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Community based participatory forest resources management practices in Chilimo forest, Dendi District, West Shewa Zone, Oromia Regional State, Ethiopia

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This research has made an endeavor to analyze the practices of community based participatory forest management and its impacts on the incomes of the forest user groups and the forest cover of Chilimo forest, Dendi District, Ethiopia. 380 households were selected from seven peasant association proportionally and simple random sampling was adopted to choose the sample households from each peasant association. Both descriptive and inferential statistics were used to analyze and interprete the data. The income of forest user groups and the Chilimo forest cover were enhanced as a result of community based participatory forest management. Forest revenue and the introduction of some agricultural activities are attributed to the income improvement of the forest user groups. The statistical test result showed that there is a significant income difference (U=10078.5, P=0.00) between forest user group and non-forest groups. The magnitude of land use in general and forest cover change in particular was drastically changed between 1990 and 2010 at Chilimo forest. A significant forest cover change variation (P=0.00) within 1900-2010 has been observed. Plantation of seedlings and protection of existing trees are the major factor for the regeneration of the forest cover. A better outcome of participatory forest management can be achieved if the government supports the forest user groups to ensure its sustainability and expand the forest user group income generating activities into the whole cooperatives.

Key words: Community based participatory forest management, income, forest user groups, Chilimo, forest cover change.

INTRODUCTION

International agencies and organizations have jointly consented to cooperate in the reduction of Greenhouse Gas Emissions (GGE) from different anthropogenic activities. Hence, various climate friendly initiatives, treaties and conventions have been ratified in the last couple of decades. The Kyoto Protocol was the breakthrough in this regard. It was signed with an ambition to reduce the GHG of industrialized nations by 5%. It was assumed that the developed nation should contribute to 20% reduction in the overall emission of the

GHG. The most recent one in light of the higher ambition to limit temperature rise by 1.5 ^{0}C and net zero emissions by 2050 was signed at Paris in 2015 (FAO, 2015). The report also highlighted that the forest sector is among the top priority which offers some of the most effective methods for achieving this.

The Ethiopian Government is carrying out different policy measures and programs in order to lessen deforestation and reduce greenhouse gas emissions from deforestation and forest degradation. The forestry sector has been identified as one of the fast-track implementation pillars for achieving high CO_2 sequestration. According to May et al. (2011), the government is fully committed to the Reduction Emissions from Deforestation and Forest Degradation (REDD+) program as an integral part of the national Climate Resilient Green Economy (CRGE) strategy. Another important milestone by the government is its endorsement of the country's first forest policy and proclamation in 2007, with a set of incentives encouraging private sector and community participation in forestry activities (UN-REDD, 2011). Participatory Forest Management (PFM), an approach that promotes the local people engagement has recently become the very remarkable technique of forest management. PFM gives the communities sense of local ownership and right to manage forests in a sustainable manner. This study was conducted in an area where the local people are carrying out participatory forest management practice through forming Forest User Groups.

In the past, the study area (Chilimo Forest) was under state control and the forest was exposed to a wide range of forest degradation by local residents despite its recognition as one of the National Forest Priority Areas (NFPA). In 1996, Farm Africa, an international NGO introduced the concept of participatory forest management as first pilot project in Chilimo forest (Michelle, 2016). Local communities in Chilimo were structured into forest users groups (FUGs) cooperatives by government and NGOs and signed an agreement with the District Agricultural and Rural Development Office (DARDO) to manage the forest. The FUG, together with representatives of the forestry department of the district office and representatives of the NGO have elected 22 members from 12 FUGs that serve as the executive committee, control committee, development committee, saving and credit committee and forest protection committee (Mohammed and Inoue, 2012). Once again, during the commencement of PFM practice Farm Africa has given the local people an economic incentive to sustainably manage and protect forests by helping them set up forest-friendly businesses such as sustainable timber production.

Despite the work on attitudes of PFM users (Gobeze et al., 2009), socio economic impacts of PFM (Yemiru et al*.,* 2010); PFM impacts on forest cover (Lawry et al., 2015); practice of CBFM in Ethiopia (Winberg, 2010; Wondimagegn and Kaba, 2013) that were conducted in Ethiopia and works on the challenge of PFM (Kassa et al., 2009; Deressa, 2014) comparative study on successful and failed PFM (Mohammed and Inoue, 2012); devolved forest governance that was particularly conducted on Chilimo forest, to my knowledge there have been no studies in Ethiopia in general and in Dendi District in particular that was conducted to explore the incomes difference between FUG and non-FUGs. Through examining the participatory forest management practice in the Chilimo PFM project, this study aimed to fill the gaps in the literature of income difference between forest user group and non- forest user groups as well as to contribute to the already existing literature on participatory forest management in Ethiopia and the study area in particular.

Study objectives

1. To analyze the pattern of participatory forest resource management practice in Chilimo forest area
2. To analyze the impact of participatory forest resource management activities on the incomes of the community in the Chilimo forest area
3. To examine the impact of participatory forest resource management practice on the forest cover changes of Chilimo forest area.

LITERATURE REVIEW

Participatory forest management

The terms such as community forestry, social forestry, joint forest management, and village forestry are used in different countries to indicate participatory forest management. However, Participatory Forest Management is used more often to comprise the other terms. According to FAO (2015) participatory forestry management is a processes and mechanisms which enable people with a direct involvement in forest resources as part of decision-making in all aspects

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offorest management, including policy formulation process. Drigo et al. (2013) mentioned the following different terms that can used interchangeable with participatory forest management. For instance, Community Forests (Nepal, Mexico, Thailand, Gambia, Uganda, Namibia, Cameroon, Guinea, Nigeria, Senegal, Ethiopia, Chad, South Africa, Sudan, Togo, Burkina Faso), Village Forest (Malawi, Mali, Benin), Social Forestry (Philippines, India), Village Forest (Malawi, Mali), and Joint Forest Management (India).

All these terms, however have the same objective of managing forest through the participation of the local people. According to Gilmour et al. (2004), the common principle of community based forest management (CBFM) is to involve local stakeholders in developing a process for the management of forests. Community Based Forest Management (CBFM) can be defined as collective forest management involving several families or communities for commercial purposes.

Global overview of community based participatory forest management

Community based participatory forest management practice in Ethiopia is a recent phenomenon as compared to other nations. For instance in Nepal, the beginning of official forestry has been recorded back to the 1950s (Gilmour et al., 2004). Philippines has also officially adopted community based forest management in 1995 as its strategy for sustainable forest management to improve the upland communities' socioeconomic condition, decentralize and devolve forest and forestland management (Gregorio et al., 2015). Similarly, in Latin America, Brazil has a good experience as a number of CBFM projects have emerged in the 1990s in the country (Drigo et al., 2013). In Africa, Tanzania has been managing over 500 village forest reserves and 1,000 clan owned forests since 1996 (Gilmour et al., 2004). Further, Benin, Cameroon, Burkina Faso, Zimbabwe, Congo have been practicing Community Based Forest Management since the last two decades.

