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REGULAR ARTICLE
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EVALUATING MEMBERSHIP DURATION IN THE PARTICIPATORY FOREST MANAGEMENT ON LIVELIHOOD IN ETHIOPIA: A GENERALIZED PROPENSITY SCORE APPROACH

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ABSTRACT

Research background: Participatory Forest Management program (PFMP) is initiated to manage forest resources and promote household participation to enhance their livelihood. In contrast, the long-term evaluation of many programs' timing remains low attention. Thus, it is vital to measure livelihood impacts on membership duration associated with the PFM program in Ethiopian farm households
Purpose of the article: To evaluate the impact of membership duration in participatory forest management on livelihoods of program participating households in south-western Ethiopia. The results of the program's periodic assessment data were analysed on the long-term effect of the activities of forest management members.
Methods: The study applied the generalized propensity score method. The research depends on cross-sectional survey data collected in mid-2018 from 267 farm households from Sheka and Kafa zones of south-western Ethiopia. The procedure matched families with similar covariates with different years of membership duration in the participatory forest management program. The technique was used members' annual per capita expenditure as an indicator outcome variable for measuring rural livelihood.
Findings, value-added & novelty: Impacts studies of PFMP on heterogeneous effects across different groups of membership duration are scarce, and there is a research gap on how membership duration affects outcomes. Our study addresses this gap by measuring the long-term evaluation of program outcomes and their impacts on the participatory member households. Furthermore, the result revealed that the program's effects were initially low but positively affected when approaching an optimum year of membership dose. The program's optimal duration of the membership dose was 11-12 years, and 4263.75 birrs were the optimal level of yearly household per capita consumption spending.
Recommendation: The results recommend more work on the participating household members by encouraging new forest-related income sources and integrating the socio-economic network more closely with the forest's ecosystem services. Although the relationship among participating members of households' longevity and income is substantial, the program has been focused on the medium and longer duration of the forest program participating.

Keywords: membership duration; participatory forest management; generalized propensity score; dose-response function; consumption expenditure
JEL Codes: Q23; D02; C01; C13; C56

INTRODUCTION

Participatory Forest Management (PFM) was brought to Ethiopia in the mid-Nineties, like in many other African countries, with the help of worldwide NGOs and bilateral businesses **(Temesgen *et al.*, 2007)**. The development of the PFM program in Ethiopia has unexpectedly extended and transferred the control responsibilities of more than 1,000,000 hectares of forests, almost one-third of the dense forests, to organized local groups. In Southern Nations, Nationalities, and People's Regional State (SNNPRS) of Ethiopia, the introduction and implementation of the PFM program started with government resources following the inception of the Energy Access Biomass Supply Management Project in 2003, with a budget obtained from the World Bank on a loan basis, government treasury funds, and contribution by the local people in the form of labour. The project started operating in nine *woredas* of the region, which have relatively more intact natural forests. These include Arora woreda in Sidama zone (eastern part of the region) and Bita, Gesha and Gate woredas in Kaffa zone, Masha and Andrache woredas in the Sheka Zone, and Sheko, Shewa Bench, and Bench (currently North Bench) woredas in Benchmaji zone **(Kelbessa & Destoop, 2007).**

PFMP is commonly used to manage forest resources worldwide to promote cooperation and reduce poverty **(Adam & Eltayeb, 2016**). Similarly, the other study

supported the idea that natural forests have an essential role in the financial improvement of forest communities **(Mislimshoeva *et al*., 2016).** Local people's involvement in forest conservation might range from simple community engagement to a complete transfer of conservation and management authority to the locals **(Okumu *et al*., 2020)).** PFMP is a technique to accomplish practical backwoods by empowering timberland ensured regions and forest assets by the networks living in and around the assistance. PFMP is recommended to develop other food security and reduce poverty in developing countries **(Kelley & Scoones, 2000).** In this way, it may contribute to achieving the three sustainable development Goals (SDGs). As community members, particularly in developing countries including Ethiopia, rely primarily on the immediate utilization of natural resources, including woodlands, achieving the three SDGs will influence the conservation, reasonable use, and management of the forest assets. For instance, **Yemiru *et al.* (2010)** discovered that forests contributed 23.53 percent of the average household income in south-eastern Ethiopia. **Melaku *et al.* (2014)** found that forests contributed 47 percent of yearly household income in south-western Ethiopia depending on income quintile.

The long-term contributions of PFMP were improved by designing forest management development approaches, an understanding of relationships among resource use patterns is critical. Particularly the Sheka and Kaffa forests are essential for the conservation of Afromontane forest, and the area also includes bamboo thickets, wetlands, and the agricultural regions. These forests provide vital products in the local communities, including forest and non-forest products, such as medicinal plants, honey, and wild fruits. The communities are committed to maintaining the longevity of the ecosystem, which includes practicing ecologically sustainable agriculture **(Ishwaran *et al*., 2008).**

PFMP is an instrument to protect forests and enhance the livelihoods of communities who use and benefit from it in the process. FM was meant to avert deforestation's persistent problems and deliver better social and economic outcomes than the former centralized command-and-control resource management approaches **(Ayana *et al*., 2015)**. In other words, the program designed twofold approaches to sustainable forest management. The first is establishing community-level forest management systems and promoting forest-based livelihoods, and the second is introducing and supporting other non-forest-based alternative livelihoods **(Temesgen *et al*., 2007)**. Many investigations have shown that PFMP contributes to improving forest protection (e.g., **Siraj *et al*., 2018; Kadir *et al*., 2018)**, but the welfare impact of household involvement in PFMP is currently unclear and remains inadequately comprehended despite their significance for the long-term economic viability of the concept. In particular, PFMP imposes new prohibitive guidelines and regulations on woodland-related job opportunities, basically through collecting limitations **(Larson & Pulhin, 2012),** which may decrease forest-based earnings (**Schreckenberg & Luttrell, 2009)**. PFMP programs introduced income-generating activities by providing value to forests (for example, tourism activities), continuing to develop alternatives of forest products and revenue (for example, woodlots), or paying for losses **(Gobeze *et al*., 2009).** However, the government assistance ramifications of these additional advantages or pay likewise remain inadequately comprehended.

Therefore, this study focused on local communities of the PFMP contribution in evaluating food security and the average total annual household income, focusing on estimating the effects of PFMP's significant livelihood indicators outcomes in Sheka and Kafa forests. This study evaluated the impact of membership duration in the PFM program in south-western Ethiopia. We tested whether the duration of membership in the PFM program has a significant livelihood impact or not. The longer the exposure of members to the program would yield to raises income (in terms of Annual Per capita expenditure) among rural membership households. Moreover, cumulative effects such as membership duration and accumulation of knowledge require the passage of time; this implies that longer the program exposure would yield more significant gains. To handle these two objectives in measuring the impact or evaluation of the PFM program, we used GPS application in simulating PFMP impacts on random experiment process with consideration PFMP effects on heterogeneous effects in membership individuals.

Previous research studies provide an excellent foundation for the research on the topic, although they have some limitations that require further analysis. First, previous studies focused on the benefits and costs of forests to communities through PFMP management are based on qualitative analysis that considers forest condition and participant income **(Bekele *et al*., 2004; Takahashi & Todo, 2012)**. They did not provide clear pictures regarding the overall impact of PFMP on local livelihoods and other outcomes. Second, many previous studies relied on average differences between PFMP participants and non-participant households without accounting for potentially confounding pre-PFMP differences (e.g., **Gobeze *et al*., 2009**; **Maharjan *et al*., 2009**). Even though some African and Ethiopian studies considered overcoming pre-PFMP differences **(Ameha *et al*., 2014b; Mutheu & Friss, 2016),** they assumed individual-level homogeneity of matched PFMP participants in non-participant households. Non-participated households of PFMPs also live close to the forests, and their livelihoods have a strong relationship with forests. It is impossible to get comparison groups that are not influenced by forests. This circumstance may result in sample selection bias. To overcome this limitation, the researchers assessed the effects of PFMP by estimating the continuous dose-response function that relates to each dose value, i.e., years of membership participation intensities to the individual post-treatment covariate using generalized propensity score matching. Thus, varying duration of membership in the program might lead to heterogeneous responses to the estimation result of program outcome and measures heterogeneity in impact among members in PFMP.

