ecosystem services and improve the rural livelihood (Tadesse *et al*., 2014; Temesgen and Wu, 2018; Tolessa *et al*., 2017).

Ethiopian has been made several efforts in managing and developing forest resources through conventional forest management approaches by declaring forests as state forests or protected forests (FAO, 2010). However, forests depletion reduction outcome is minimal, as the resources have been suffered from mismanagement mainly due to loosely defined property relations (Gobeze *et al*., 2009). The conventional forest management has alienated local communities from participating in forest conservation and protection in Ethiopia, which has led to illegal and unsustainable resource utilization (Farm Africa, 2002). This requires a paradigm shift from conventional forest management to PFM that promotes the participation of the local community in the management and development of forest resources.

Participatory Forest Management (PFM) is a management tool that involves mobilizing local people for group action in managing specific forest areas adjacent to their settlement to ensure socio-economic development of community and reduce pressure on forests (Ahmid and O'Hara, 2010; Schreckenberg and Luttrell, 2009). This involves sharing responsibilities and benefits according to a well-defined and mutually agreed rules and regulations. The agreed rules and regulations are planned, implemented, maintained, and monitored by the village institutions (Mbuvi *et al*., 2009).

Several cases in Ethiopia cases showed a positive impact of PFM on forest and livelihood status. In fact, in some cases, the impacts of PFM may be varied depending on local conditions (Ahmid and O'Hara, 2010; Tesfaye *et al*., 2011). That is why site-specific research required among which Sheko woreda is the one that pursuing PFM since 2010. Before the introduction of PFM, poaching of forest products, encroachment, and charcoaling were alarming illegal activities taking place in the Sheko forest (Plan, 2014). Nowadays, due to PFM intervention, the communities are carrying out protection and rehabilitation of catchment areas (Ahmid and O'Hara, 2010; Aklilu *et al*., 2016) which are causing positive changes in the forest conditions and livelihood of local communities. However, there were few studied that gives account on the performance of the scheme. Thus, this study aims to investigate the role of Participatory Forest Management arrangement in sustaining the rural community's livelihood and improving forest conditions in Sheko forest.

2 Materials and Methods

2.1 Description of the Study Area

Our study area, Sheko district, is located in Southern Nations Nationalities and People Regional State of Ethiopia at about 600 km from regional city Hawasa (Figure 1). It lies between latitude and longitude of 6^o58'N and 35^o45'E, respectively, and at an altitude that ranges from 900 to 1850 m.a.s.l. (Ayalew *et al.*, 2015). The mean annual temperature is 22.6^oC and the annual rainfall ranges from 1200 to 2200 mm.