Studies undertaken by different authors (Pokharel et al., 2007; Gobeze et al., 2009; Yemiru et al., 2010) on community-based forest management in Ethiopia indicated that the system has been established in some parts of Ethiopia. These studies witnessed that participatory forest management has brought a significant change in the social assets of the local communities as well as in the management of the forest. However, Pokharel and Nurse (2004) stated that in the Philippines community forestry has reduced PFM non-user groups access to resources, with consequent negative impacts on their livelihoods.

Significance of community based forest management practice

It is obvious that community based forest management practice is becoming a means to improve the livelihood of the community through increasing their income. A study in Nepal showed that the average FUG fund size of about 8,000 in 1996 has increased to 13,000 Nepalese rupees due to CBFM activities during the project lifetime (Pokharel and Nurse, 2004). Another study conducted by Gilmour et al. (2004) in Terai districts of Nepal showed that the local income from community based forest management practice amounted to almost 747 million Rupees. This is mainly due to implementation of different income generating activities under PFM. For instance, according to Gobeze et al. (2009) the annual income generated per household from wild coffee and honey was ETB 179 and ETB 127, respectively before the introduction of participatory forest management. These levels rose to ETB 582 and ETB394 respectively after the implementation of participatory forest management. It is evident that CBFM is important in shifting the communities' livelihood from dependence on forest products to diversified livelihood. The study conducted in Chilimo forest has also shown that the introduction of PFM increased agricultural income of FUGs (Kassa et al., 2009). Further, improved income and livelihood diversification have given the locals the commitment and sense of ownership to manage their forest sustainably. A study in Dendi, Ethiopia stated that the driving factor for better forest protection and forest regeneration in the area was the enhancement of the financial assets of the project members (Getacher et al., 2012).

In addition to this, participatory forest management implementation reportedly enhance the forest cover due to the limitations on forest resource extraction and the community desire for timber harvesting and charcoal production was reported to have ceased completely or decreased greatly (Winberg, 2011). Kassa et al. (2009) also observed that prior to participatory forest management, the Chilimo forest in Ethiopia was protected by the government and people have been exploiting the forest resources through illegal cutting and pit sawing. But, after the PFM implementation in Chilimo forest, the natural forest has recovered. Similarly, in Adaba-Dodolla, total stem density (a measure of forest growth) of four selectedspecies had higher density under participatory management as compared with forests that had not adopted this type of management (Lemenih et al., 2015).The study from Bonga also shows a healthy vegetation structure, with higher seedling, sapling and mature trees in PFM forests than in adjacent non-PFM forests (Gobeze et al., 2009).Once again another study conducted in Nepal showed that canopy cover of community forests increased from 11 to 23% in the

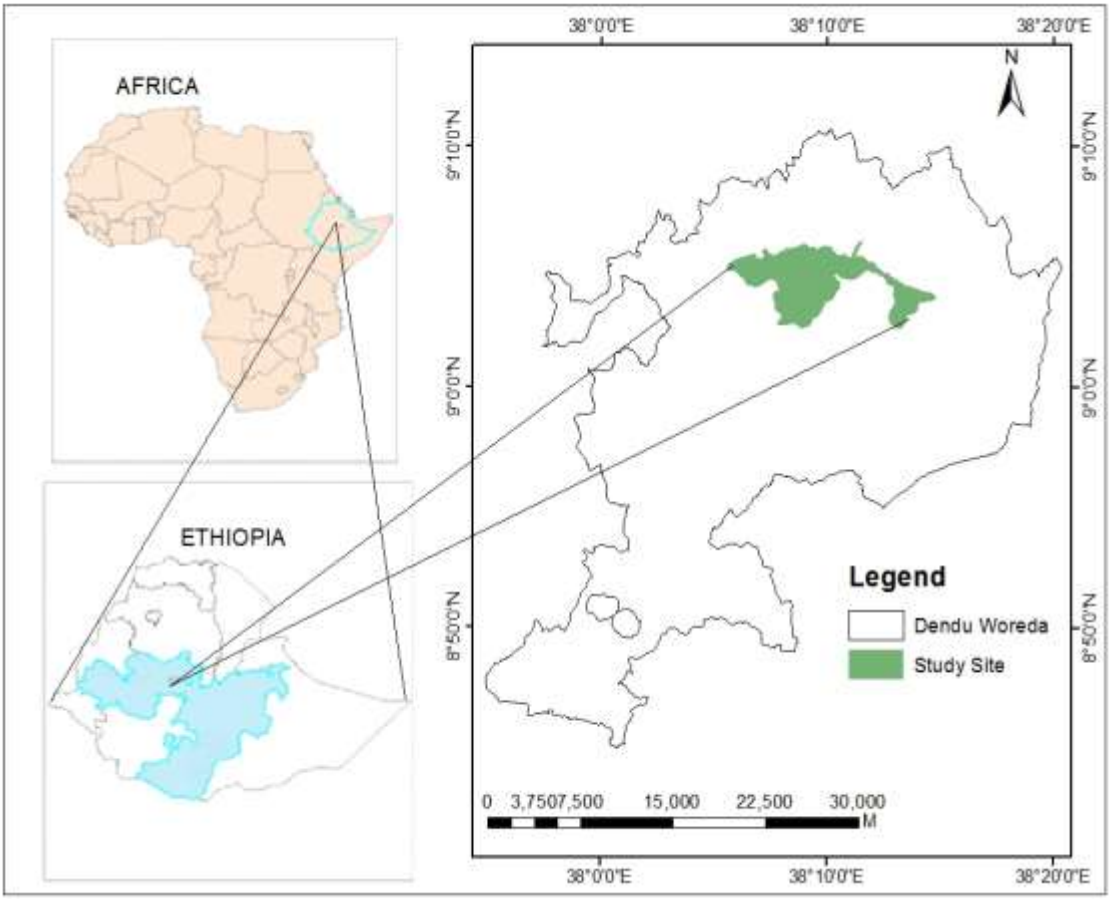

Figure 1. Map of the study area Country map of Ethiopia, showing geographic location of study area. Source: Authors data obtained from satellite image.

Dhaulagiri hills due to the forest user group activity between 1996 and 2001 (Pokharel and Nurse, 2004).

MATERIALS AND METHODS

Description of the study area

The study was conducted in Dendi District of the Oromiya Regional State. Dendi District is one of the eighteen districts of West Showa Zone, as shown in Figure 1.