In designing community-based forest management approaches, an understanding of the It is critical to understand the relationships between resource use patterns. Cases in which resource users are discriminated

against are of specific interest. Diverse stakeholders with various interests and forest dependency vary across households **(Adhikari *et al.*, 2004; Wehn *et al.*, 2019; Masozera & Alavalapati, 2005)**. Community-managed forests are particularly susceptible to such information flow gaps because it requires a broad approach beyond the forest ecosystem and includes policymakers and local people. To meet the criteria for the sustainable use of forests and the development of participatory forestry, policymakers, planners, and project designers need to have information within the context of the dynamic interaction between heterogeneity of impacts.

The study at hand also contributed to the areas of study in estimating the impacts of PFMP. However, the research methods and findings will have broader relevance to help other forest conservation areas include community values, involvement, and management perceptions. This study aims to quantify PFM program impacts on outcome indicators of livelihoods, i.e., annual households' per-capita consumption expenditure. The primary research questions to be addressed in this study include: Is there a link between the duration of PFMP membership and the consumption expenditures of rural farm households in the Sheka and Kafa participatory forests? If yes, what is the heterogeneous nature of their relationship? To what extent do families participating in PFMP have improved their livelihoods? What are the optimal levels of Membership duration at which its benefits are maximized?

The article's overall aim was to assess the impact of participatory forest management on household livelihood in rural southwestern Ethiopia's Sheka and Kafa forests. The study's specific objectives are: To measure the Impact of PFMP on the livelihoods of the participating families; To determine the heterogeneous nature of the involvement and estimate optimal levels of Membership duration at which its benefits are capitalized on membership in the Participatory Forest Management in Sheka and Kaffa zones.

LITERATURE REVIEW

Impacts of PFMP on livelihoods

An expansion has been underway in Ethiopia, escaping a variety of forest management arrangements that could benefit from the contributions of families in dense forest areas and the potential benefits of the forests **(Ameha *et al.*, 2014a).** Based on the stages and social foundations of community forest management, various studies have discussed the impact and benefit of different forestry administration (PFM) programs. One of these studies, based on the dependence on natural resources **(Gatiso, 2017),** shows that rural Ethiopia's participatory forest plays an essential role in the livelihoods of society and indicates that the local community is more likely to contribute to the forestry administration. Similarly, **Tesfaye *et al.* (2011)** noted that the local community's forest income is a good source of income that allows low-income families to enhance their living conditions. However, gain from the forest program was limited by market distance, age of the household head, and geographical constraints

Mutheu & Friss (2016) studied the impact evaluation of the livelihood outcomes of PFMP in Kenya. It does so by comparing members and non-members of community forestry associations (CFA) among communities residing near the Eburu and Sururu Forest Reserves. Mainly, they examined the policy of PFMP as it unfolded in practice on the ground and sought to evaluate its impacts through matching of CFA and non-CFA member (NCFA) households based on recall data to generate estimates of effects on household income. Results show that CFA member households had higher total family, forest, beekeeping, and tree seedling incomes than non-CFA households. Overall livelihood impacts were driven more by differential forest-related labour and market opportunities supported by NGOs and donor institutions than by differential access to forest products. However, there were indications that poor NCFA households experienced reduced relative forest incomes following the increased intensity of forest patrolling.

Ameha *et al.* (2014b) studied the impact evaluation of the livelihood outcomes of PFMP in Ethiopia. This study was conducted in two forest provinces in Ethiopia. The paper analyses how PFMP affects members of groups in the forest management program collects income data from 635 members using random sampling. Results from the propensity score matching revealed that when members' gross income in Ethiopia's forest management program is calculated, it is less diverse than non-member resources in the program. Notably, In Dodola, where commercial timber harvesting is permitted, the implementation of PFMP means that FUGs now have more livestock assets and forest income than non-members. However, the average total income and expenditure for members and non-members were not statistically different. According to the Chilimo site, the introduction of PFMP means that FUG members have lower real incomes and assets than non-members. Research findings recommend revising the PFMP scale-up approaches in Ethiopia, which currently allow FUGs only subsistence use from forest resources. It should amend the provision to be reproductive and participants to benefit from the management.

DATA AND METHODS

Study Areas

This study was conducted in Sheka and Kaffa zones of Southern Nations, Nationalities, and People's Regional State (SNNPRS) of Ethiopia, where the PFMP project was implemented. Sheka zone is located in the SNNPRS, southwest part of Ethiopia. Sheka zone covers 2387.54 km^2 [(Sheka zone Finance and Economy Development Department (SZFEDD, 2012). The administrative center of the Sheka zone is located 676km southwest of Addis Abeba. Geographically, the area lies between 7°24' - 7°52' N latitude and 35°13' - 35°35' E longitude and consists of three districts, namely the Masha, Andracha, and Yeki. The zone is bordered to the north by Oromia Regional State, the west by Gambella Regional State, the east by Kaffa Zone, and the south by Bench Maji Zone. In the two

districts of Masha and Yeki(town name, Teppi), there are 45 rural and two urban Kebeles (Kebele- a minor authoritative grouping in Ethiopia).

Kaffa zone is located in SNNPRS, the most ethnically and linguistically diverse region of Ethiopia. Bonga is the administrative town of the location situated 450 km away from Addis Ababa. The zone is mainly covered with evergreen montane forest and is part of the Eastern Afromontane Biodiversity Hotspot. According to the 2007 census, the area's total population is 858,600, with a population density of 90 persons per square kilometer. Its altitude ranges from 500 to 3500 m.a.s.l (above sea level) with the mean annual rainfall and temperature ranging from 1001 - 2200mm and 10.1 - 27.5°C, respectively. The agro-ecological condition of the Kaffa zone is very suitable for growing coffee, tea, spices, and other crops. The study areas in the PFMP project are located in the south-western part of Ethiopia in the SNNPRS and focus on four woredas: Anderacha and Masha woredas in Sheka Administrative zone, Gimbo, and Chena woreda in the Kaffa administrative zone.

Sampling Techniques and Sample size

The study mainly used a structured survey questionnaire to collect cross-sectional data on a face-to-face household interview in November and December 2018. The study applied multi-stage sampling techniques. In the first stage of the sampling procedure, four *Woredas* from two zones were selected based on the PFMP targeted and actively participating Woredas; Masha and Andracha from Sheka zone; and Gimbo and Chena from the Kafa zone. In the second stage, the selection of Kebeles from respective Woredas; gives all Kebeles in the survey an equal probability of being selected as a sample. Three from Masha, two from Andracha, three from Gimbo, and two Kebeles from Chena woreda were selected based on these criteria. Finally, 267 households were randomly selected based on PFMP participated household head lists in the sample *Kebeles*.

Data types and data gathering

A questionnaire was used to collect relevant data. The questionnaire encompassed demographic, socio-economic, institutional services, social capital, networking, and forest management issues. Different questions were posed to informants based on their professions and their responsibilities. This allows us to recognize better the problems raised and triangulate the answers given by respondents - critical informant interviews with government officials and development agents in each sample kebele of Sheka and Kaffa zones. The discussion with experts focused on the different livelihood activities and environmental income of participant households, knowledge on forest management, and their perception of forest conservation.

Analytical Methods

The econometric model, generalized propensity score matching (GPS), is the potential outcome approach that **Hirano & Imbens (2004)** developed and is now widely used in different interventions evaluation literature. Suppose a representative sample of elements from a high proportion, adjusted by $i = 1, \ldots . N$, for each unit i, and there is a set of potential outcomes referred to $\{Y_i(t)\}\, for\, t \epsilon T$ for each unit I under the level of treatment t. A group of possible results $Y_i(t)$ For t known as the causal inference of a single – dose-response function (DRF). PFMP participation with varying length of membership doses (years of PFMP membership in a household) is in the T interval $[t_0, t_1]$, with $t_0 > 0$ **(Hirano & Imbens, 2004).**

The primary goal is to calculate the average dose-response function (ADRF) $\mu(t) = [Y_i(t)]$ denotes the mean livelihood indicators of the outcome across all members of PFMP participation levels. $Y_i(t)$ is a livelihood indicator of annual household per-capita consumption expenditure for a household member of the PFM program.

The observable variables for each univariate vector of covariates, the level of the treatment that unit i receives, and the potential outcome corresponding to the treatment level $Y_i = Y_i(T_i)$. Because of the GPS effect of the process on ADRF and marginal treatment tasks for household members of the PFM program, families who did not participate in the PFMP are not included in the model.

