INNOVATIONS

Determinants and Sustainable Financing Mechanisms for Participatory Natural Resource Management in North Shewa of Oromia Region, Ethiopia

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Abstract :This study investigated personal, physical, and institutional factors affecting farmers' participation in participatory natural resource management and sustainable financing mechanisms for participatory natural resource management practices in the North Shewa of Oromiya regional state. This will greatly inform efforts to bring down land degradation in the area. Thebinary logit model was estimated as analytical tools. The study is based on household-level data collected in 2020 from 396 randomly drawn households living in WaraJarso, GirarJarso, and HidabuAboteworeda. The logistic regression analysis indicated 7explanatory variables were significant in explaining the factors influencing the farmers' decision to participate in participatory natural resource management programs. These variables were gender, agricultural labor force, extension service, farm size, and slope, level of education, productive safety net program, and livestock ownership. Of these, Farm size, agricultural labor force, agricultural extension services, access to credit, educational status, and status safety net program indicated positive influence, while gender and slope exerted negative impact. The study identified introducing PES in watersheds in the zone, REDD+ Project, and Forest Management and PES in Water Supply of towns in the study area could be suitable for a sustainable financing mechanism for participatory natural resource management in the study area. The result of the study suggests working on raising the awareness of farmers' about the long-term benefits of the participatory natural resource management and to design a strategy to diversify their livelihoods.

Key Concepts: 1. NothShewa 2. Ethiopia 3. logit model 4. sustainable financing 5. Oromiya

1. Introduction

Ethiopia facesnumerous types of land degradation including water and wind erosion; salinization (and recently acidification); and physical and biological soil degradation. Eyasu, 2003, reported soil erosion, water resource degradation, and loss of bio-diversity are a key problem that reduces land productivity in the highlands of Ethiopia.

Soil erosion, nutrient depletion, and deforestation are common environmental problems in the Ethiopian Highlands (Awulachew et al., 2008), not least in the North Shewa of Oromia zone. Like most other areas of Ethiopia, the North Shewa zone(Oromia) has been facing core problems that its rich stock of natural resources are not well managed. Existing literature documented loss of land productivity, loss of biodiversity, flooding, shortage of fodder, the decline in quality and quantity of water resources, decreasing Carbon dioxide (CO_2) sequestration, etc in the zone. Hagos et al., 1999 reported poverty, land fragmentation, tenure security, weak extension, and lack of credit services, as well as high human and livestock population pressure were major causes of land degradation in Ethiopia in general and North Shewa of Oromia zone in particular.

Government and non-governmental organizations have been working in the areas of watershed management and sustainable finance mechanisms in Ethiopia. There is a need to evaluate sustainable financing mechanisms used and develop a more comprehensive understanding and provide guidance on sustainable financing integrated watershed management in the context of our study area. North Shewa of Oromia zone agricultural and land-use office has been the executive government body responsible for integrated watershed management in the zone.

Among major efforts made to address land degradation, since the 1970's, is the introduction of Soil and Water Conservation (SWC) measures. At the beginningof the 2000s, community-based integrated watershed development was launchedby the government to promote watershed management as a means to realize broader integrated natural resource management and livelihood improvement objectives of the community (Gebregziabher, et al., 2016). However, as reported by Tesfaye et al., 2014, many of the watershed management programs undertaken in Ethiopia in the past were unsuccessful in either causing voluntary adoption of conservation practices among farmers or protecting the structures constructed. The factors that cause the success of natural resource management are multidimensional (Gebregziabher, et al., 2016), and the payback requires a long-time to happen. But Gebreselassie et al., 2009 presented farmers' focus more on short-term advantages than the long-term investment in land and water management.