The district capital, Ghinchi is located at seventy-five kilometers West of Addis Ababa on the Addis Ababa-Naqamte road. The district has a total area of 109,729 m^2 with an altitudinal range from 2000-3200 m.a.s.l (Mohammed and Inoue, 2012). The population of the district is 209,554. It has 48 rural peasant associations and 7 urban and semi-urban peasant association, out of which 5 towns like Ginchi, Olankomi, Asgori and Bodda Asgori have municipal status (Deressa, 2014). The district is endowed with natural flora and fauna species which can attract tourists and researchers. Among these tourist destination sites, Chilimo Forest is one of the 58 National Forest Priority Areas of Ethiopia. Chilimo forest, the center of which is located at coordinates of 9° 5′ north latitude and 38° 10′ east longitude, is one of the very few remaining dry afromontane forests found in Ethiopia. The main species in the canopy layers are Junipers procera, *Podocarpus falcatus, Prunus africana, Olea europaea subspecies cuspidata, Hagenia abyssinica, Apodytes dimidiata, Ficusspp, Erythrina brucei, and Croton macrosytachus* (Deressa, 2014). According to the locals, Chilimo was named by the then Emperor Minilik. “Chilimo” means dark in the local language, describing the once dense natural forest.

Data source and data collection

Both primary and secondary data sources were used for the accomplishment of this study. Primary data were collected from questionnaire, key informant interview, and observation. The questionnaire was validated and tested in the field before using it. The source of secondary data included published and unpublished materials, that is, books, journals, project reports, and maps. Further, online sources such as United States Geological Survey database (USGS) site were also used in order to get the imagery data of the study area and related information about forest cover

Table 1. Sample population of the study.

Peasant Associations (PAs)	Total number of the household	% from total household	Share of PAs from 380 household
GareArera	1150	15.5	59
Galessa	1028	13.8	53
DanoEjersa Gibe	1134	15.3	58
Tanko	936	12.6	48
YubdoLagaBatu	830	11.2	42
Galessa Kota Geshar	1122	15.1	58
QabaBareda	1200	16.2	62
Total population	7400	100	380

Source: Authorcomputed based on Dendi District Administration Office.

change. In order to collect data, the researcher used questionnaire, key informant interview, and observation methods.

Sample and sampling procedure

A multi-stage sampling procedure that involves, purposive and simple random sampling was used in this study. The first stage of sample choice was the selection of the peasant associations purposively. Then, 380 households were chosen proportionally from each peasant association. Again, simple random sampling was used to choose an equal number of households from two groups i.e. forest user groups and non-forest user groups.

There are seven peasant associations which surround the Chilimo Forest area. According to Dendi District Administration Office, a total household of 7400 live inside and around the seven peasant associations, out of which, 1439 households are participating in the 12 FUG cooperatives of participatory forest management project. Whereas, there are 5961 households who are living in the seven peasant associations who are not participating in forest management project scheme. All the 12 forest user groups are located in the seven peasant association. Hence, these peasant associations were selected purposively.

The sample selection method employed the following simplified formula provided by Yamane (1967) to determine the required sample size at 95% confidence level and with 5% level of error.

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

Where; ‘n’ = is sample size, ‘N’= is the population size (total households) and ‘e’= margin error.

Using the above formula a total 380 households were selected from the two separate independent groups. The households from each peasant association were selected proportionally according to the total sample size of the household (Table 1). Again an equal number of forest user and non-forest user group were selected from each peasant association using simple random techniques. The reason for selecting two separate groups was to make a comparison and analyze to what extent the PFM has created an income difference between the two groups.

Research design

The study aimed at exploring the patterns of participatory forest management practice, the impact of participatory forest management practice on the incomes of the FUGs, and the impact of PFM on the forest cover in Chilimo forest area. In order to accomplish this, both categories of qualitative and quantitative research approaches were used. The data were analyzed and interpreted in the form of frequency, percentage, tables and charts while qualitative approach was used in describing and portraying accurately participatory forest management practice in the study area.

Methods of data analysis

Data collected through structured interview schedule were coded and processed using SPSS Version 20 software. In order to analyze the data, both qualitative and quantitative data analysis techniques were employed.

The descriptive statistics such as frequencies, percentages, cross tabulation, measures of central tendency, standard deviation, standard error of mean, minimum and maximum were employed in presenting and summarizing the quantitative data. On the other hand, the qualitative data were analyzed based on describing and portraying accurately the participatory forest management practice, incomes of the community, and the forest cover changes in the study area. The qualitative data include the key informant’s data that were collected from Farm Africa, Forest User Group Committee, and the District Agricultural office.

The strength and direction of the relationship between the different selected independent variables and the dependent variable (income) were examined using correlation and multiple regression analyses. Correlation between independent variables and between dependent and independent variables were used in order to measure the strength of the relationship between variables. Correlations were also used to check the collinearity problem among variables. Once again, multiple regression was used to analyze the relationships between the independent variables (family size, age, education, marital status) with the dependent variable (income). The aim of regression analysis was to see whether these variables have an impact on the income level of the households. Among the independent variables participation in PFM and education level were again categorized using dummy variables to allow the regression look at directionality by comparing two sides, rather than expecting each unit to correspond with some kind of increase. A dummy variable is a variable that assumes only a finite number of values (such as 0 or 1) for the purpose of identifying the different categories of a qualitative variable (Eyisi, 2016). Hence,

each categorized variables (non-participant and participant under participation and no education, primary education, and secondary education under education status) were again coded as 0 and 1 numerical value. While, the other variables were used as continuous variables.

Mann-Whitney U test was used to investigate the income difference between the forest user groups and non-forest user groups. This test was chosen because of the non-normality distribution nature of the data. Further, according to Eyisi (2016) the data meet the following assumptions; the data available for analysis have been independently and randomly drawn from their respective populations, the measurement scale is at least ordinal, and the variable of interest (income) is continuous.

Moreover, Erdas Imagine Software and Arc GIS 10.3 were employed to analyze the spatial forest cover changes of the study area. Erdas Imagine is an image processing software package that allows users to process geospatial and other imagery as well as vector data. All the three images (1990, 2000 and 2011) data downloaded from Land Sat Enhanced Thematic Mapper Plus (ETM +) were analyzed using Erdas Imagine software and ARC GIS software. Also, one-way analysis of variance (ANOVA) was used to test the significant variation of the forest cover and the significant variation between three land uses.

RESULTS AND DISCUSSION

Patterns of participatory forest management practice

Organization and selection of forest user groups

Decentralized forest resource management in Ethiopia was initiated in the 1990s with the collaboration of international non-governmental organizations to mitigate natural resource degradation and to support the livelihood of the local people (Mohammed and Inoue, 2012). Chilimo and Bonga PFM sites were the first participatory forest management pilot project (Stephanie, 2016).

The district agricultural office experts reported that there are twelve FUG cooperatives under Chilimo forest that are taking part in participatory forest management practice. However, the PFM was first established through forming the forest user groups and later the forest user groups restructured in to forest user group cooperatives.