Hirano & Imbens's (2004) critical assumption generalizes the unconfoundedness and Balancing belongings assumptions similar to the binary treatment **Rosenbaum & Rubin (1983)** made to the continuous impact study. It asserts that once observable elements been controlled for, X_i, any residual variation in treatment response T_i Throughout units is independent of possible effects outcomes $Y_i(t)$ (Equation 1).

$$Y_i(t) \perp T_i / X_i \text{forall } t \in T \qquad (1)$$

The random variable treatment T_i is assumed to be conditionally independents of random effect, measured at an arbitrary treatment level t. Therefore, the assumption of weak unconfounded in the average dose-response function is obtained by estimating intermediate outcomes at different levels of treatment. Calling $r(t,x) = f_{T/X}(t/x)$ the conditional density of the continuous treatment given the covariates in $R_i = r(T_i, X_i)$.

GPS has a balancing property test for treatments within strata with the same value of $\mathfrak{r}(\mathfrak{t}_i, \mathcal{X})$ the probability that $(T = t)$ does not depend on the value of $\mathcal{X}$, i.e., the GPS has the property that $X \perp \{T = \mathfrak{t}_i\} / \mathfrak{r}(\mathfrak{t}_i, \mathcal{X})$.

Given this result, applying the GPS to remove bias caused by covariate variations in two steps. The first stage is to calculate the outcome's conditional expectation as a function scalar variable, the treatment level T and the GPS R., as expressed in $\beta(\mathfrak{t}, \mathfrak{r}) = \mathrm{E}[Y/\mathrm{T} = \mathfrak{t}, \mathcal{R} = \mathfrak{r}]$ The second stage is to estimate the DRF averaging the conditional expectation function over the GPS at that specific level of the treatment (Equation 2).

$$\mu(\mathfrak{t}) = \mathrm{E}\left[\beta\left(\mathfrak{t}, \mathfrak{r}(\mathfrak{t}, \mathcal{X})\right)\right] \mathfrak{t} \forall \mathrm{T} \qquad (2)$$

As a result, estimating intermediate outcomes at different levels of treatment yields the assumption of weak unconfoundedness in the average dose-response function. Thus, the parameters of the treatment duration function i.e.β_0 ,β_1 and $\{Y_i(t)\}\, for\, \varepsilon\, T$ (conditional distribution of

membership duration) are estimated using maximum likelihood or ordinary least squares regression according to Equation (3).

$$T_i/\chi_i \sim N[\beta_0 + \beta_1 \chi_i, \delta^2] \quad (3)$$

Before moving on to step two, GPS can be estimated after evaluating the model of the treatment component in Equation (3). GPS can be calculated in Equation (4).

$$\hat{R}_i = \frac{1}{\sqrt{2\pi\delta^2}} \exp\left[-\frac{1}{2\hat{\delta}^2}\left(T_i - \hat{\beta}_0 - \hat{\beta}_0' X_i\right)^2\right] \quad (4)$$

The conditional is determined in the second stage. Expected function of the outcome (Y_i), given modeled as a flexible function (polynomial approximation) of experimental treatment (T_i) and estimated GPS (R_i), for the analytical approach, uses the quadratic approximation followed in Equation (5).

$$E\left(\left[Y_i/T_i, \hat{\mathcal{R}}_i\right]\right) = \alpha_0 + \alpha_1 T_i + \alpha_2 {T_i}^2 + \alpha_3 \hat{\mathcal{R}}_i + \alpha_4 \hat{\mathcal{R}}_i^{\,2} + \alpha_5 T_i \hat{\mathcal{R}}_i \quad (5)$$

As a result, the study's outcome variable is continuous; g was assessed using the ordinary least squares (OLS) regression model. Lastly, the average response function at a given treatment t value was evaluated by taking the mean (estimated) results for each individual of observed treatment (T_i) and estimated GPS, $\hat{R}_i$ is used.

Given the estimated parameters in the second step, we estimate the average dose-response function at a particular value of the treatment t Equation (6).

$$\mu(t) = E\left[\hat{Y}(t)\right] = \frac{1}{N}\sum_{i=1}^{N} g^{-1}\left[\hat{\alpha}_0 + \hat{\alpha}_1 . t + \hat{\alpha}_2 . t^2 + \hat{\alpha}_3 . \hat{r}(t, \chi_i) + \hat{\alpha}_4 . \hat{r}(t, \chi_i)^2 + \hat{\alpha}_5 . t . \hat{r}(t, \chi_i)\right] \quad (6)$$

Accordingly, the GPS evaluation findings are presented graphically, showing dose-response relation and marginal impact capabilities.

Definition of Outcome, Treatment, and Explanatory Variables

Once the analytical procedure of the study and its requirements are known, it is necessary to identify the potential outcome, treatment, and explanatory variables used in the model. Combinations of socio-economic and demographic factors were used to explain households' membership duration in the PFMP and the outcomes in terms of household wellbeing indicators; the result, treatment, and explanatory variables were used in the GPS estimation are defined as follows.

Outcome Variable

Household per capita consumption expenditure (HPCExp): A continuous outcome variable referring to households' yearly consumption expenditure expressed in Birr. Our interest is to investigate membership duration in the PFMP or dose (treatment) in rural households. Empirical studies indicate that consumption expenditure fluctuates less than income in the short run and provides information over the consumption bundle that fits within the household's budget **(Skoufias & Olivieri, 2013, Haddad & Ahmed, 2003).** As a result, we use per capita consumption expenditure as the key outcome variable in measuring a household's livelihood. The robustness of inference was quantified by included three additional outcome variables. These outcome variables are:

- Income from non-timber forest products: (IncmNTFP). This variable refers to annual household income from non-timber forest products measured in Birr.
- Income from livestock production (IncmLivstk). This variable refers to annual household income measured in Birr.
- Income from crop production (IncmCrop): This variable refers to annual household income measured in Birr.

Treatment Variable

Membership Duration (MDurn): Duration of membership to PFMP in years is the treatment variable used in the GPS estimation is a continuous variable. Participants were asked to answer the question: "For how many years did you participate and stayed period on average in the PFMP?" These reactions were averaged and used as the variable of membership duration. The duration was divided into three categories: less than or equal to six years was considered shorter, while longer than six and less than nine years was deemed medium, and longer than or similar to nine years was defined as longer membership duration. We discard observations with treatment duration two and below two years; since such short durations arguably do not imply a severe effect on outcome variables. Durations above 12 years are also discarded since only very few observations are available.

Explanatory Variables

The explanatory variables expected to have an association level with participation in the PFMP are presented in Table 1. Hence, the demographic and socio-economic factors which are selected based on theoretical background and related literature are defined.

RESULTS AND DISCUSSION

Demographic, socio-economic, and institutional characteristics

A summary of the sampled households' demographic, socio-economic, and institutional characteristics was provided in Table 2. Disaggregating whole sample households into three different years of membership duration, the member groups were categorized into three equal portions at the 30th and 70th percentiles, approximately dividing the sample households into three similar groups **(Hirano & Imbens, 2004; Kluve *et al.*, 2007).** Accordingly, Membership duration ≤ 6 years as shorter; 6 < Membership duration < 9 years as medium and ≥ nine as longer membership duration, and it was observed that 34.33 percent, 33.83 percent, and 31.72 percent of the sample households fall into the shorter, medium, and more extended years, respectively.

Table 2 presents summary statistics of the outcome variables and the covariates for the whole sample and the three sub-samples households, i.e., shorter duration, Medium level of duration, and longer duration. We were looking at the entire model. The average age of the

participant households was 42.76 years. The average age in shorter, medium and more extended duration categories is 41.47, 42.51, and 44.32, respectively. Regarding family size, sample households in the shorter, medium, and long years of membership categories had 5.29, 5.85, and 6.25 family sizes, respectively. Furthermore, the F-test result shows that the difference among the three membership categories in family size was statistically significant at the 5% probability level.

Most of the respondents in the group of longer membership duration are old and had many family labourers than more recently joined membership households. Due to higher consumption, larger family sizes had a higher demand for forest products.

Further, livestock holding in TLU for medium and longer treatment duration were the lowest and the highest, respectively. According to the F- test result, the difference is significant at the 5% probability level. The results may further imply that participation as membership in the program gets grass and forage availability for their livestock animals. Furthermore, according to the survey result, the majority of the sample households, on average, had four years of education in study areas.