Participatory natural resource management projects will be found to be the best development strategies for the rain-fed area. For successful implementation of natural resource management, it is essential to ensure peoples' participation. Several factors affect the farmers' participation in natural resource management. However, to our knowledge, comprehensive studies on assessing the determinants and financing mechanisms of sustainable participatory natural resource management have not yet been undertaken in our study area. Keeping this in view, this study was undertaken with the objectives to identify personal, physical, and institutional factors affecting farmers' participation and identifies sustainable financing mechanisms for integrated watershed management practices in the zone. It intends to add to the status of knowledge on the factors that determine farmers' decision

to participate in participatory natural resource management and investigate financing mechanisms for sustainable participatory natural resource management in North Shewa of OromiaZone. This study seeks to assess the determinants and financing mechanisms of sustainable participatory natural resource management practices in North Shewa of the Oromia zone. The specific objectives of this study were: i) Identify factors that determine farmer's decision to participate in participatory natural resource management in the zone; ii) Asses innovative and sustainable finance mechanisms working in other areas with a similar context and iii) Identify opportunities exist for piloting PES in the context of North Shewa of Oromia zone.

2. Materials and Methods

2.1 Study area description

This study was conducted in the North Shewa of Oromia regional state, Ethiopia. North Shewazone (Oromia) has fourteen (14) woredas, including Fitche urban Administration. Fiche town is the administrative center of the zone which is 115km Addis Ababa.The zone is geographically located in 9008′52²to 10035′17²North latitude and37056'13" to 39034'47" East longitudes.Based on the 2007 census conducted by the central statistical Agency of Ethiopia, the North Shewa zone has a total populationof 728846, of whom 370648 are men and 358198 women (CSA, 2007).More than 90% of its population livelihoods depend on agriculture for subsistence.

Like most of the other parts of Ethiopia, the North Shewazone (Oromia)is facing from land degradation. There are considerable interventions taking place in the zone, even if land degradation is still going on in the area. It was expected as there is a significant potential for improved LES in the area.

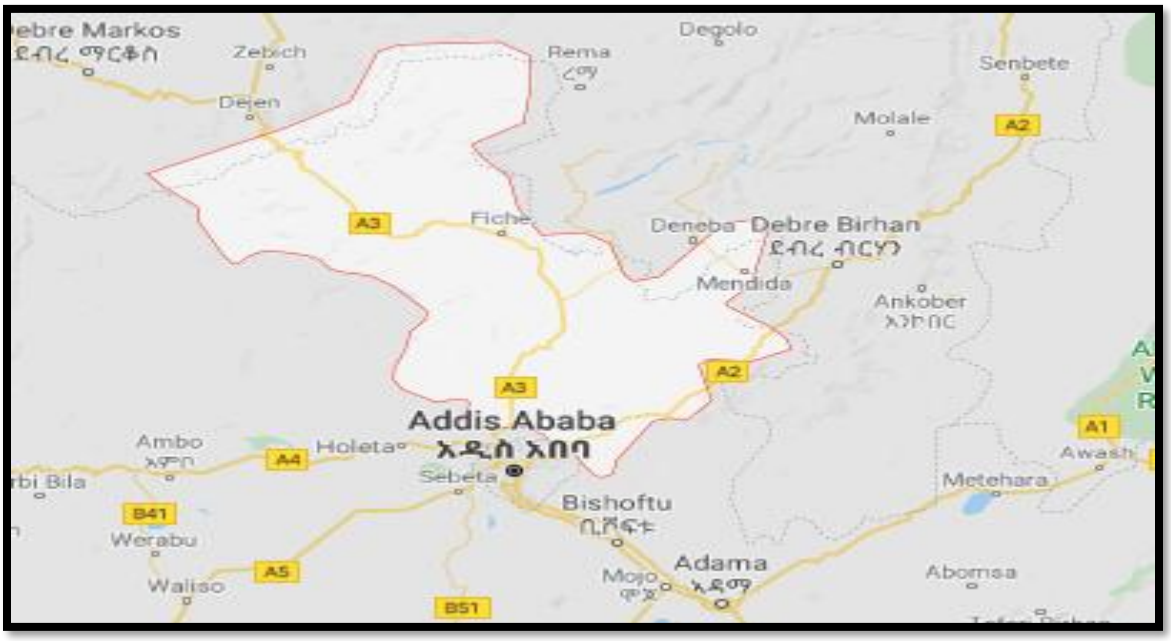

Fig 1: Map of North Shewa Zone (Oromia)

2.2 Sampling and data collection technique

Determination of the appropriate sample size is largely a case of constrained optimization. The sample size required to be large enough to obtain trustworthy estimates subject to the project budgetary constraints (Hoyos, 2010). Given budgetary and other constraints we selected a target sample size of 396 households.