The Dendi agriculture experts also added that in Chilimo each FUG cooperative has their own elected executive committees which comprised the head of FUG, vice head, secretary, and cashier. These committees are responsible for a particular activity in the management of the forest. For instance, the head of FUG is responsible to receive appeals from non-members when unforeseen events such as fire happen in their residential areas. Apart from the executive committee, each cooperative has forest management committee comprising the head, vice head, and secretary. The main task of this committee is to organize and coordinate members in the management of the Chilimo forest.

Unlike other PFM sites of Ethiopia such as Adaba-Dodola where criteria such as forest carrying capacity are used to choose FUG members, the condition used to be members of the Chilimo forest user groups cooperatives depends on the following criteria. These criteria include the interest of an individual, the distance between the forest and the residential area of the households, awareness about PFM, availability during the establishment of PFM in the area, independence from family members, age limit, and membership fee.

Deressa (2014) noted that membership fee in Chilimo PFM was not the requirement to join FUG. It became a criterion after the FUGs were merged into FUG cooperatives. Although the fee is marginal, in some FUGs a certain period is given for poor members of the community to pay their membership fee.

Among all the FUG selection criteria used in Chilimo PFM, the distance between the forest and residents house is the main factor that determines one's membership application for a particular FUGs cooperatives. The household survey also examined the non-forest user group reasons for their exclusion from FUGs membership and the result revealed that 35% of the non-FUG members were excluded from membership due to their residence out of the forest periphery (Table 2). The FUG committees also stated that if a member is residing very far or out of the periphery, it would be difficult to keep the forest and easily take part in the participatory forest management activities. Due to these, they do not choose members who are living very far from the forest area. Lack of interest by the households is the second major factor for the exclusion of non-FUGs from membership. However, some of the non-FUGs admitted that they feel sad for missing the opportunity and they would consider the options to join the cooperative in the future.

Role of forest user groups in the forest

The forest user groups in the Chilimo forest often carry out one of the following activities simultaneously on weekly bases. These activities include nursery plantation, protection of existing trees, protection of regenerating trees, and protection of harvestable trees. The household survey shows that 87% of the FUGs carry out protection of regenerating trees, whereas 86% take part in the protection of the harvestable tree. Other activities, that is, nursery plantation and protection of existing trees are practiced by 22.1 and 62.6% of the respondents respectively. These activities are determined by variables such as education level, age, and land size of the forest user group. The statistical test result showed that education level has significant (x^2=18.4, p = 0.001) effect on the plantation activities of the forest user groups. Hence, members who are educated (members who have

Table 2. Non-FUG reasons for the exclusion from FUG membership.

Reasons for exclusion	N	%
Lack of interest	53	27.9
Residing very far from the forest	66	34.7
Lack of awareness	16	8.4
Financial problem to pay a membership fee	12	6.3
Dependence on parents	13	6.8
Unavailability in the PFM area	10	5.3
Age	2	1.1
Refusal by the committee	18	9.5
Total	190	100.0

Source: Household survey data (2017).

Table 3. The Effect of Education on the PFM activities.

PFM activities		Education Level			χ2 /P-value
		No education	Primary education	Secondary education	
Carry out plantation in the FUG	Yes	49	54	16	18.4/ 0.000
	No	12	51	8	
Total				190	
Protection of existing tree in the FUG	Yes	55	64	14	8.85/ 0.012
	No	11	36	10	
Total				190	
Protection of regenerating tree in the FUG	Yes	62	85	20	3.52/ 0.172
	No	4	15	4	
Total				190	

Source: Household survey data (2017).

completed primary and secondary education) plant more seedling than un-educated (non-members who have no education). Once again, the result indicated that education level has significant (x^2=8.85, p = 0.012) effect on the protection of existing trees (Table 3). This implies that the educated (household who have completed primary and secondary education) members have more awareness about the importance of forest conservation. Therefore, they were able to take part in guarding and patrolling of the forest as compared to un-educated members.

The landholding capacity of forest user group is highly associated with the participatory forest management practices. The statistical test indicated that land size of the households has asignificant effect on the seedling plantation(x^2=10.53, p=0.005) and protection of existing trees (x^2=8.76, p=0.02). Unlike the case of Chhetri (2005) where the participation of the respondents in forest management activities tended to be enhanced with the decrease in the land ownership of an individual, in Chilimo the forest user groups who own large hectares of land were enormously participating in the PFM activities. The forest user groups with large land size belong to the weathier member. Hence, they did not devote their time to other income generating activities, rather they invest their time in the PFM activities (Table 4).

The FUG cooperative members can decide how many seedlings to be planted per member. However, Leaders have significant involvement in all three decisions of when, where and what to plant, but final decisions are made by the majority of the forest user groups (Mohammed and Inoue, 2013).

These activities contributed highly to the increment of Chilimo forest cover. The reduction of forest extraction

Table 4. The effect of land size on the PFM activities.

PFM activities		Land size (hectares)			χ2 /P-value
		<1.5	1.6-3	>3	
Carry out plantation in the FUG	Yes	37	57	25	10.53/0.005
	No	39	22	10	
Total				190	
Protection of existing tree in the FUG	Yes	45	58	30	8.76/0.02
	No	31	21	5	
Total				190	
Protection of regenerating tree in the FUG	Yes	63	72	32	2.97/0.23
	No	13	7	3	
Total				190	

Source: Household survey data (2017).

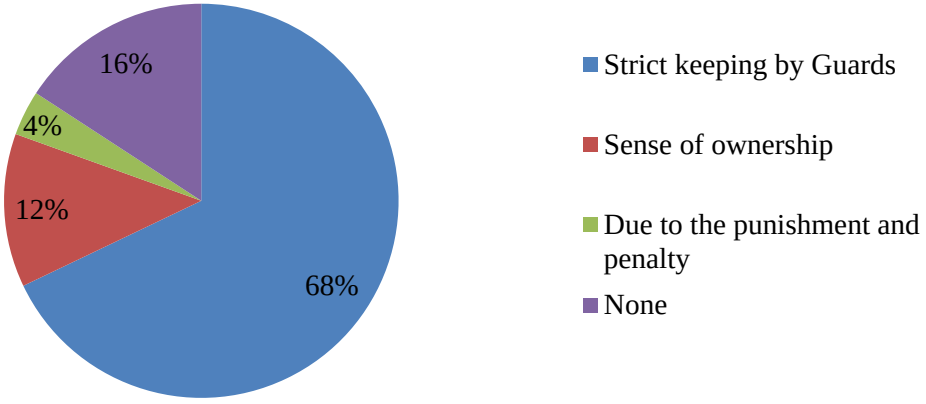

Figure 2. Forest user group reasons for reduction of cutting tree in the forest.
Source: Household survey data, 2017.

and cutting off trees by FUGs is also another factor for regeneration of Chilimo forest cover. These are confirmed by the household survey as 84% of the FUG replied that they have reduced cutting trees after the introduction of PFM in the forest. The strict keeping by guards is the major reason of FUGs for reduction of cutting the tree.