The result shows that households who are members of the shorter, medium, and long years of duration on average travel to the nearest market in walking times are long distance to the PFMP forest points was observed for a shorter period of membership households. In contrast, the short length was recorded for a longer duration of membership households. Based on walking minutes, the result indicates that early entry membership households are located about 25 minutes closer to PFMP forests. The development might be related to the fact that household membership duration is highly forest-dependent, especially indigenous people near forest areas where forest product availability is critical. Regarding sample households who are groups in shorter, medium, and longer duration of membership categories had, on average, travelled 1.92, 3.3, and 5.15 km to the nearest main road. The difference was statistically significant at a 1% probability level. Other variables have statistically insignificant variances in subgroups of membership households. These results may indicate that some pre-treatment variables have not been associated with participation.

Table 1: Description of explanatory variables

Variable	Variable description	Measurement	Sign
Age	Age of the household head	Years	-
Sex	Sex of household head	Dummy(1=male;0=female)	+
Family size	Number of individuals in the HHS	Number	+
Land size	Landholding size in hectares	Hectare	+
Livestock holding	Livestock owned	TLU	+
Education level	Education level of household head	Years	+
Off/non-farm income	Off and non-farm income	ETB	+/-
Market distance	Distance to the nearest market	Minutes	-
PFMP distance	Distance to the PFMP forest	Minutes	-

Table 2: Demographic characteristics of member households

	Full Sample	Shorter	Medium	Longer	F-test
Continuous variables					
Age	42.76	41.47	42.51	44.32	2.26
Family size	5.80	5.29	5.85	6.28	6.95**
Land size	2.37	2.39	2.64	2.34	2.21
Livestock Asset (TLU)	10.61	10.7	11.4	12.3	7.5**
Education	4.36	3.95	4.37	4.23	1.52
Off/Non-farm	0.23	0.27	0.20	0.22	0.65
Dist._mkt(nearest)	17.2	16.96	21.27	15.4	6.908**
Distance from PFM forest	30.66	36.054	30.09	25.85	7.3***
Outcome Variables					
HPCexp	2895.71	2146.97	2796.68	3743.47	63.18***
IncmNTFP	20615.06	17580.13	20525.87	23739.17	8.31**
IncmCrop	17643.07	16077.99	17607.64	19243.57	8.58**
IncmLivstk	6871.6885	5860.045	6841.955	7913.06	7.31**
No of observations	267	92	90	85	

Table 3: Estimated effects of treatment duration on consumption expenditure

Variables	OLS estimate	Std. Err.	t-value
Treatment duration(G-1)	495.16 ***	79.63	6.22
Treatment duration(G-2)	402.38***	50.68	7.94
Treatment duration(G-3)	384.19***	37.32	10.29
Constant	-219.21	377.73	-0.58
Number of observation	267		

An outcome variable among different categories of the treatment duration (Table 2) shows that the annual household per-capita consumption expenditure is relatively higher in the medium and longer membership duration category level than the shorter membership duration category. The consumption expenditure in the more extended membership duration level is 3743.47 birr.

In line with the primary outcome variables, the study used three additional outcome variables to quantify the robustness, i.e., income from non-timber forest products, crop production, and livestock. The income share from non-timber forest products in the more extended membership duration is 23739.17 birr. In medium duration, about 20525.87 birrs., results reveal that the impacts of PFMP increase with the length of membership duration. It implies that members of longer duration have higher returns on their contribution than members of shorter membership duration households. There could be two explanations for these findings. Firstly, longer membership duration household's practices yield technologies management, which may improve the forest conditions relative to recently entered member's households **(Pokharel, 2012)**. Secondly, longer membership duration households harvest large quantities of harvestable non-timber forest products, and the amount of harvested non-timber forest products is directly linked with the household benefits. In general, the effect of the entry rate concerning continuous years of membership duration in the program was firmly incorporated with additional income obtained from forests. Their involvement may have made them more competitive and generated more benefits from forests.

Effects of Treatment Duration on Consumption Expenditure

Before presenting the GPS model results, we first explore the relationship between annual per-capita consumption expenditure and the duration of treatment (household membership duration) using correlation and regression analysis. The correlation between variables specifies that as one variable changes in value, the other variable tends to change in a specific direction. Understanding that relationship is helpful because we can use the value of one variable to predict the value of the other variable. For this study, household membership duration and consumption expenditure are correlated—as membership duration increases, per-capita consumption expenditure is also likely to increase. Therefore, if we observe an individual who early entered the program and participated for longer years, we can predict that his per capita consumption expenditure is also above the average households who have recently joined the program.

The correlation between membership duration density (dose in treatment duration) and household per capita consumption expenditure seems optimistic with Pearson's correlation of r =0.56. Still, in the square of treatment duration, a cubic form of treatment duration and the fourth power of treatment duration increases with Pearson's correlation coefficient, r = 0.593, r = 0.640, r= 0.695, respectively. Positive coefficients show that when the value of the membership duration increases, the per capita consumption expenditure tends to increase. Again, the positive relationships produce an upward slope on a scatter plot (Figure 1). These results assume a linear relationship between the treatment (membership duration density) and the outcome variable. They do not indicate any causality under the situation of causal inference correlation does not show causation illustration of causal inferences based on observational data we applied GPS model.

Table 3 shows the estimated effects of treatment duration on consumption expenditure investigates the relationship between consumption expenditure levels after entering the program and the treatment duration. There are many situations where there could be non-linear relationships of the explanatory variable on the outcome. We want to examine how much membership duration affects consumption expenditure in our data set. We were estimating the members' level of consumption expenditures (HPCexp), and membership duration (MDurn) has a typical linear, and quadratic effect in farm households are as follows:

The estimated equations resulting from the linear regression line understates the effects of staying for shorter years of membership duration. The trend line slope is lower than the general slope and would overstate the impact of membership duration for higher values of membership duration. The alternative models that could better fit the data are the square of treatment duration and spline function. Square of treatment analysis suggests that longer membership duration leads to more significant consumption expenditure. (Figure 1).

For each value of the membership duration group, the implications of the independent variables on the outcome would be different.; we can apply a spline function. We allow membership duration have a different linear effect at different levels of membership duration categories. Thus, we can estimate the separate marginal impact of "membership duration of $\leq$ 6 years", "between 6 and 9 years," and (9 $\leq$ duration $\leq$ 12 years).

The regression estimates show that there is a positive relationship between per-capita consumption expenditure and membership duration, positive regression results between levels of consumption expenditure and treatment duration are more considerable, and the explanatory power of the treatment is high ($\mathcal{R}^2 = 0.57$), these suggest that the impact of the treatment duration on per-capita consumption expenditure is high or significant. However, regression estimates analysis such as OLS has a higher risk of misspecifiying the model of making comparisons between an only observation, which could bias the estimations. Generalized propensity score approaches can improve these potential problems to some extent.

Estimation of Generalized Propensity score (GPS)

Given the identified covariates, the conditional distributions of membership duration were estimated using Equation (1) and presented in Table 5. Before evaluating GPS, the goodness-of-fit tests for normality were conducted. The treatment variable, the membership duration of participating households in the PFMP after entry into the program, statistics were approximately normally distributed. The Kolmogorov-Smirnov is used to

check the null hypothesis that a data set comes from a normal distribution. The Kolmogorov Smirnov test at information with degree normality is satisfied at the 0.05 level of freedom parameter (Table 4). Based on normality tests, the distributions of membership duration among the sample households were graphically depicted, and the distributions covered in ranges of exposure intensities are distributed normally (Figure 2).

Balance of covariates test

Here, after assessing the balance of covariates test, the GPS property of credit was examined. The balancing tests' results within each year of membership duration (dose) interval were reported in Table 6. The GPS's balancing property was tested by comparing the conditional mean of the pre-treatment factors. The GPS is not diverse between families belonging to a specific treatment of members group and households belonging to all other treatment members' groups **(Rosenbaum & Rubin, 1983).**

The balancing property of GPS was evaluated by cutting the length of membership data at the 30th and 70th percentiles, as the procedure suggested by **Hirano & Imbens (2004).** Accordingly, covariates distributions of the study area were analysed among three groups. For categories group one (members with a length of membership ≤ 6); group two (6< households with the size of membership (dose) < 9) and group three (9 ≤ households with the length of membership (dose) ≤ 12) and families in the first, the second and the third membership groups were 92, 90 and 85, respectively.