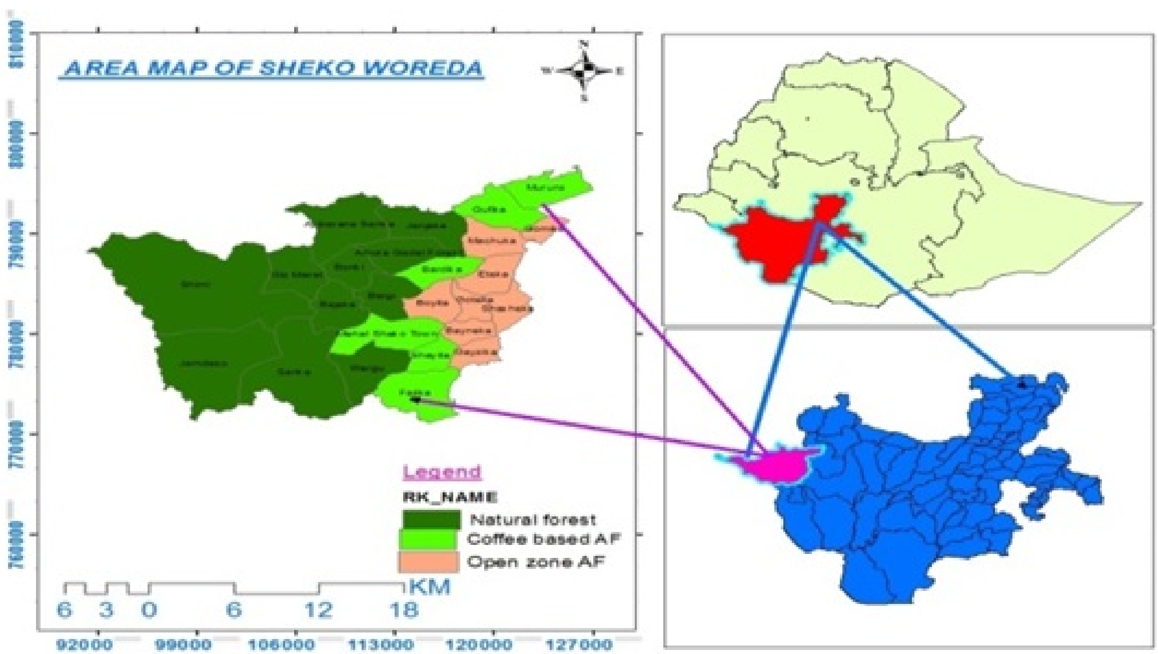

Fig. 1 Location map of the study area.

The area is endowed with large areas of natural vegetation and having a total human population of 64,661(Ayalew *et al.*, 2015). As considered by the same author, the dominant land use system of the study area is a mixed farming system with various types of coffee exploitation like wild coffee extraction, garden coffee cultivation, coffee plantations, and small scale agriculture, with some locally marketable products and the major cereal crops are maize and sorghum.

2.2 Data sources and analysis

Socio-economic data was collected through direct interview with the forest users, specifically heads of households and village leaders in the selected association using structured questionnaires which aimed at capturing both qualitative and quantitative information. Secondary data that could support primary sources were collected from published and unpublished documents. The population sample was determined according to Yamane's (1967) formula that recommended at least 10% of households could participate in the research in each of the selected PFM association. From thirty-eight associations practicing in PFM, six (two from each of the three forest zone) were randomly selected and the questionnaire was administered on 95 households reached through a simple random sampling approach.

Forest in the study area is comprised of (1) unmanaged natural forest – UNF (vegetation of >3 ha with trees above 5 m in height and canopy cover of more than 10%); (2) semi- forests coffee-based agroforestry – SFCBAf where coffee is cultivated under native forest canopies through planting coffee seedlings and allowing natural regeneration of coffee plants and by clearing the understory vegetation (Senbeta and Denich, 2006); and (3) garden coffee systems (open zones agroforestry – OZAf) where naturally regenerating and nursery coffee plants are grown with other crops under native shade tree species (Wiersum *et al*., 2008). Vegetation sampling quadrants were based on line transects. A total of six line transects were laid out across the contour at a regular interval of 300m from the three forest zones. Vegetation samples were collected from 27 plots (9 plots from each forest zone in 900m^2 at the interval of 200m which belongs to the three forest zones. In each plot, parameters such as abundance (individuals) and tree diameter at breast height (cm) was collected. To ensure that all vegetation types are visited, the population of the forests were further stratified into individual plants with the diameter at breast height (DBH) > 5 cm and height > 1.3 m were classified as trees, individuals with a DBH < 5 cm but height > 1.3 m were classified as saplings and individuals with height < 1.3 m were classified as seedlings (Omoro *et al*, 2010).

The obtained data were analyzed statistically using the SPSS and GraphPad Prism statistical packages. Therefore, frequencies, descriptive, bivariate correlational analysis, and cross-tabulation techniques were employed. Several bivariate statistical analyses were made to explore the correlations between different socioeconomic variables. The density of woody plant species per hectare among the three forest zone was derived from the number of individuals recorded in the sampled plots. Different diversity indices such as species richness, species abundance, and Shannon index. One way ANOVA analysis at a 10% level of significance was used to test differences in woody species richness, abundance, and diversity indices among the three forest Zones.