The forest user groups keep the forest as guards in accordance with their schedule in the forest management plan and agreement. The Chilimo FUG chairman reported that the executive committees have delineated the Chilimo forest into three blocks and in each block, the committee deploys four members per day to keep the forest (Figure 2). Each member will be assigned to keep the forest once in a week. It is the responsibility of each member to take part in guarding and patrolling. However, female-headed households only guard nearby planted area against animal trampling (Mohammed and Inoue, 2013). Similarly, a study in Nepal stated that despite their involvement in PFM decision-making activities, women rarely take part in patrolling and guarding activities (Agarwal, 2001). Though in most Nepal and India PFM sites patrolling and guarding are typically the responsibility of male participants.

Impact of participatory forest management on the incomes of the community

Income of forest user groups before PFM and after PFM

All the key informants agreed that participatory forest management practice has improved the incomes of forest user groups. The household survey result shows that the

average annual income of FUG's has increased from 3828 ETB to 8952 ETB after the introduction of PFM practice. The introduction of participatory forest management in Bonga, Ethiopia has also increased annual incomes of the household by 8.446% (Gobeze et al., 2009). Also, in Nepal, the average FUG fund size of about 8,000 in 1996 has risen to 13,000 Nepalese Rupee in 2000 (Pokharel and Nurse, 2004).

According to the forest user group committees, seedling sale for different government and non-governmental organization have contributed to the increment in the incomes of forest user group. The committees also noted that sale of logs and seeds have helped the Chilimo of forest user groups to generate and improve their incomes. Pokharel and Nurse (2004) also indicated that in Nepal the forest user group fund was generated from the sale of forest products.

Further, the forest revenue from the sale of timber also contributed to the increment in the incomes of the FUGs. In order to sell the timber products, forest expert team comprising the concerned organization should first conduct a forest assessment and decide on the timber products to be sold in each cooperative. Consequently, the cooperative in collaboration with the district agriculture office announces a tender in Ethiopian Adiss Zemen Magazine. Also, as in the case of Mohammed and Inoue (2013) the plantation timber may be sold through bidding system to local wealthy merchants from the capital city Addis Ababa.

Accordingly, 70% the revenue from the sale will be distributed to the cooperative while 30% will be handed over to the government. Again, the FUG share of revenue will be distributed for different activities. Hence, 45% will be circulated for forest user group members equally, 20% for forest development activities, 30% will be deposited into the cooperatives account for contingency, and the remaining 5% will be invested for development activities such as irrigation, and other infrastructure development.

Similarly, the incomes generated from the sale of timber in other PFM sites were invested in different activities. For instance, about 36% of the income from community forests in Terai, Nepal was spent by the forest user groups on community development activities such as the building of schools, roads and drinking water facilities (Gilmour et al., 2004). However, in order to take the appropriate share of the 45% dividend, the FUGs must follow the rule and regulation stated under the forest management plan. This includes participating in meetings regularly and keeping the forest according to their schedule. A member who is taking part in all of these PFM activities will not get an equal share from the dividend.

The district agriculture office reported that the 70% of dividend which the cooperative gets from the sale of forest products such as trees have also contributed to the improvement in the incomes. The FUGs revenue from timber plantation has shown a drastic increase over time. For instance, before 2007 Chilimo and Mesalemiya FUG cooperatives were able to earn only 392,500 ETB but, both forest user group cooperatives were able to earn 5,086,391 ETB on approximately four occasions after 2007 (Mohammed and Inoue, 2013). Moreover, the introduction of some agricultural activities such as honey production, home garden crop production raised the incomes of FUG as confirmed by our transect walk. However, such agricultural activities are limited to some FUG cooperatives.

Similarly, in other PFM sites of Ethiopia, the incomes of FUGs from agricultural and other non-wood activities have improved following the introduction of PFM. For instance, in Bonga PFM site the annual income generated per household from wild coffee and honey has increased from 179 ETB and 127 ETB to 582 ETB and 394 ETB, respectively after the establishment of PFM (Gobeze et al., 2009). Likewise, a case study in Bale eco-region, Ethiopia discovered that following the implementation of PFM project, the Birbirsa FUG cooperatives total revenue from forest coffee has increased from 153,000 ETB to 1, 200, 000 ETB within two years. Gobeze et al. (2009) stated that the increase in the income of Chilimo FUGs comes partly from increased social and marketing services provided to members by the cooperative, and partly through the extension service and support of Farm Africa for vegetable farming.

Income difference between FUG and non-FUG

The community source of income varies among forest user groups and non-forest user groups. Apart from access to forest products such as dead tree and leaf, the forest user groups have more diversified means of income such as crop production, livestock production, coffee production, honey production, and timber production. Whereas, the non-forest user groups have limited means of livelihood to generate income. Their livelihood is dependent on crop and livestock production. Before the implementation of participatory forest management, they were exploiting the forest for their daily basic needs. However, currently their access to the forest resource is limited due to the strict procedure and regulation.

The household survey result showed that there is an income difference among the incomes of forest user group and non-forest user groups. The Mann-Whitney U statistical test result also indicated that there is significant income difference (U=10078.5, P=.001) between forest user groups and non-forest groups (Tables 5 and 6).

The U test showed that the mean rank of FUG and Non-FUG is 148.5 and 233 Ethiopian Birr respectively.

Table 5. Statistical test shows the income difference between FUG and Non-FUG.

Parameter	Value
Mann-Whitney U	10078.500
Wilcoxon W	28223.500
Z	-7.453
Asymp. Sig. (2-tailed)	0.000

Source: Household survey data (2017).

Table 6. Mean of income ranks for non-forest user group and forest user groups.

Group	N	Mean Rank	Sum of ranks
Non-FUG	190	148.54	28223.50
FUG	190	232.46	44166.50
Total		380	

Source: Household survey data (2017).

This indicated that forest user groups earn a higher income than non-forest user groups.

As it was discussed earlier PFM activities which were carried out by the members have contributed to the income difference between two groups. The non- forest user group cooperatives are not allowed to use forest products since the establishment of PFM in Chilimo forest. While the FUGs generate an income from the sale of other forest products in addition to 70% of the revenue that cooperatives get from the sale of the forest. According to Kassa et al. (2009) particularly those people who are considered very poor are allowed to collect the wood twice a week and they can sell fuelwood. However, they have to pay a monthly fixed fee to the cooperative. It is the responsibility of the cooperative executive committees to decide who is allowed to engage in minor income-generating activities such as sale of fuelwood in the district and the nearby town (Mohammed and Inoue, 2013). They are also responsible to make final decisions regarding who should receive logs and other wood products for subsistence uses (Kassa et al., 2009).