The balance for each group variable was examined by testing whether the average in one of the three treatment groups was different from the average in the other two treatment groups combined **(Bekele *et al*., 2018**). In Table 6, the t-test values for each group variable were reported. The balance findings reveal that 10 (13) of 87% of t-statistics are less than 1.96 (1.65) in value. Out of 12 covariates, the t-values of 11(12) covariates were less than 1.96 (1.645) in total value, which shows balances. Therefore, stopping here and estimating the DRF in this analysis, balancing the covariates was done without adjusting GPS.

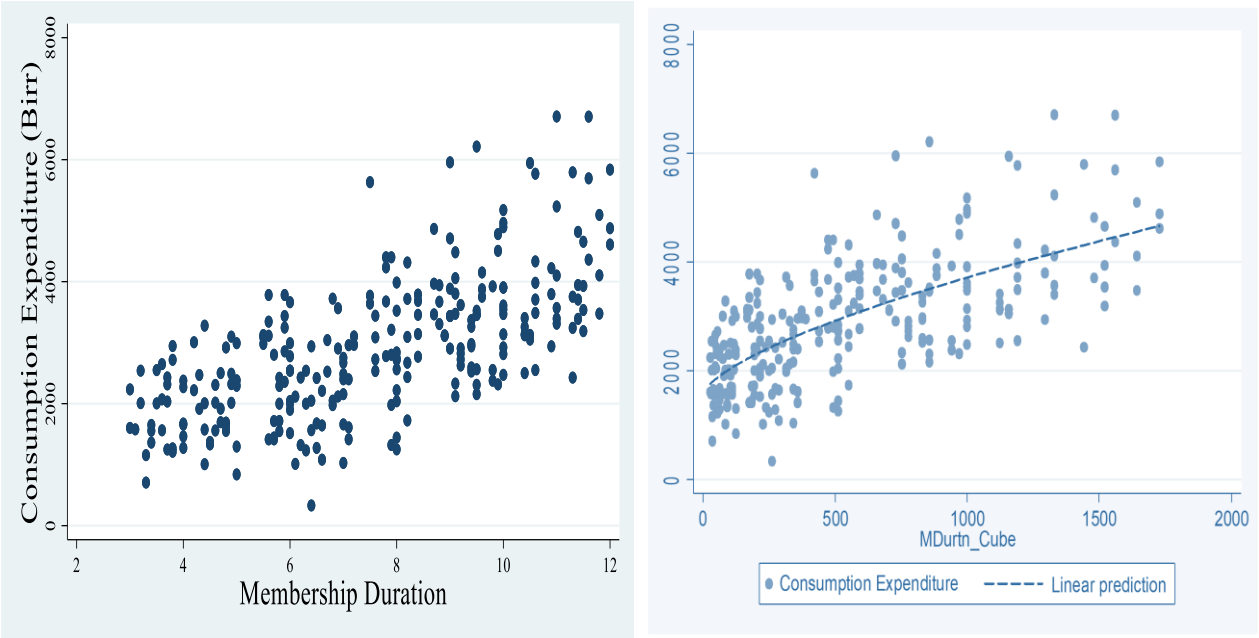

Figure 1: The relationship between consumption expenditure linear, prediction, and duration

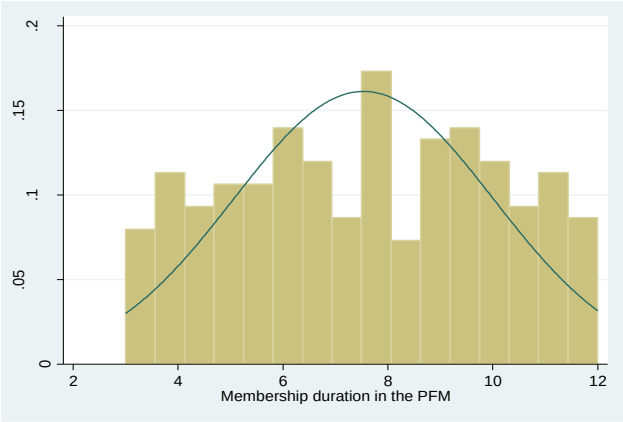

Figure 2: Distribution of estimated membership duration among sample households

Table 4: Normality test of the distributions

Smaller group	D	P-value	Corrected
res_etreat:	0.0527	0.227	
Cumulative:	-0.0826	0.026	
Combined K-S:	0.0826	0.052	0.044

Note: Test of normality would be statistically significant at 0.05 significance level

Table 5: GPS results: Duration of membership intensity on covariates

Variables	Coef.	Std err	Z-value
Age of the household head	0.082***	0.23	3.63
Sex of household head	- 0.23	0.35	- 0..65
Family size	0.37***	0.09	3.75
Education	-0.067	0.911	- 0.74
Off farm income	-0.104	0.301	-0.35
Livestock	0.13*	0.49	2.63
Nearest_pfm	-0.025***	0.006	-3.68
Nearst_mkt	-0.024***	0.007	-3.25
Land size	1.58***	0.37	4.29
Marital status	0.039	0.198	0.2
Age square	-0.005***	0.0012	- 3.76
Age cube	0.001***	0.000015	3.46
Livestock owned square	-0.068	0.262	-1.18
Livestock owned cube	0.002	0.003	0.6
Household size square	0.217	0.262	0.83
Household size cube	-0.067	0.015	-0.89
Education square	0.052	0.043	1.21
Education cube	-0.002	.002	0.9

Note: ***, **, * shows significance levels at 1%, 5%, and 10%, respectively
Source: researchers' calculations

Table 6: Balancing check of Covariates

Variables	T(3,6)	T(6.1,9)	(9.1, 12)
Age of the household head	0.623	0.314	-0.287
Sex of household head	0.621	-1.149	-0.830
Education	0.773	-1.452	0.448
Family size	0.487	-0.322	-0.088
Livestock owned	-0.525	0.141	1.063
Nearst_pfm	-0.639	0.111	0.468
Nearst mkt_	-0.516	-0.221	1.239
Land Size	1.147	-0.128	-2.645
Marital Status	-0.760	1.201	0.639
Off farm/Non-Farm income	-1.379	0.994	-0.652
Age_square	0.890	-2.428	2.026
Age_cube	1.101	-2.690	2.133
Eduyears_square	0.738	-1.868	0.847
Eduyears_cube	0.744	-1.993	0.993
Famuly size _square	0.663	-0.780	0.325
Famuly size _cube	0.731	-1.033	0.603
Livestock owned _square	-0.241	0.219	0.793
Livestock owned _cube	-0.122	0.459	0.499

Common support condition

Common support conditions for the membership duration were tested; we divided the sample into three groups as we have done above when examining balancing covariate tests. Then we estimate the GPS of the entire selection at the median treatment duration of group 1, i.e., 4.7 years. After that, we plot the distribution evaluated GPS for group 1 versus the rest of the sample in the exact figure shown in Figure 3. We then assess the GPS at the median treatment levels of the second and third groups and repeat the similar course of action for the distributions**.** Finally, for the data sets, each GPS set of three common support domains are depicted in (Table 7) and Figure 3. Consequently, the overall common support region would examine and trim out six from group two 19 from group three, then the common support condition is satisfied in our data.

Impact of PFMP on households' per capita consumption expenditure

For the study area, following the confirmation of balancing property of the respective estimated GPS, per capita expenditure of anticipation of the households was estimated as a function of two scalar variables (membership duration and the GPS) and their interaction via Equation (5) (Table 8). In Table 8, the outcome variable household per capita expenditure (HPCExp) is a continuous variable, and the DRF at membership duration, t, is estimated through the polynomial of order two regression Equation (7)

$$\mathrm{H}PCExp(t) = \alpha_0 + \beta_1 \mathrm{MDurn_i} + \beta_2 (MDurn_i)^2 + \beta_3 GPS_i + \beta_4 (GPS_i)^2 + (MDurn_i)(GPS_i) + \varepsilon_i \qquad (7)$$

Note that the result obtained has two purposes but does not have to render causal implications to develop causal inference – to generate average DRF and to re-assess whether the covariates introduce bias **(Hirano & Imbens, 2004; Liu & Florax, 2014).**

The final step of impact analysis using the GPS method is measuring the mean DRF, which shows inferences. The moderate impact of membership duration on household per capita consumption expenditure at a particular year of membership dose was estimated using Equation (6). The average potential outcome was assessed based on **Hirano & Imbens (2004)** on ten values of duration 3, 4, 5… 12. For the study area, the DRF at membership duration t, an average membership duration effect t was evaluated as E [HCPexp (t)] and depicted. The solid line illustrates the estimated results of the dose-response function (mean membership duration effect); lines with a splash are 95% upper and bottom bound distances of confidence acquired through bootstrapping. However, it does not sense to discuss the graph's dashed lines as a causal relationship between membership length and consumption expenditure because of a pretty large confidence band (Figure 4) that emanates from small sample households in these segments.