3 Results

3.1 Socio-Economic Characteristics and Forest Resources

The majority of the sample respondent households were men headed (77%) and with an average family size of six members. The sample respondents were, on average, 36 years of age, and their holding size ranges from 0.25 ha to 8 ha with an average of 2.5 ha. Their livelihood mainly depended on crop production, forest coffee collection, wild spice collection, fuel wood collection, honey production and off-farm activities (petty trade and wage employment). The mean annual income of the sampled households in the study area for the year 2017/18 was 58983.45 ETB with minimum and maximum income ranged between 1760 and 140,800 ETB (Table 1). Much of the income from the forest products go to household subsistence as they purchase most cereals which are not grown in the study area. From the total annual income of the household, about 71.76% income is derived from the coffee collection, 5.2%, from honey production, 12.1% from wild spice collection, 10.2% from crop production, and 0.74%, from off-farm activities.

Table 1 Growth inhibition (Mean ± SEM) of the four bacterial strains by crude ethyl acetate extract (CEaE) of *C. macrostachyus* leaves and the isolated compound, Methyl laurate.

Income Sources	Mean	Std. Deviation	Minimum	Maximum
Coffee	42328.89	26481.736	1760	140800
Honey	3063.43	7024.940	0	38400
Spices	7144.90	7551.884	0	36000
Crop production	6018.37	9504.989	0	39000
Off-farm activities	427.86	766.670	0	3311
Total	58983.45	20459.326	1760	140800

The most important forest products on which most livelihoods-based in Sheko forest include forest coffee harvesting, fuelwood collection, honey production, wild spice harvesting and timber and construction materials were identified as the preferred and major sources of income. Interviews indicated that the communities' did not allow extracting the forest products like charcoal and timber freely from the forest. Of the sampled household almost all were engaged in forest product collection for their income source even though the types of forest product preference varied among the studied households. Forest coffee harvesting was the most important and valuable commercial forest product in which about 66% of the sampled households were engaged in wild coffee collection, while the remaining shared among different forest products like spice with coffee production (12%), fuelwood and timber harvesting (8%) and integrating honey with coffee production (13%), and construction material (1%) (Figure 2). As a result, there has been increasing interest in forests as a source of local rural employment and income, particularly through non-farm activities (trade, own small business, daily labour). The interview showed that the average production of coffee was 24.86 quintal ha-1yr-1 and 92.4% of the products were for sale and the remaining 7.4% were used for home consumption. Regardless of its eminence, the survey showed that wild coffee varieties have been nowadays attacked by Gibrilla diseases especially in the semi-forest coffee-based agroforestry system.