The forest resources benefited the FUGs to use forest wood for cooking/heating and construction purposes, and fodder/pastures for livestock (Getacher et al., 2012). This again has reduced the extra cost that the members would spend to fulfill the above-mentioned subsistence costs. Additionally, the FUG forest management by-law clearly states that when the FUGs house and fence are burned the committee provides a tree for house construction for the members based on different criteria (Deressa, 2014). However, the non-FUGs obviously spend money during such unforeseen events.

Factors affecting the income of forest user and non-forest user groups

There is a significant relationship (r=0.24, p=0.00) between participation in the PFM and the land size of the household. Further, age is significantly related to primary education level (r=-0.226, p=0.00) and family size of the households (r=0.265, p=0.00). The annual income of the household is positively related with land size (r=0.93, p=0.00), participation in PFM (r=0.26, p=0.00), secondary education (r=0.15, p=0.04), and family size of the household (0.26, p= p=0.00). In contrast, there is a negative correlation (r= -0.1, p=0.04) between primary education and annual income of the households. Generally, it can be concluded that there is no problem of collinearity among the variables.

The multiple regressions result indicated that among household-specific characteristics included only the size of land holding and participation of the community in participatory forest management activities are statistically significant in influencing the income of the community. As a result, a one-hectare increase in the land size of a household increased the annual income of a household by more than 7762 ETB, and households who participated in PFM activities earn more 599 ETB annual incomes than non-forest user groups. Further, the regression result showed that households who have completed primary education earn less 393 ETB annual income than households who have no education; while households who completed secondary education earn more 579 ETB annual income than households who have no education. Similarly, a household with one higher level of age, and

Table 7. Regression Result Shows Factors Affecting the Incomes of the Households.

Parameter	B	Sig.	Collinearity Statistics	
			Tolerance	VIF
Constant	-7778.87	0		
Primary Education	-393.556	0.212	0.819	1.221
Secondary Education	579.09	0.307	0.82	1.22
Participation in PFM	599.258	0.045*	0.912	1.096
Land size	7762.003	0.000*	0.874	1.144
Age of the respondent	4.653	0.719	0.737	1.356
Family sizes of the respondent	28.593	0.695	0.749	1.336
R^2	0.865			
Adjusted R^2	0.863			

*Denotes the significance of their corresponding coefficient estimates at 5%.
Source: Household survey data (2017).

family size earn more annual incomes of 5 and 28 ETB respectively than their respective lower variables. The factor affecting income is shown in Table 7.

Chilimo forest cover change

The status of Chilimo forest between 1990 and 2000

According to the Dendi district agriculture experts between 1970 to early 1980's the socialist government (DERG Regime) has replaced the vast agricultural lands that were owned by the feudal members and nobility with huge State-owned plantations for political and economic purposes. The then regime has established a very centralized and strong forestry institution which was capable of demarcating and administering all the forested land. The local peoples stated that intensive forest development activities had been conducted including various plantations activities. The chairman of Chilimo FUG also added that the Chilimo forest cover at the end of 1970's was estimated to be 12,000 ha.

However, administration of forest resource management activities by the central government and ignorance of the local community in the management of Chilimo forest has created a gap between government and the local residents. Hence, the residents were logging and exploiting the forest for different basic needs. It is understood from the discussion with district agriculture that the regime's decision to place armed guards around the forest boundaries to prevent communities logging has failed to prevent clearance of the forest for logging, firewood, and agriculture. Consequently, prior to PFM introduction, the locals were misusing the forest resources through illegal cutting and pit sawing and firewood sales were rampant (Kassa et al., 2009).

Further, following the transition of power from the socialist Derg to Ethiopian People's Revolutionary Democratic Front (EPRDF) in 1991, the government priority has shifted from forest development to agricultural intensification. Hence, the huge state-owned forest was converted into agricultural land for crop and livestock production. As a result, the forest has been degraded through time and the forest cover was registered to be 3292 hectares in 1990. The Satellite image also showed that the agriculture land in Chilimo has been expanded from 510.9 ha in 1990 to 1526.9 ha in 2000. In comparison to the previous regime, EPDRF has ensured the participation of local communities, NGOs and other community-based organization in the management of the forest. One such peculiar example was the introduction of community-based forest practice in Ethiopia. This has marked the beginning of PFM practice in Chilimo forest in 1996. However, according to Farm Africa Experts, the local communities did not understand the benefits of joint forest management at early stages of PFM practice. Further, lack of awareness by members has made it difficult to introduce the PFM practice easily. During early stages of the PFM in Chilimo forest, the management and conservation of forest were assumed the sole responsibility of forest guards and residents around the forest. Hence, the communities were exploiting the Chilimo forest for their daily use Similarly, Gobeze et al. (2009) stated that in Bonga, Ethiopia the burden of protecting the forest against outsider were handled by few community members. In addition to these, Mr, Abera, head of Chilimo Forest has indicated that mass forest degradation in the worebeo site has accounted for the reduction of the Chilimo forest cover. The forest cover details are shown in Table 8, Figures 3 and 4.

The forest cover of Chilimo forest between 2000-2010

The forest cover of Chilimo has started regeneration after

Table 8. The Area Coverage of Chilimoby Year (1990-2010).

Types of land use	Area in hectares (ha)		
	1990	2000	2010
Forest	3291.754815	2527.420274	2907.072896
Cultivated Land	510.916464	1526.900722	636.167028
Grass Land	851.96384	600.431631	1110.93271

Source: Data obtained from satellite image.