As a result of GPS estimations, the optimal mean household per capita expenditure was achieved between 11 and 12 years of membership duration. The corresponding optimum values of yearly average household per capita consumption expenditures at these optimum years of membership duration are at a dose-response of Birr 4263.75. The concern here is where the desired optimum membership duration should be maintained. Forest management implies reduced transaction prices for its participants and improves the coherence of forestry movements at the product scale. Increasing the scale of the control unit improves market positioning, allows more technical management, and improves the corresponding household per capita consumption expenditures.

Sensitivity Analysis

Recently, checking the sensitivity of the estimated results has become an increasingly important topic in the applied valuation literature **(Caliendo & Kopeining, 2008)**. The matching method is based on the conditional independence or unconfoundedness assumption, which states that the evaluator should observe all variables simultaneously influencing the participation decision and the outcome variables. The main drawback of GPS as an impact analytical technique is that its fundamental assumption is statistically non-testable, i.e., weak unconfoundedness. They were matching via generalized propensity score, in this study, conditional on sample household membership duration density-independent of household per capita consumption expenditure. The credible explanation is to carry out various sensitivity tests on the main finding **(Kluve *et al.*, 2012)**. First, indirect assessments were guided by examining the link between treatment and added livelihood indicators to predict the primary outcome variable. Different sensitivity analyses were performed to improve the reliability of identifying the sensitivity of the version used in the outcome.

The association between membership duration and household per capita expenditure is the program's cumulative effects on various household livelihood activities. Three livelihood indicators were analysed for their average dose-response: per capita household income from non-timber forest products and crop and livestock per capita household income.

Impact of membership duration on household income from non-timber forest products

Considering reasonable confidence bandwidth, results in Figure 5 reveal that household income from non-timber forest product sales strongly increases with membership length in the area. Though the causal relationship is positive, revenue from non-timber forest products sales strongly responds to the membership duration dose in the study area. Results are also revealed in the marginal effect figure (Figure 6). The livelihood activities of households in the study area consist of forest-related activities, mainly harvesting of NTFPs, and off\non-farm activities. With such diversified income sources, the exploitation of NTFPs plays an important role - Farmers harvest NTFPs from the forest for different commercial and subsistence purposes. The income derived from the sale of NTFPs demonstrates that the forest plays a vital role in household incomes. Most NTFPs (forest coffee, honey, and spices) were collected for sale and contributed 47% of annual household income.

Thus, households in the forest area use NTFPs for household consumption and as a source of cash income. Individuals who lived in the area for long years of exposure to the program and had an excellent experience using NTFPs were selected.

Impact of membership duration on household income from crop production

Annual household income from crop production has a positive causal relationship with membership beyond four years (Figure 7). However, Figure 7 shows the negative relationship between this duration dose (38% of the sample households fell). From the right-hand side of the constitution, it is observed that the maximum marginal effect is attained. membership duration of 6 - 8 years' dose

Impact of membership duration on household income from livestock production

Annual household income from livestock production has a positive causal relationship with membership beyond four years (Figure 8). The effect of the entry rate concerning the continuous years of membership duration in the program was firmly incorporated with additional income obtained from forests. Longer membership duration can survive based on their livestock; they diversify their livelihood by earning income from sources other than farming strategies **(Gebru *et al.*, 2018).**

Table 7: Common support region

Treatment D	Dosage group	Min	Max
≤ 6	Duration<6 (GPS_G1)	0.0022	0.2142
	Duration>6 (GPS_G2&3)	0.0010	0.1107
	Common support Region [0.001 , 0.2142]		
6 to 9	6<Duration ≤ 9 (GPS_G2)	0.0202	0.1172
	Duration ≤ 6 & Duration >9 (GPS_G1&3)	0.0059	0.1024
	Common support Region [0.0059 , 0.1172]		
>9	Duration>9(GPS_G3)	0.0026	0.1003
	Duration ≤ 9 (GPS_G1&2)	0.0106	0.1372
	Common support Region [0.0026 , 0.1372]		

Source: Results based on survey data, 2018.

Table 8: Results of dose-response consumption expenditure

Consumption Expenditure	Coef.	Std. Err.	t-value
MDurn	-271.03	179.78	-1.53
MDurn _square	37.36***	12.01	3.11
GPS	-8656.27	6454.54	-1.34
GPS_square	41368.4*	22359.51	1.85.
MDurn *GPS	222.93	441.75	0.54
Intercept	2695.14***	676.46	3.98
Adj R-squared	0.44		
Obs.	241		

Source: Results based on survey data, 2018.

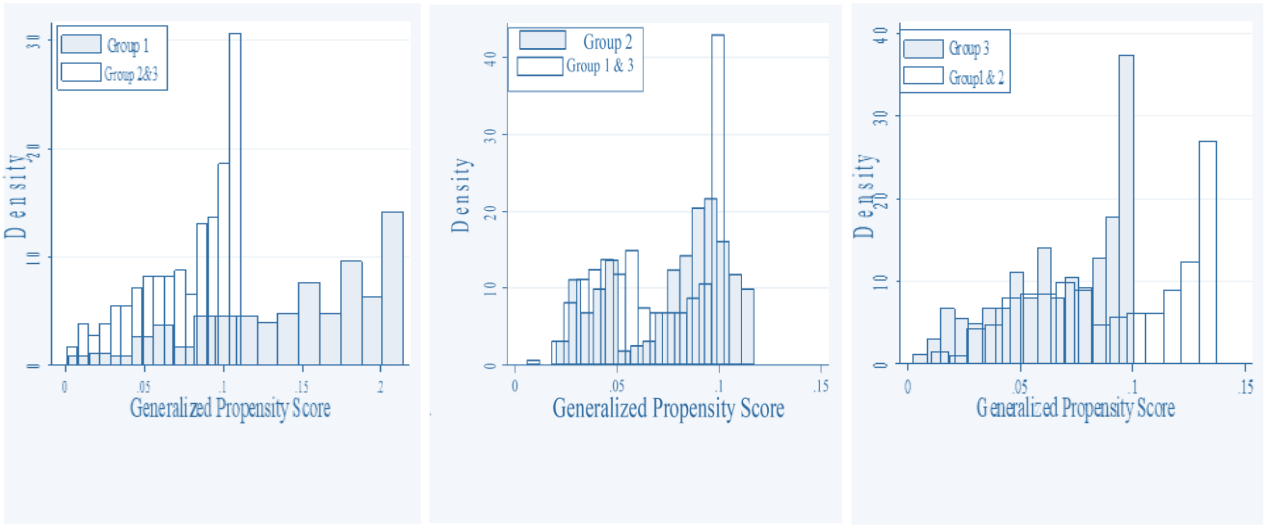

Figure 3: Common support region

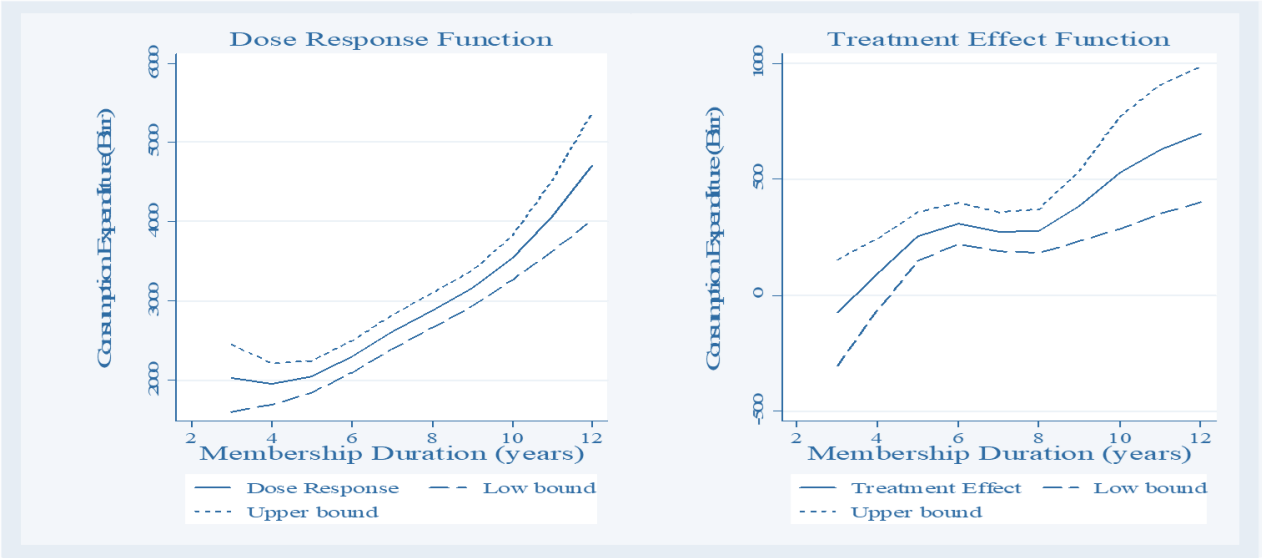

Figure 4: Average dose-response estimated for Per-Capita consumption expenditure [Quadratic] HCPCexp.