In this study, a multi-stage sampling technique was used to select the sample farm households. In the first stage, HidhabuAbote,WaraJarso, and GirarJarsoworeda were objectively selected. These three woredas' were selected for accommodating lowland, midland, and highland landscape. In the second stage, 3 kebeles which represent all landscape in the zone were purposively selected by consulting agricultural and land use management staffs of the respected woredas'. In the third stage, sample farm households were randomly selected from each selected kebele's using the lists of the farm households (in each kebele) by Development Agent (DA) of respected kebeles.

In this study to select sample size from the total population, Yemane (1967) sample size determination formula is used. It is possible to determine the sample size at 95 % confidence level and 0.05 precision levels. According to the respective woreda agricultural office (2011),the total households of GirarJarso, HidabuAbote, and WaraJarsoWoreda are 11,773, 25,389, and 15,000 respectively. The total households in the selected woredas are 52,162.

$$n = \frac{N}{1 + N(e^2)} = \frac{52{,}162}{1 + 52{,}162(0.05)^2} = 396$$

Where,

n= is number of respondents

N = population size

e = sampling error/level of precision

The total sample size of respondents based on the above sample size determination is 396 households. Then based on their proportion households were selected woreda

GirarJarsoWoreda = $11{,}773/ (1+52{,}162(0.05)^2 = 89$

HidabuAboteWoreda = $25{,}389 / (1+ 52{,}162(0.05)^2 = 193$

WaraJarsoWoreda = $15{,}000 / (1+ 52{,}162(0.05)^2 = 114$

Accordingly, a total of 396 respondents were selected. Finally, a structured and pretested questionnaire was prepared and administered to the sample farm households to collect data. The data was collected via face to face (in-person) interview by well-trained enumerators. Enumerators who have better experience were carefully screened.

2.3 Method of data analysis

The study was analyzed both quantitatively and qualitatively. The qualitative analysis focuses on literature review and analysis of secondary data from the agricultural office of the woredas', in-depth focus group discussion and key informant interviews (KII) with experts previously and currently involved in natural resource management (NRM). STATA version 12 was used to analyze quantitative data. In this study,descriptive statistics such as mean, standard deviation, and

percentages will be used to see the relationships between explanatory variables and the level of farmers' participation in participatory natural management. A binary logistic regression model was used to know the correlation between the dependent and independent variables of the study.

The dependent variable in this study is the level of farmers' participation in participatory natural resource management. Thus, farmers' participation in participatory natural resource management was measured as a binary dummy variable (1 = participated in participatory natural resource management, 0 = otherwise). Explanatory (independent) variables selected are credit services, agricultural labor force, land tenure security, frequency of developmental agent contacts, whether farmers receive incentives or not, farm size (in timad), educational status, land slope, livestock ownership, and off-farm income. A binary logistic regression model was used to investigate factors affecting farmers' participation in natural resource management programs in the study zone. As outlined above, this model was employed because of the binary nature of the dependent variable (level of participation). The binary logistic model is specified as:

$$P\left(Y_{t=1/X_t}\right) = \frac{\exp\left(X_t B\right)}{1 + \exp\left(X_t B\right)}$$

An equivalent logit model form can be stated as

$$\boldsymbol{ln(y) = ln\left(\frac{Y}{1-Y}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots \ldots + \beta_n X_n + u_i}$$

Where,

Y =The predicted probability of the event (farmers' level of participation in participatory natural resource management), which is coded with 1= participants; and 0= non-participants).

1 − Y= the predicted probability of the non-participants of the participatory natural resource management programs.

β_0= Constant

β_n= Coefficients of explanatory variables

X_n= Predictor variables

U_i= Error term.

The probability that binary assumes the value one is,

$$\text{Prob}(q_{it} = 1) = \frac{\exp\left(B_0 + B_x\right)}{1 + \exp\left(B_0 + B_x\right)}$$

The hypothesis of the study

In setting our hypotheses, our main interest is to identify factors affecting farmers' participation in participatory natural resource management program. The effects of key explanatory variables were hypothesized in the table below.