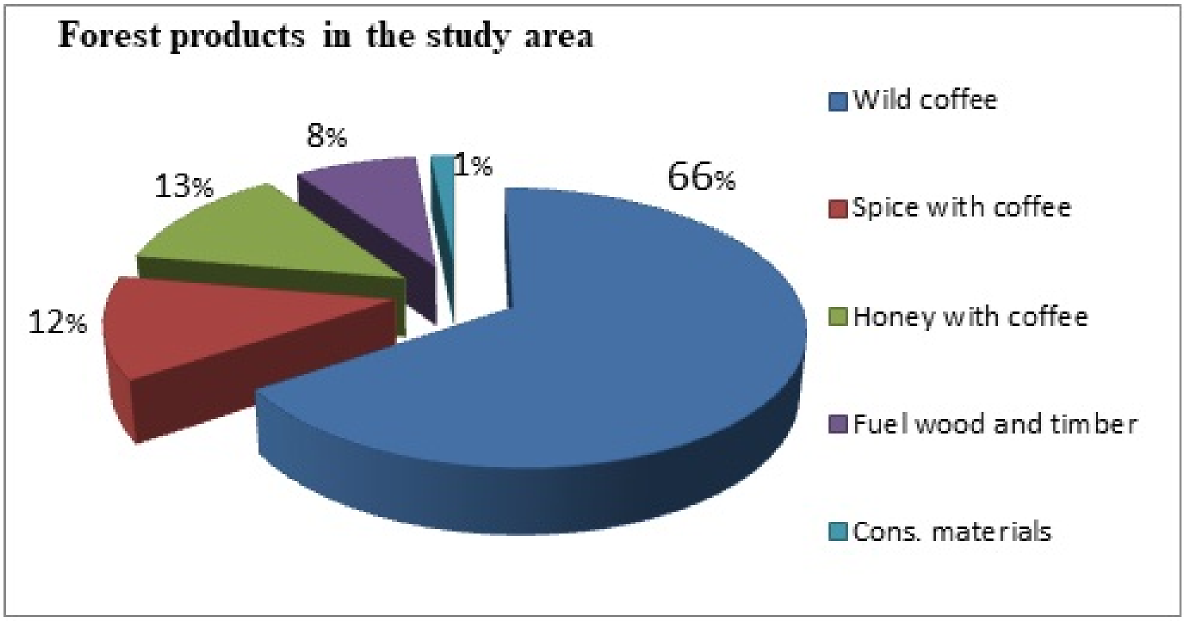

Fig. 2 Forest products collected by studied households in study area.

The most important wild spices grown in Sheko were Korerima (*Aframomum corrorima*), Turmeric (*Curcuma domestica*), ginger (*Zinigiber officinale*), Mitmita (Chilies) and black paper, (*piper nigrun*) (Figure 3). These spices are used for several purposes including medicinal values, traditional food processing (e.g., butter, oil) and as a flavour for food. Even though spices are highly demanded, and have the potential to improve local livelihood, the dependence of mode of production on the wild population and traditional production system have caused in low yield, poor quality and unreliable supply. Moreover, lack of market linkage and governmental support for the promotion of wild spice make their sustainability questionable.

Fig. 3 Wild spices in the study area – (a) turmeric plant, (b) black pepper and (c) wild coffee harvesting (All photos by the researcher, 2018).

Flora diversity (Appendix) is one of the opportunities for honey production and it has been an encouraging natural endowment for the long-standing traditional bee-keeping activity, which is one of the sources of livelihood for the local communities and developed over years to meet household honey consumption or sale requirements. The most widely used tree and shrub species for bee-keeping in the study area include *Croton macrostachyus*, *Cordia africana*, *Lecaniodiscus fraxinifolius*, and *Vernonia amygadlina*. The honey production system in the study area was the traditional system and the farmers were not yet transformed into modern beehive system and this leads to a low level of honey production and quality.

3.2 Community Participation on PFM

Regarding the extent of community participation in PFM, apparently, 96.5% of the respondents confirmed their active participation for more than 3 years while 3.5% did not. The non-participating individuals are not permanent residents and hence the rule forbids them to join the association. The level of gender-based community participation and decision making in the three PFM stages (conservation, development, and utilization stages) were also evaluated. Accordingly, about 84.7% of the respondents replied that both men and women have equal rights of voting and participation in decision making and equitably shared responsibilities of managing the forest. However, the remaining 14.3% revealed that there is no equal participation in all PFM stages especially in forest patrolling. This unequal participation is mainly attributed to women's home related burden and topographical difficulties to regularly engage in forest patrol.

3.3 PFM vs. Trends in Forest Products Utilization

The result showed that both non-timber (wild coffee, spice, medicine, and honey) and woody (fuelwood, timber, and construction material) forest products played an important role in household needs. Before the PFM introduction, 53.1% of the respondents replied as they have had a high level of utilization, while 27.6% medium and 19.4% replied low utilization level. After PFM implementation, 52% of the respondents replied as they have had a low level of forest product utilization, 27.6% medium and 20.4% replied high utilization level. This utilization level reversal is attributed to the introduction of community agreed management and utilization plan of PFM that specifies restrictions and rights of forest product utilization for the members. More specifically, PFM intervention strictly limited some destructive utilization types, namely: timber, charcoal, and fuel wood products which had been the most important source of income. Thus, the new PFM plan generally regulates extraction levels and period in cases where the extraction is not prohibited. In both cases, before and after PFM, the community has been allowed to access forest products for their household needs.