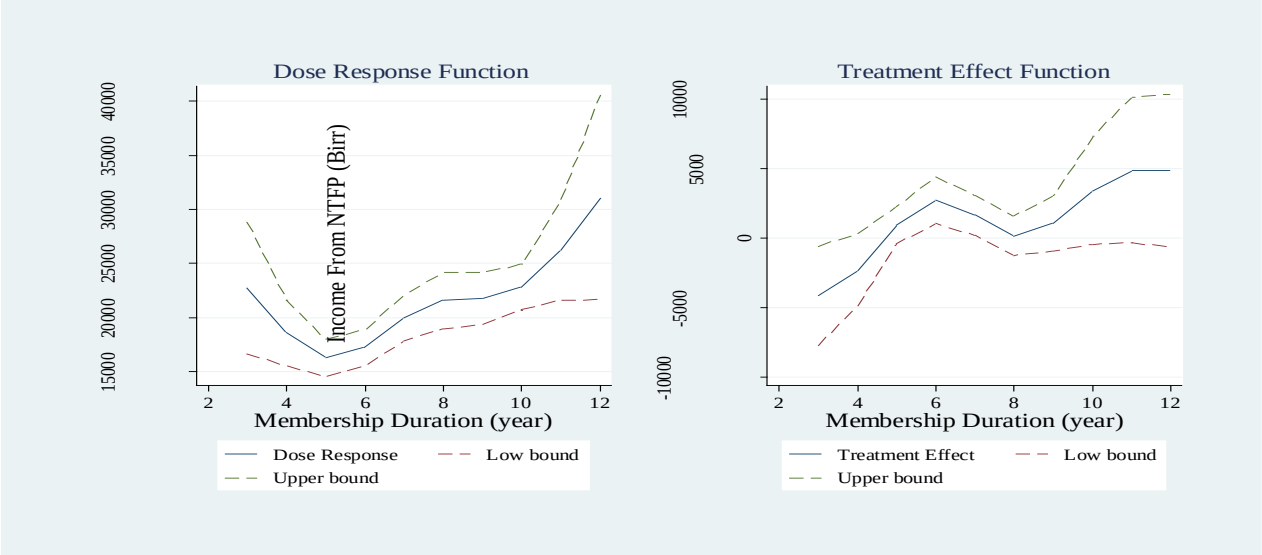

Figure 5: Average dose-response estimated for household income from non-timber forest products [Quadratic] IncmNTFP.

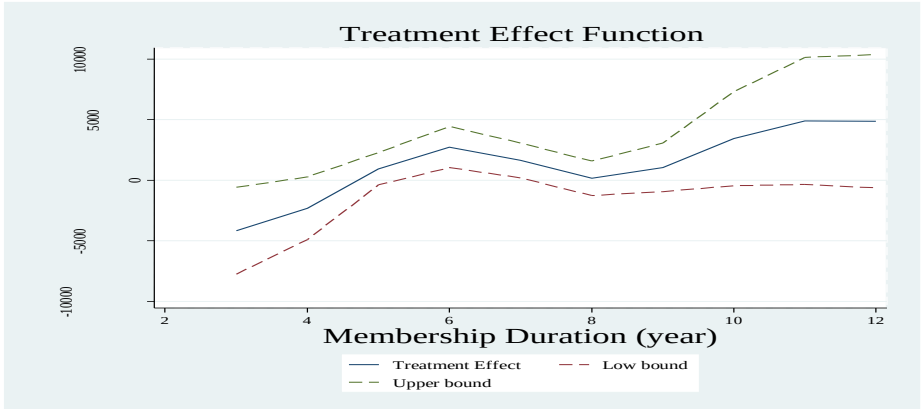

Figure 6: Marginal dose-response estimated for household income from non-timber forest products(IncmNTFP)

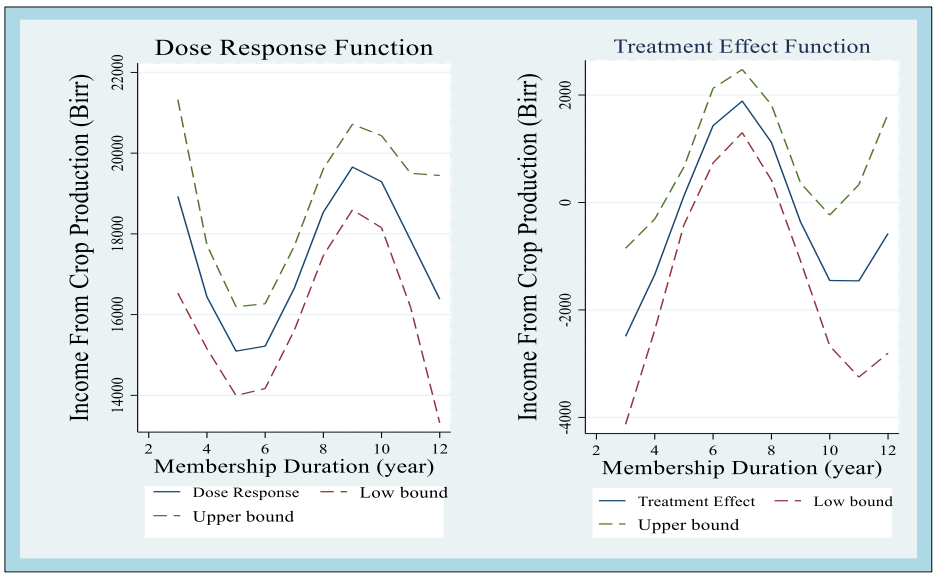

Figure 7: Average dose-response estimated for household income from crop production [Quadratic] IncmCrop.

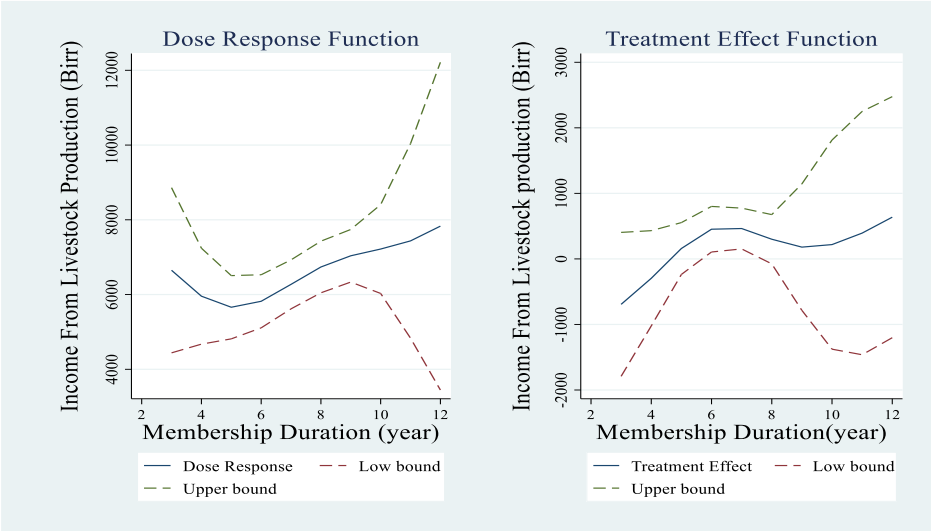

Figure 8: Average dose-response estimated for household income from livestock production [Quadratic] IncmLvstk.