Table 1: Hypothesis of the study

Dependent variable	**Description**	**Unit**	**Hypothesized correlation between dependant and Independent Variables**
Y=LFP, Level of farmers participation	Level of household heads' participation in participatory natural resource management program	1 if participated, 0 otherwise	
Independent variables	**Description**	**Unit**	
X1 = OFI, Off-farm income obtainedfrom non-farm activities	Off-farm income	if a household has participatedin off-farm activities, 0 otherwise	+
X2 = LSO, Livestock ownership	Households livestock ownership	Number in TLU	-
X3 = LRD, Periodic land redistribution	Periodic land redistribution	Yes = 1; No = 2	-
X4 = ES, Educational level	Household headseducational level	1 if a household head is literate, 0 otherwise	+
X5 = LT, Land tenure security	Land tenure security of a household	Yes = 1; No = 2	+
X6 = GHH, Gender	Gender of the household head	1 if a household head is male, 0 otherwise	+
X7 = NALF, active labor force	Number of household members activelyinvolvedin farming activities	Number	+
X8 = FS, Farm size	Farm size of the household	Timad(0.5Hectare (ha))	+
X9 = EV, Frequency of extension Visit	Frequency of agricultural extension visits received	At least five times in a year = 1; otherwise = 2	+
X10 = CS, Credit service	Access to credit services	Yes = 1; No= 2	+
X11 = PSNP, productive safety net program	Household heads' productive safety netbeneficiary	1 if a household head is a PSNP beneficiary, 0 otherwise	+
X12 = S, Slope	The slope of the farmland	1 if the slope is gentle, 0 otherwise	+

3. Results and Discussion

3.1 Descriptive statistics

The descriptive statistics for selected socio-economic variables of the sample respondents are presented in table 2. As table 2 shows male consists of 93% of the respondent. Since our respondents are household heads or someone who acts as household heads, this result is not surprising because like in most of our country male-dominated every decision making in household affairs due to socio-cultural reasons as in line with the studies of Singh et., Al (1993). The average yearly income of the respondent was about 7500.55 ETB per year. About 51% of sample respondents can read and write. As far as the education level of the household members is concerned majority of the household members did not take education. From total sampled household members, 65.5% of them illiterate, 20.2% are of primary education (1-8 grades) level, 14.3% are of secondary education (9-12), and above. The average respondents' age was 36 years and 91% of them are married with a family size of 4.5 members. The average number of family size is almost equal to the national 5 per household (DHS, 2011). The mean farm landholding was 5.5 timad (1 timad ≈ 0.25 hectares), which is much lower than national figures. The result showed that only 15% of respondents participated in non-farm activities. This shows that more than 85% of the respondents' livelihood depended only on agriculture, mainly mixed farming.

Table 2: Descriptive statistics for selected socioeconomic variables of the sample respondents

Variables	Description	Mean	Std. Dev
Age of the household head	Age of the respondent	36	8.05
Sex of the household head	= 1 if the respondent is male, and zero otherwise	0.93	0.26
Family size	The number of family members	5.5	1.81
Whether the head could read and write	= 1 if the respondent can read and write, and zero otherwise	0.51	0.50
Marital status	= 1 if the respondent is married and zeroes otherwise	0.91	0.18
Participating in the non-farm sector	= 1 if the respondent participated in non-farm activities, and zero otherwise	0.15	0.11
Farm size	The size of farmland respondent hold in timad	6.5	1.13
Income	Yearly respondent income in Ethiopian Birr	7500.55	5527.94

Source: own survey, 2020

Regarding responses to natural resource degradation, 40 percent of the respondents said land degradation rate in their area is medium, while 48% and 12% of respondents responded that land degradation in their area was high and low respectively. Besides this, they were also asked that what are the major causes of land degradation in the area, and then most (90%) of respondents claimed soil erosion is the major cause of land degradation. Interestingly, about 97% of respondents agreed to participate in participatory natural resource management in the study area.