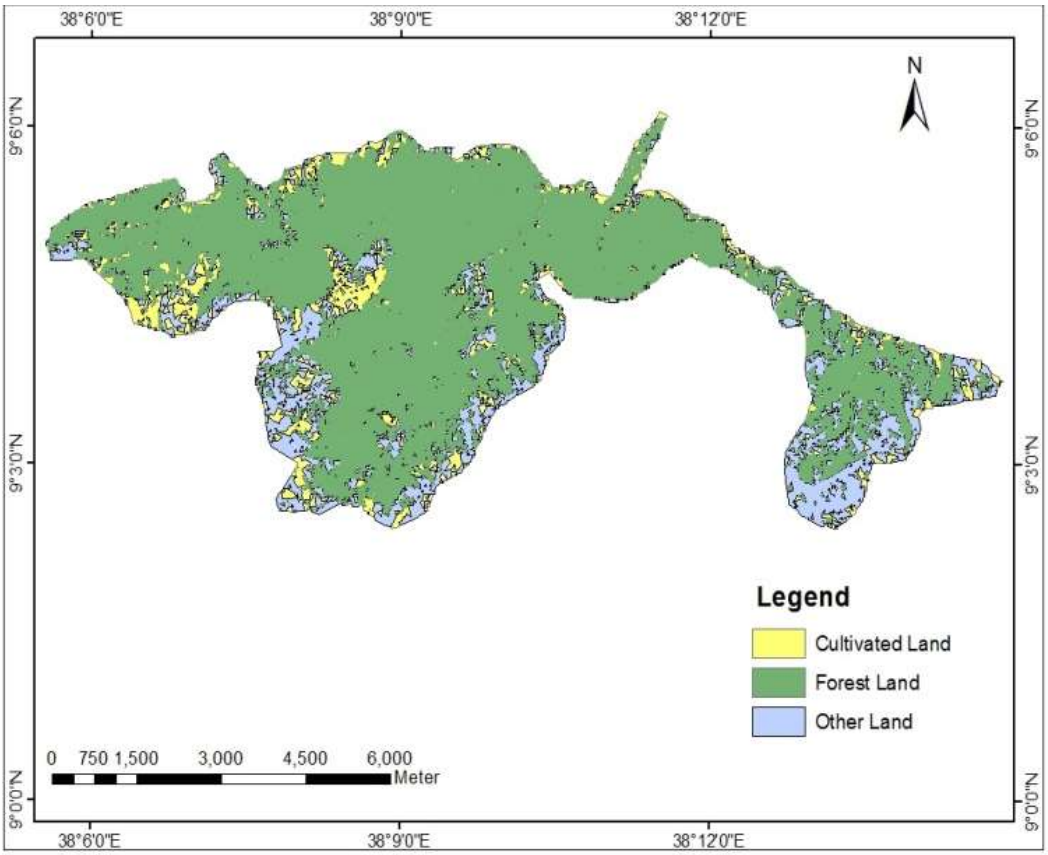

Figure 3. Chilimo Forest Map of 1990.
Source: Computed by author from data obtained from satellite image.

2000 where the FUG has a fully developed sense of ownership and start practicing the PFM very well as a result of improved awareness by the members. The district development agents explained that the increasing change in the forest cover is a result of PFM activities which were carried out by the FUGs. A study in Nepal also revealed that following plantation, protection of denuded hills, and other forest management activities the PFM forest cover showed improvement (Pokharel and Nurse, 2004). Further, A Case Study from Bayombong, Philippines indicated that because of strict forest protection policies, there was a relative increase in area of closed canopy, natural forest, open canopy forest and plantations 2010 compared to 1989 (Hashiguchi et al., 2016).

Farm Africa supported the FUGs by providing training to plant a variety of trees and enabling them to produce more seedlings from their community-managed nursery. These include fast-growing eucalyptus alongside slower-growing and higher-value grevillearobusta, pine and

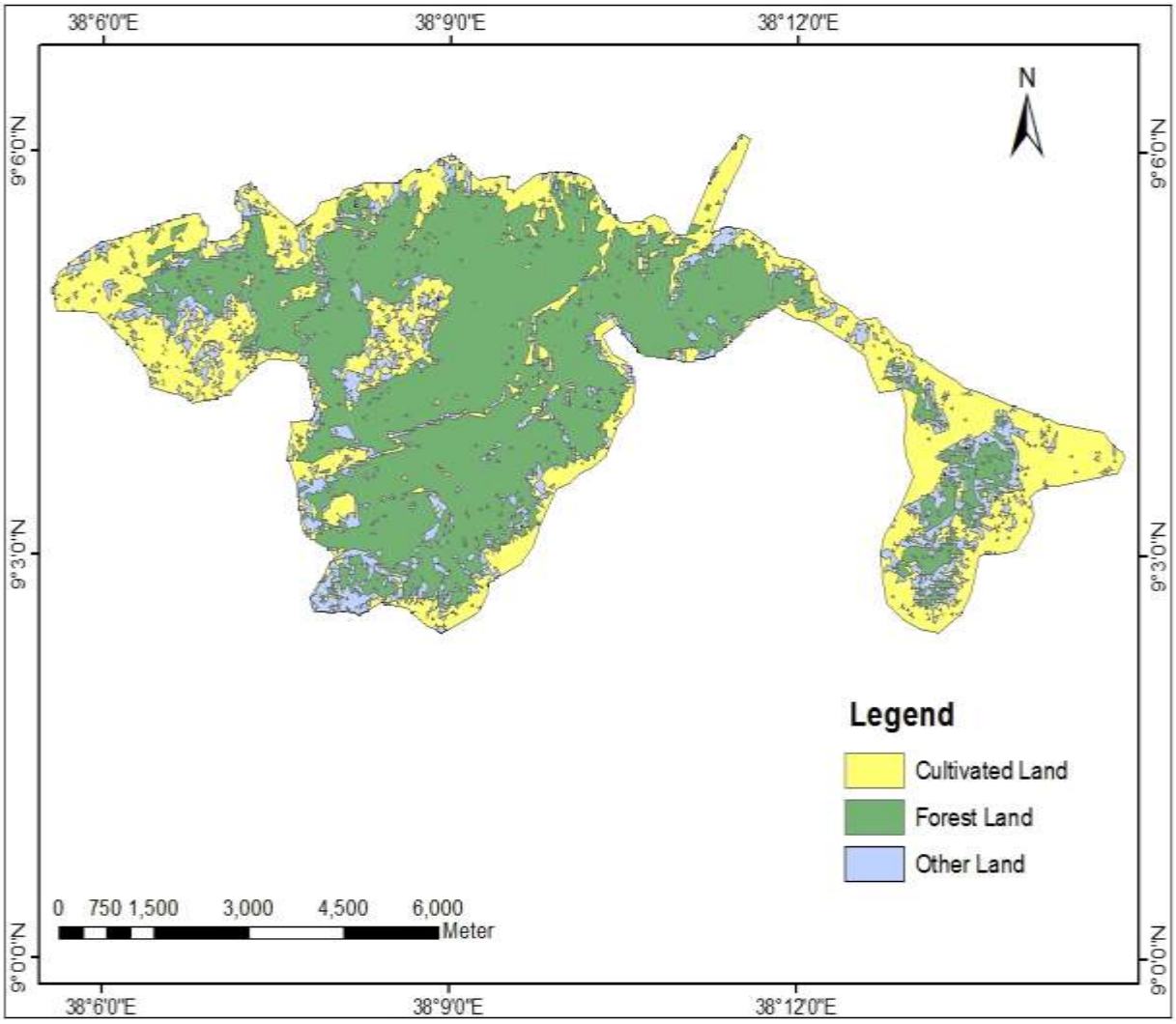

Figure 4. Chilimo Forest Map of 2000.
Source: Computed by author from data obtained from satellite image.

cypress. For instance, in Mesalemiya and Chilimo FUG cooperatives a total of 21,000 seedlings (covering an area of approximately 6.6 ha) and 53,000 seedlings (approximately 21.2 ha) were planted respectively (Mohammed and Inoue, 2013). The species were selected by the local community on the basis of either species-site matching or based on local knowledge. The common species planted were *Grevillearobusta, Cupressuslusitanica*, and *Eucalyptus globules*. In addition to these, some of the forest types were regenerating themselves. Further, the key informant's interview with the Dendi District expert revealed that strict keeping by guards also contributes highly to the improvement of the Chilimo forest cover. Hence, logging and deforestation of the forest have gradually reduced (Figure 5).