DISCUSSION

In sum, in the study areas, all the three livelihood indicators have relationships with membership duration in the PFMP dose as a priori expectations. These results confirm and strengthen the impacts of membership duration on members' yearly consumption expenditure. Figures 5 and 6 show the results of estimated average dose-response function curves and marginal effects curves characterized changes in a causal treatment analysis, respectively. The shape of the dose-response curves shows increasing marginal effects. The values of results exhibit the marginal impact with a length of membership of the treatment significantly, affecting consumption expenditures. When stayed years of members in the program increase, the households have the more excellent marginal value of consumption expenditures. The slope of the dose-response curve is flatter at higher levels of treatment. Considering the plot with the first six years of membership increases at an increasing rate and reaches the maximum, indicating the association. This association of causal inference specification for respective outcome variables shows households in the forest area use NTFPs for household consumption and as a source of cash income. Individuals who lived in the area for long years of exposure to the program and had an excellent experience using NTFPs were benefited. Similar to this study, **Rai *et al.*, 2016** emphasize that household involvement may have made them more viable and produced more profits because older forest user groups provide more gains to households than more recently established ones.

Figures 4 and Figure 8 show the separate dose-response curves for per-capita consumption expenditure and household income from livestock production. There is a significant distinction between the three groups, at a 5% significance level. The dose-response curves have similar intercepts and shapes; both plots are steeper, around six years of membership duration. However, the impact marginally significant at a 5% significance is similar across their duration from 6 - 8 years in terms of the outcome measurement it's different. One year or concise duration does not appear to drive the main result in Figure 4. was observed. Increasing throughout the graph leads to improvements in households' livelihoods, i.e., the higher

the membership duration affects consumption expenditure beyond nine years of membership duration. The shapes of the plots are pretty similar to the results from the main model specification. Thus, results from specifications indicate membership duration to PFMP affects annual per-capita household consumption expenditure of rural households, the period increases.

Further, the slope gradually increases, eventually flattening out around just over nine years' treatment duration, suggesting that beyond nine years' treatment duration, result in additional income (Figure 5). This result supports the findings of **Gelo & Koch (2014)** and **Ameha *et al.* (2014b).** In the determined association in PFMP membership groups, strengthening south-western membership groups increased revenue and raised forest income from timber products.

Generally, this result from the generalized propensity score and dose-response functions revealed that a positive effect of membership duration to the program brings about better benefits in terms of per-capita consumption expenditure.

Surprisingly, the plot showed in Figure 7 dose-response relations between length of membership and income from crop production was found to be between more extended and the medium length of membership in the program. The strong association could offer a compelling challenge to the future implication of the program management. This observation aims to determine the impact duration of the participant's membership on participatory woodland communities and intake expenditures. The effect membership years of the period of members has not been analysed through everyday benefits received from the program. Take a look at implying long-term effects on members of participatory forest management

CONCLUSIONS

In this study it has been observed from descriptive analysis based on households intensity of duration longer length membership households and distance to the nearest market is a positive relationship, in contrast shorter duration members household is travel long distance to PFMP forest point in particular ratio analysis F-test results are statistically significant differences among the three groups of membership duration the result showed a substantial difference in the family size of the farmers livestock assets NTFPs income crop production and livestock production are statistically significant among the three groups at less than five percent probability level moreover the result of this study has shown that as the size of livestock is increased the gross margin earning status of the participant farmers will increase here the stakeholders should critically evaluate the real benefits that the members can get from the livestock the correlation test also revealed that the variables provision of membership duration density in different specification models showed substantial positive effects on household per capita consumption expenditure farm income shows positive and significant results in determining the consumption expenditures status of households the correlation test also revealed that the variables provision of membership duration density in different specification models showed substantial positive effects on household per capita consumption expenditure farm income shows positive and significant results in determining the consumption expenditures status of households

Spline regression results between consumption expenditure and treatment duration are positive, and the explanatory power of the treatment is high. The differences among three groups at the Households level in the study area obtain their farm income from non-timber forest products selling, livestock assets, animal by-products, and crop production. Introducing a better forest management system can improve NTFPs harvesting yield, resource utilization, and available credit that helps purchase modern agricultural inputs providing adequate rural infrastructure such as large and small-scale irrigation schemes.

The result of the econometric analysis was also revealed by following extensive steps on GPS application and the mean dose-response functions, which shows inferences to secure conclusions of the association. Evaluating associations between membership duration and consumption expenditure inform that participatory forest plays an essential contribution to bear members enjoying their participation. Overall program management has generated opportunities, infrastructure development, and enhanced non-timber product marketing, collaborative planning, and action. Although the effects are concentrated on their sufficiently longer forest program participants, medium and shorter duration membership benefit flows and income are compromised

In developing countries like Ethiopia, PFMPs have a fundamental role in natural resource protection. Impact study provides empirical evidence on how the members of participation in PFMPs improve their livelihoods at the household's level. This analysis will have expected to show government regulators' policy options and improve the Management of the PFMPs in allocating resources that satisfy the two-fold outcomes, protecting the forest and enhancing the livelihoods of the beneficiaries. It also enables investors, stakeholders, policymakers, donors, and development practitioners to better understand the impact of PFMP on livelihoods and inform local communities' preferences regarding their economic priorities. Contribute to designing proper and effective forest management program strategies that support local communities' socio-economic needs compatible with conservation objectives - the natural resource sector conservation programs for monitoring the status and influencing their rural participation performance. Developing countries have recently adopted community members' involvement in forest membership structures, such as forest users' cooperatives (FUCs) and forest Users group (FUGs). While this type of program has been observed in the study areas of PFMP to raise smallholder incomes, there is evidence on saving and consumption

expenditure responses to such income gains from the program.

This study examines the relationship between annual per-capita consumption expenditure and the duration of treatment (household membership duration) in rural households in south-western Ethiopia. The analysis revealed that the PFM program had raised membership households' annual yearly consumption expenditure. The average program impact at the optimum level of membership duration dose around at ETB 4263.75 in treatment dose-response of per-capita consumption expenditures in each membership duration separately. Further, the results of membership duration analysis at the household level indicate that PFMP in south-western Ethiopia is economically influential in the present socio-economic context. The results also reveal that the impact of PFMP increases with the length of membership duration. It implies that members of longer membership duration have higher returns on their contribution than those of shorter membership duration households. There could be two explanations for these findings. Firstly, longer membership duration households' practices yield technologies management, improving forest conditions relative to recently entered member's families **(Pokharel, 2012)**. Secondly, longer membership duration households harvest large quantities of harvestable non-timber forest products, and the amount of harvested non-timber forest products is directly linked with the household benefits. In general, the effect of the entry rate concerning the continuous years of membership duration in the program was firmly incorporated with additional income obtained from forests.

Membership duration to forest management has detrimental effects on adopting new, improved markets integration in their NTFPs and enhanced quality of products. In addition, membership duration to the programs was observed to lead to higher yields for bananas and related products. The association for strengthening membership duration of participation in the PFMP should also concern policymakers, especially considering that the country invests in agricultural extension through groups. Therefore, it is recommended that strict follow-up work be done on the members of the participating forest communities to encourage new incomes and integrate the socio-economic network more closely with the forest ecosystem and biodiversity.

Although the relationship between forest participating communities' longevity and income is substantial, the program has been focused on the more extended duration of the forest program. Accordingly, it is proposed to mitigate the effects on management functions, and future research lines should be presented based on the limitations of the work and the dynamic nature of the participation.

Recommendation

Therefore, it is recommended that more work be done on the participating household members by encouraging new forest-related income sources and integrating the socio-economic network more closely with the forest's ecosystem services. Although the relationship among participating members of households' longevity and income is substantial, the program has been focused on the medium and longer duration of the forest program participating. Accordingly, it is proposed to mitigate the effects on the association of annual household income functions, and membership duration should be strict follow-up on their performance by the concerned entity presented based on the limitations of the program and the dynamic nature of the participation.

Based on this fact, the aspects are suggested for cognizance in optimizing the productivity in the participatory activities in study districts when broadly viewed as enhancing the benefits gained from PFMP operations are limited in volume due to farmers in the study area having limited access to modern agricultural inputs fertilizer and a comprehensive yielding variety institutional support credit and extension advice thus this study highlighted critical recognition and PFMP activities policy consideration has given in the area of research influence farmers marketing of farm produces changing cultures of farmers towards for members

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