3.2 Econometrics Results

Finding the factors that determine farmers' level of participation in participatory natural resource management goes beyond the descriptive analysis and requires employing an econometric model. The Binary econometric analysis helps us to identify factors that influence farmers' participation in participatory natural resource management. As it was discussed in the methodology part of this study, a logit model is estimated to identify the major determinants of farmers' participation in participatory natural resource management. Usingthe level of farmers' participation in participatory natural resource management as a dependent variable where 1 is given to farmers being participated in participatory natural resource management, and 0, otherwise.

The below table regresses the binary response variable, the probability of being participated in participatory natural resource management (P(Y=1)). A glance at the results shows that most of the explanatory variables in the model have the signs that conform to the researcher's prior expectations. It is also evident that most of the variables are statistically significant at and 1% and 5% confidence level

Table 3: Logitand marginal effect (dy/dx) Results

Name of independent Variables	Logistic Coefficients	Marginal Effect dy/dx	P-Value
Gender	−0.251**	0.242	0.032
Farm size	1.126**	0.654	0.041
Agr labor force	0.590*	0.518	0.000
Agr extension service	2.549 *	0.456	0.001
Off farm income	0.456	0.129	0.253
Access to credit	0.672**	0.347	0.020
Educ status	0.784***	0.253	0.065
Land tenure	1.06 5	0.215	0.124
Live stock ownership	−0.287	0.034	0.370
Safety net program	0.971 *	0.891	0.002
Slope	− 0.570**	0.550	0.049
Constant	4.503	0.682	0.341

Source: own survey, 2020

Note: *, ** and * indicate that the coefficients are statistically significant at 1%, 5%, and 10% level**

Interpretation of significant Variables from the logistic regression output

Gender: Contrary to our prior hypothesis, the binary logistic regression analysis of this variable was found to be statistically negative and significant at the 5% level of confidence.The marginal effect shows being female increases the probability of participation in participatory natural resource management by 24.2 %.

Farm size: In line with expectation, farm size was found to have a positive relationship with farmers' participation in participatory natural resource management and is statistically significant at a 5% level of significance.This may be becausefarmers who have large farm sizes are more confident in getting better production than their counterparts. This result is supported by a prior study conductedby Bekele and Drake (2003).The marginal effect shows the participation of farmers' increases by 65.4% as farm size increases.

Agricultural labor force: In linewith our expectations, the result of the regression analysis revealed that the agricultural labor force is found to be statistically positive and significant at the 1% level of confidence. This means as the number of the agricultural labor force of a household increases, the farmer's decision to participate in participatory natural resource management increases. This could be because of the farmer's having sufficient labor force enables them to participate in the program. Holding other things constant, the marginal effect of the variableindicates the probability of farmers' participation in the participatory natural resource management increases by 51.8% as farmers' labor force increases.

Agricultural extension service: The regression analysis of this variable revealed that the frequency of agricultural extension service is found to be statistically positive and significant at the 1% level of confidence. This means as the frequency of agricultural extension services received by a farmer increases, his/her decision to participate in participatory natural resource program increases.The marginal effect shows the probability of farmer's participation in the participatory natural resource management increases by 45.6% as the frequency of agricultural extension services increased by 1%.

Access to credit: The results of the study revealed that the variable under consideration is positively related and significant at a 5 percent probability level with the probability of farmers' participation in participatory natural resource management. Holding other things constant, the marginal effect of the variable shows the probability of farmers' participation in participatory natural resource management increases by 34.7% as a farmer has access to credit service.

Education of household head (EHH): The coefficient oneducation reflects the prime role that human capital plays in determining farmers' participation in participatory natural resource management program.The educational status of the household head is positively related to the dependent variable and is statistically significant at a 10% level of significance.The marginal effect shows, other things

remaining constant, the probability of participating in participatory natural resource management program increases by 25.3% as the head of the household becomes literate. It is explained in terms of the contribution of education on improving farmers' ability to perceive, interpret, and better adapt to changing conditions. This is becausecompared to illiterate farmers literate farmers know the long-run and short-run benefits of natural resource management.