Regarding the collection and sale of different forest products, results of household inventory showed that before the introduction of PFM, the average production rate of coffee was 11.43 quintal $ha^{-1}yr^{-1}$, honey 6.3Kg per beehive and spice 18 quintal $ha^{-1}yr^{-1}$ with a mean market price of 16.12, 13.57 and 18.25 Birr per Kg for coffee, honey, and spice products, respectively. While after the introduction of PFM, the average production rate was changed to 12.82 quintal $ha^{-1}yr^{-1}$ for coffee and 10kg per hive of honey production, and the market price was changed to 24.02 per kg for coffee and 76.42 birr per Kg for honey. But, the production for spice before and after the introduction of PFM remains the same while the price changed from 18.25birr to 34 birr after PFM introduced (Figure 4).

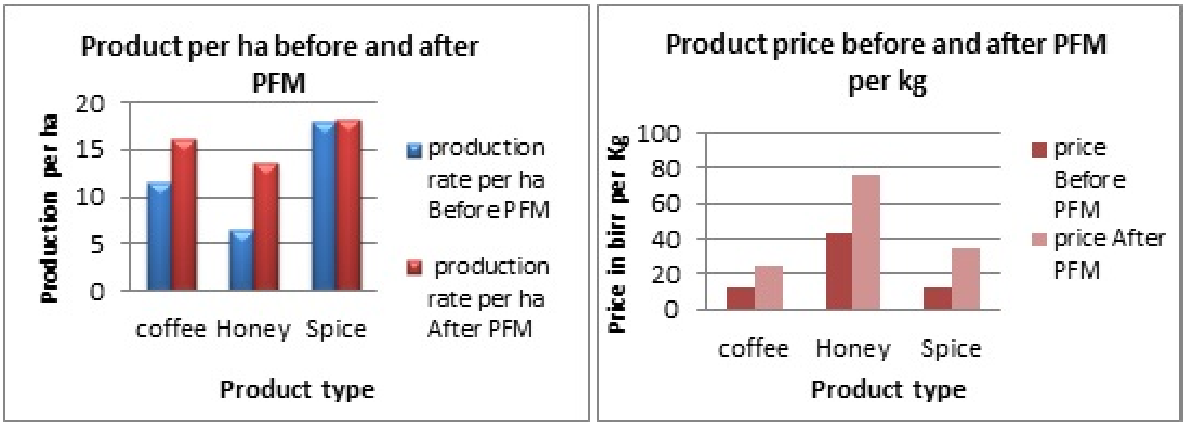

Fig. 4 Production and marketing price changes before and after PFM.

3.4 PFM vs. Trend of forest conditions

Tree inventory, stem density, and species composition were assessed in three forest zones of Sheko district to detect trends of forest conditions. In the unmanaged natural forest (UNF) the diameter at breast height (DBH) class of the tree species was evenly distributed as no management interventions undertaken (Figure 5a). In the semi-forest coffee-based agroforestry (SFCBAf), shrubs and emerging tree seedlings are annually removed with exception for coffee where coffee saplings were planted as enrichment planting. Field measurement result showed that the SFCBAf is dominated by higher-level diameter class trees with little or almost no seedlings and sapling because farmers open up the canopy by thinning shade trees and clear the understorey vegetation to increase coffee yield. In SFCBAf zone, the overall individual tree distribution in DBH classes displayed J-shape (Figure 5b) and showed the limited number of saplings and seedlings with a higher number of big trees. In contrast to SFCBAf, the individual DBH classes in open zone agroforestry (OZAf) displayed an inverted J-shaped which were dominated by seedling and saplings and with a little number of big trees (Figure 5c) as forest clearance and agricultural land expansion was high before PFM introduction.