The forest cover of Chilimo forest between 1990-2010

Overall, the forest cover of Chilimo has gradually reduced within two decades. The forest cover which used to be 3291.7 hectares in 1990 is found to be 2907 hectare by the end of 2010. This is the result of mass destruction in the early 1990s during the regime changes. Unlike the 1980s where forest management was centralized and highly managed by the government, in the 1990s the concept of state- community joint forest management gives the local forest user open access to the forest. Hence, a tremendous amount of forest has been degraded in the 1990s. The introduction of PFM in the mid-1990s has resulted in improvement in the forest cover. However, it needs time to bounce the forest cover

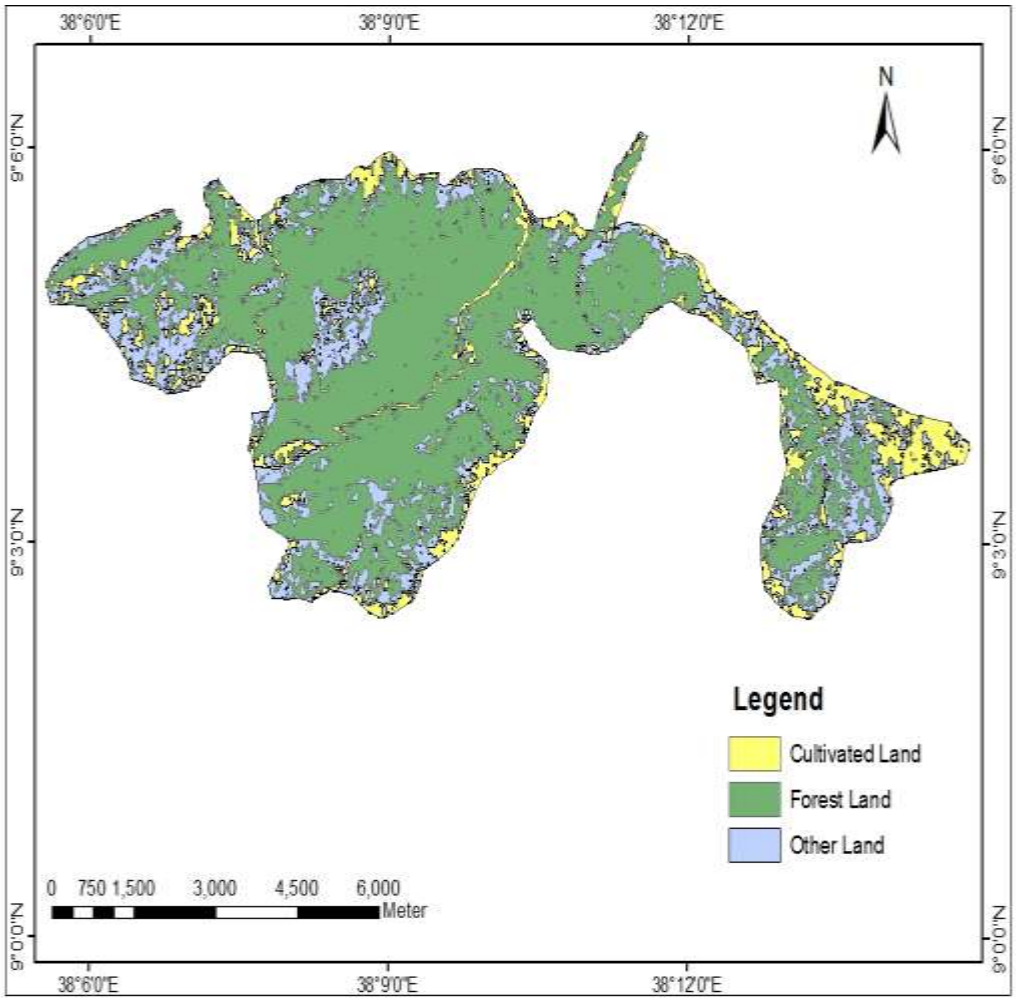

Figure 5. Chilimo Forest Map of 2010.
Source: Computed by author from data obtained from satellite image.

to its prior status.

Conclusion

Participatory forest management practice in Chilimo forest was initiated / undertaken in 1996 by an international NGO called Farm Africa. Twelve FUG cooperatives took part in participatory forest management practice activities and each FUG cooperative has their own democratically elected executive committees. In addition to this, each cooperative has its own forest management plan and signed an agreement with the district agriculture office on the management and use of the forest. The FUG members regularly carry out activities such as nursery plantation, protection of existing trees, protection of regenerating trees, and protection of harvestable trees.

The average income of forest user groups has increased from 3828 ETB to 8952 ETB following the implementation participatory forest management practice in Chilimo forest. Introduction of some agricultural activities such as honey production, home garden crop production and income generation from the sale of timber mainly contributed to the increase in the income of forest user groups. Further, the finding showed that there is an income difference between the incomes of forest user group and non-forest user groups. The Mann-Whitney statistical test result showed that there is significant income difference (p=0.00) between forest user groups and non-forest groups. The income from the sale of timber and the implementation of PFM activities are attributed to the income difference among two groups.

Additionally, the FUG cooperatives can use forest products such as timber for house construction, logs for fences, wood for coffins, and poles for house construction which again reduced their additional expenditure for these subsistence needs.

The magnitude of land use in general and forest cover change, in particular, was drastically changed between 1990 and 2010 at Chilimo forest. The ANOVA result also revealed that there is significant variation (p=0.00) in the forest cover within 1990-2010. Particularly, the decline of forest cover and expansion of both cultivated land and grassland were observed. The areal extent of Chilimo forest cover has been fluctuating from time to time. The empirical findings indicated that about 3291.75 ha of forest in 1990 declined to 2527.42 ha in 2000. But, this figure was increased to 2907.07 ha in the year 2010. The forest cover regeneration is the result of participatory forest management establishment in 1996. Among others, plantation of seedlings, and protection of existing trees are the major factors of the regeneration of the forest cover.

Recommendations

(1) Further research to be undertaken for introducing more interventions which can generate more income to forest user groups
(2) In order to fully prevent illegal logging, the district government officials should act timely and take necessary actions that can be a lesson for other community members.
(3) Measures should be undertaken by local government to expand PFM activities into more cooperatives
(4) Capacity building of participating forest user groups in order to manage the forest sustainably and improve local ecosystem

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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