Safety net program: As expected, a productive safety net program was found to have a positive relationship with farmers' participation in participatory natural resource and is statistically significant at a 1% level of significance. The marginal effect shows including farmers in the safety net program increasethe probability of farmers' decision to participate in a participatory natural resource program by 89.1%.

The slope of farmland: As opposed to our expectation, the regression analysis result of this variable is found to be statistically negative and significant at the 5% level of confidence. This may be due to farmers' lack of awareness about the effects of slope for soil nutrient losses from their farmlands. This output is supportedby the study conducted in Ethiopia by Alemu (1999).

3.3 Global Experiences payment for Eco-system services(PES)

This section reviewed the experience of other countries around the world which could be a good model for our study area. In addition to east African experience, the experiences of Chine, Costa Rica, Ecuador, Carbon Trading were taken from working paper "Investigation of the modalities for an innovative financing mechanism for participatory natural resource management in the Bale Eco-region, Ethiopia conducted Fitsum et al, 2018". Because the researchers found that the global experiences reviewed in this working paper can also considered as a good experience for our study area according to information obtained from focus group discussion and key informant interviews.

East African Experiences

PES has been designed as a strategy to reduce deforestation around the Kilombero wetlands catchment area in Tanzania, based on surveys rural and urban water users would be willing to pay funds to forest conservation (Mombo et al. 2014). Farmers around Mount Elgon in Kenya willing to pay between USD 0-18 for the protection of forest for watershed management (Kipkoech et al. 2011) while, in Rwanda, three quarters of the population agreed in principle to the idea of paying for the conservation of forest ecosystem services, with particularly high values for erosion control and sediment retention (Kalisa and Habiyaremye 2015).

In the Lake Naivasha watershed in Kenya, a study to assess the willingness of large scale farms, hotels, ranches, water and energy utilities to invest in a water fund (in this case, to the tune of some USD 110,000 a year) informed the development of a water-related ecosystem services scheme (Mulatu et al. 2015). Surveys carried out to assess Nairobi water users' willingness to pay for increased and reliable water supply via catchment management (on average around USD 40 per household per year on top of their water bills) were used as part of the basic information used to guide the design of payments to capitalise the Nairobi Water Fund (Balana 2011, Namirembe et al. 2014).

Experiences in China

We thought China'sSloping Land Conversion Program (SLCP) will be a good lesson for North Shewa of Oromia regional state, Ethiopia. The program was introduced by the government of China to reduce water and soil erosion in 1999. Li et al. 2011 indicated SLCP is one of the largest PES schemes around the world. The goal of the program was to reduce water and soil erosion, by converting agricultural land on steeply sloping and marginal lands into the forest. This experience is relevant to the North Shewa of Oromia zone because SLCP was a public arrangement created to fight land degradation. Contrary to the existing land policy, farmers in North Shewa of Oromia regional state use steep sloping and peripheral lands as cropland, and this underlined the importance of the government's high involvement in watershed management and expected role in the zone. In SLCP, in addition to direct compensation of farmers, the Chinese government has also formed favorable tax conditions for forest products to make the conversion of farmland to forestland economically sustainable (Li et al. 2011).

According to Liu 2014, the program was designed to change 14.67 million hectares of farmland to forestland by 2010. Song et al. 2014 reported following the introduction of the program forest cover increase significantly, although its sustainability is questioned.

Experiences in Costa Rica

The other best program that could be taken as a good model for our study areais Costa Rica's PES platform. The program was planned in 1996, to reward forest owners for the following services: protection of water for both rural and urban use; reduction of greenhouse gases; and protection of biodiversity for conservation and landscape beauty for tourism(Porras et al. 2013). Since its inauguration, the program has had significant positive impacts on forests through protection, reforestation, and agroforestry systems (TEEB 2009; Porras et al. 2013).