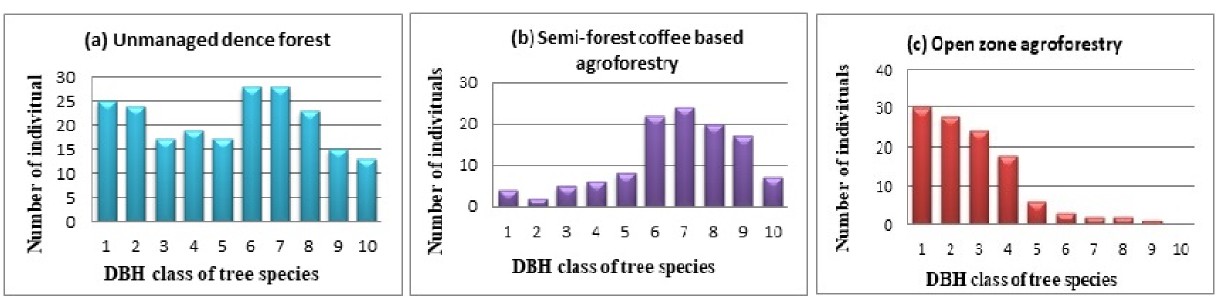

Fig. 5 Diameter classes of the individual trees in three forest zones: where 1- seedlings, 2- saplings, 3= 10-20cm, 4-=21-30cm, 5= 31-40cm. 6= 41-50cm, 7=51-60cm, 8= 61-70cm, 9= 71-80cm and 10= above 81cm.

Species distribution of the forest zones is heterogeneous, with most species observed only in few plots and with low average densities. Most species abundant in the forest were *Albizia gummifera*, *Cordia africana*, *Croton macrostachyus*, *Ehretia cymosa*, *Graville robusta*, *Leucaenea leucocenhala*, and *Militia ferruginea*. These species constituted 76% of the abundance. A total of 55 woody species in

34 families were recorded in the three forest zones (Appendix), of which 45 were found in the UNF zone while 41 were found in SFCBAf zone and 21 species found in OZAf. From the total woody species recorded, tree density was 1765, 902, and 378 individuals' ha^{-1} in UMF, SFCBAf, and OZAf, respectively. A comparison between the three land use systems showed that the UNF zone had higher stem density as their relative ecological stability enhance growing ability. Economically responsive trees like Eucalyptus species and G. Robusta were common in OZAf, while indigenous tree species like *F. vasta*, *C. macrostachyus*, *M. ferruginea*, and *C. africana* are more common in SFCBAf and UNF as community prefers them for coffee shed and soil fertility improvement.

The mean values of Shannon diversity indices are very high in UNF and SFCBAf as compared to OZAf. Diversity indices of SFCBAf are close to those of UNF. A one way ANOVA and Turkey's test showed significant differences in the diversity indices between the OZAf and UNF (p=004). A similar significant difference was found between the SFCBAf and UNF (p=0.027). A comparison between the different locations (plots) established that UNF accounts for higher tree diversity in comparison to any of the two other sites 2.89 and 1.9 in SFCBAf and OZAf, respectively. From the researchers' field observation, the variations of the three land use systems were judged to be from human and animal frequent interference in OZAf and SFCBAf land use systems.

4 Discussion

4.1 The Role of PFM in Sustaining the Rural Livelihood of the Community

From the findings of this study, it is evident that the majority of the respondents embraced the role of PFM on the sustaining of rural livelihood and forest conservation. The study results indicated that approximately 96.5% of respondents participated in PFM. A similar study conducted in Kenya reported that 95.2% of the respondents supported involvement in forest management and conservation program (Musyoki *et al*., 2016). Responsibility sharing is also well-practiced and both men and women had equal rights in decision making and equitably shared responsibilities of managing the forest and forest-based products in the study area. This result is in line with the findings of Gobeze *et al*. (2009).

Wild coffee, spice, honey, fuelwood, timber, construction materials, and medicinal values were identified as the major types of community preferred forest products extracted from Sheko forests and played an important role in income generation and other household needs. Studies conducted in Kenya (Matiku *et al*., 2011), northwestern Ethiopia (Gashu and Aminu, 2019), and Bonga forest (Gobeze *et al*., 2009) reached similar findings. In Sheko district, forest coffee is the most important and high-value commercial forest product reported by the sampled households followed by spice with coffee production, fuelwood, and timber harvesting, integrating honey with coffee production and construction material, as Jose (2002) conclusion also indicated the high dependence of rural households on forest products.

In the Sheko district, recently, there has been an increasing interest in forests as a source of local rural employment and income, particularly through non-farm activities. After PFM has been introduced with schemes of the management agreement, specific restrictions and rights of forest utilization were imposed. As a result, the extractions of destructive (woody) forest products like timber, charcoaling, and construction materials was controlled with some ease for income generation and home consumption. Our result revealed that, in the year 2017/18, the maximum total annual income of households was 140,800 ETB with mean and minimum income 58983.45 and 1760 ETB, respectively. About 89.6% of sampled households were involved in the sale of forest products and 10.94% from crop production and off-farm activities.

A study in the Bale Mountains of Ethiopia showed that forest products are important sources of income contributing to 34% and 53% of household per capita income and per capita cash income, respectively (Yemiru, 2011). Non-timber forest products including butterfly pupae sold at the Kipepeo market place, additional honey from the forest or modern beehives placed in the forest, and fruits collected for domestic consumption accounts 39 USD for each household per year (Matiku *et al*, 2013).

4.2 The role of PFM on forest improvement

From the three forest zones of the study area, a total of 55 woody species representing 34 families were recorded. The higher tree species diversity and the highest Shannon index of 3.25 were recorded in UNF than OZAf. A study reported from south-eastern Rift Valley escarpment (Gedeo agroforestry) of Ethiopia, revealed a total of 58 woody species, belonging to 49 genera and 30 families (Negash, 2013). The highest overall tree density of 1765 individuals ha-1 was recorded in Shako UNF, which is 902 and 378 individuals ha^{-1} in SFCBAf and OZAf, respectively. This is in concurrent with findings of Gobeze et al. (2009) whereby a total of 52 woody species, representing 30 families, were recorded in the forest blocks under PFM and non-PFM with a tree density of 1756 individuals' ha^{-1}.

The higher species diversity and abundance exists in UNF than SFCBAf and OZAf which suggests better protection of the forest conditions in UNF than other forest zones. This is reflected by the observed variation in the abundance of seedling and sapling population among the three forest zones. For instance, in the SFCBAf the individual distribution in diameter classes displayed J-shape which shows a limited number of saplings and seedlings with a higher number of big trees. While in UNF the forest condition is apparently in uniform condition due to no management interventions. In contrast to SFCBAf, the diameter classes in OZAf displayed an inverted J-shape which was dominated by seedling and saplings trees with a little number of big trees. These findings are in conformity with several similar studies (Ameha, 2013; Farm Africa, 2015; Gobeze *et al*, 2009). For instance, Plano (2014) reported a better forest structure that shows a healthy tree population distribution across diameter classes in PFM than non-PFM forest. In Adaba-Dodolla, Ethiopia, total stem density (a measure of forest growth) of four selected species were higher in forests under PFM (Ameha *et al*., 2014) as compared to forests not adopted PFM. The study from Bonga area also showed a healthy vegetation structure with higher seedling, sapling, and mature trees in PFM than in adjacent non-PFM forests (Gobeze *et al*, 2009). According to Gobeze *et al*. (2009), PFM improved forest conditions such as seedling and sapling densities and capacitate the local community to form new institutional arrangement that increased their participation in forest management. A comprehensive review of previous studies on PFM in Ethiopia also confirmed the positive contribution of PFM on forest conditions and livelihood (Siraji, 2018).

5 Conclusion

In general, the results of the study reconfirmed the potential of PFM for improving forest conditions and sustaining the livelihood of rural peoples. The introduction of PFM to the area achieved the dual purposes of improving forest conditions and of positively affecting the livelihoods of participant local communities. PFM in Ethiopia has shown good signs of successfully reducing an 'open access' mentality to natural forest and has demonstrated the benefits of increasing the value of forests for local people through increased local control and user rights, as opposed to trying to delink people and forests (O'Hara, 2013). With regard to the forest condition seedling and sapling, populations were observed in UNF and OZAf compared to SFCBAf within PFM. PFM also increased income sources diversify for the rural community in order to reduce the influence on the forest. Hence, improvements in income sources from forest products continue to play an important role in household livelihoods and in poverty alleviation in the study areas where other income opportunities are limited.

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Conflict of interest

The author declare that no conflict of interest.

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Appendix

List of species encountered in three land use under PFM

Species scientific name	Local name	Family name	Local use*
Albizia gummifera	Sessa	Fabaceae	FU, CO,SH
Annona senegalensis	Giishta	Annonaceae	FU, TI,CO
Antiaris toxicaria	Tengi	Moraceae	FI, FO, ME, FR
Baphia abyssinica	Shiffo	Fabaceae	FU, CU
Bersama abyssinica	Booqqoo	Francoaceae	FU, CU, SH
Blighia unijugata	Banga	Sapindaceae	FU, HO , SH
Cajanus cajan	Yergibater	Fabaceae	FD , FU
Carica papaya	Papaya	Caricaceae	FO FD WB, MU
Cinnamomum verum	Kerefa	Lauraceae	FU, TI, SH
Clausena anisata	Limich	Rutaceae	FU, CO, SH
Clematis semensis	Azohareg	Ranunculaceae	FU, CO, TI
Cordia Africana	Wanza	Boraginaceae	FU, CO
Croton macrostachyus	Bisana	Euphorbiaceae	FU,CO
Cupressus lusitanica	Yeferenjitid	Cupressaceae	FE
Diospyros abyssinica	Kuri	Ebenaceae	FU,CO, SH
Dracaena fragrans	Wago	Asparagaceae	SH
Ehretia cymosa	Sertte	Boraginaceae	FU,CO
Erythrina abyssinica	Korch	Fabaceae	FE
Eucalipttus glublus	Bahirzaf	Myrtaceae	FU,CO SH
Euphorbia abyssinica	Kulkual	Euphorbiaceae	FU, CO, SH
Ficus sur	Warka	Moraceae	FU,CO SH
Ficus vasta	Shola	Moraceae	FU,CO SH
Garcinia buchananii	Chachu	Clusiaceae	FU,CO SH, HO
Gravilea robusta	Gravilea	Proteaceae	FU,CO SH
Hallea rubrostipulata	Mety	Rubiaceae	FU
Hippocratea africana	Harge	Celastraceae	FO,FU
Lecaniodiscus fraxinifolius	Sember	Sapindaceae	FU,CO SH
Leucaenea leucocenhala	Lusniea	Fabaceae	FU,CO SH
Macaranga capensis	Balantine	Euphorbiaceae	FU,CO SH
Maesa lanceolata	Kelewa	Primulaceae	SHAND ME
Mangifera indica	Mango	Anacardiaceae	FU,CO SH
Manilkara butugi	Butigi	Sapotaceae	FU,CO SH
Millettia ferruginea	Birbira	Fabaceae	FO and FU
Mimusops kummel	Gojbaro	Sapotaceae	FU, CO

Moringa oleifera	Shiferaw	Moringaceae	FU,CO SH
Ocimum lamiilifolium	Demakesse	Lamiaceae	FU,CO SH
Olea capensis	Kerewayu	Oleaceae	FU,CO SH
Olea welwitschii	Baha	Oleaceae	FU,CO SH,TI
Persea Americana	Avocado	Lauraceae	FU,CO SH,TI
Phoenix reclinata	Zembaba	Arecaceae	SH
Phytolacca dodecandra	Endod	Phytolaccaceae	FU,CO SH
Polyscias fulva	Gomu	Araliaceae	FU,CO SH
Pouteria adolfi-friderici	Kerero	Sapotaceae	FU,CO SH
Prunus africanus	Tikurinchet	Rosaceae	FU,CO SH
Ricinus communis	Gulo	Euphorbiaceae	FU,CO SH
Sapium ellipticum	Bosoka	Euphorbiaceae	SH and HO
Schefflera abyssinica	Getema	Araliaceae	FU, CO, SH
Sesbania sesban	Sesbania	Fabaceae	FO and FU
Spathodea campanulata	Chaka admik	Bignoniaceae	FU,CO SH
Trichilia dregeana	Luiya	Meliaceae	FO and FU
Trilepisium madagascariense	Gebo	Moraceae	FU,CO SH
Vepris dainellii	Tossa/megeto	Rutaceae	FU, CO, SH
Vernonia amygadlina	Girawa	Asteraceae	FU,CO SH, HO

* CO – Construction, SH – Shade, FE – Fence, FO – Food, FU – Fuel wood, TI – Timber, ME – Medicine, FR – Fodder, HO – Honey, WB – Wind break, MU- Mulch