Experiences in Ecuador

Since the problems of land degradation in Ethiopia and Ecuador ar the same(i.e., there is high land degradation as a result of agricultural expansion in both cases), the PES experience in Ecuador is relevant for Ethiopia in general and the North Shewa of Oromia zone in particular. The use of a mixture of government finance and new, voluntary, and dispersed financing mechanisms for watershed management, the financial security achieved therein, the introduction of a drinking water fee, and management of the water fund implemented in Ecuador could be good lessons for Ethiopia when designing its PES scheme. These experiences could be important for the development of PES supporting legal and political framework and, probably, the introduction of revised water bills.

Carbon Trading

The current worldwide challenge, global climate change has led to an interest in reducing emissions of CO2 and, under certain conditions, considering the extra carbon absorbed in soils and vegetation as a part of the emission reduction (UNFCCC 2015). One option for slowing the rise of GHG concentrations in the atmosphere, and thus possible global climate change, is to extend the quantity of carbon removed by and stored in forests (Gorte 2009).

After the Kyoto Protocol,carbon sequestration has been the main target of considerable controversy in international dialogues. Earning credits through protecting forests in emerging countries has started under the Kyoto Protocol. Mitigating global climate change by enhancing forest carbon sequestration could also be a comparatively low-cost option and would likely yield other environmental benefits.

3.4 Suitable Financing Mechanisms for participatory natural resources management

Introducing PES in Watershed in the zone

Evidence on rates of soil erosion in the North Shewa of Oromia regional state is comparatively scarce, however, most data produced in northern Ethiopia and the central highlands (Haregeweyn et al. 2015).

Several studies indicated that watershed management is essential to reduce soil erosion, runoff, and the sediment inflow to the downstream and fill the water, and damage crop and grazing land. Introducing a new price for the contribution of watershed management to the beneficiaries by accounting for the cost of watershed management is vital to make sure that watersheds are rehabilitated and protected in the future. It's possible to envisage that the beneficiaries will be willing to be a part of a PES scheme as long as the watershed intervention alleviates their problems. Research organizationsmight be liable for establishing the baseline and frequently monitoring the changes due to interventions planned to improve ES, as necessary.

Introducing PES in Water Supply of towns in the North Shewa of Oromia zone

There are experiences in the world (New York, Quito, Nairobi, etc.) related to PES for urban water supply where the catchment of the water source is treated significantly through a PES system, and the urban households also donate to the cost of watershed management through the payment of increased water bills. We strongly recommend that PES could be applied in the study area because the idea could be attractive and affordable to the consumers, and the intervention will improve the quality and quantity of water. To implement this payment scheme estimating the cost of the intervention and monitoring the impact of the intervention(return on investment) is essential.Assessing water consumers willing to pay for a PES scheme given that the watershed management intervention improves their water quality and quantity is possible.

Implementing REDD+ Project and Forest Management in the Zone

In Ethiopia from 2007 to 2012 forests were reduced from 167,350 km2 to 120,144 km2 (World Bank, 2015). This shows that how much forest degradation is severe in the country. To scale back this problem proposals should be developed to reduce emissions from deforestation and forest degradation, and enhancement of carbon stocks (REDD+), focusing on conservation, sustainable management, and forest enhancement activities. Different studies show this can greatly reduce CO2 emission, protect biodiversity, and improve Non-Timber Forest Products (NTFPs). Currently, Voluntary Carbon Markets (VCM) are a notable platform through which emission reductions from forestry are traded(Diaz et al. 2011). The environmental honesty of REDD+ requires the generation of actual, stable, and confirmable emission reductions (UNDP 2009). Because of the uncertainty of forest carbon stock estimates having reliable baseline data and properly monitoring the changes that occur because of reforestation and improved management is important (Watson et al. 2013).

4. Conclusion and Recommendation

This study investigated determinants and sustainable financing mechanisms for participatory natural resource management in North Shewa of Oromia regional state. This study was undertaken with the objectives of identifying personal, physical, and institutional factors affecting farmers' participation and identifying sustainable financing mechanisms for participatory natural resource management practices in the zone. A multistage sampling technique was used to select sample farm households. In the first stage, WaraJarso, GirarJarso, and HidabuAbote were objectively selected. In

the second stage, 3 kebeles (one kebele from each woreda) were selected. In the third stage, a total of 396 sample farm households were randomly selected from selected kebele's using the lists of the farm households (in each kebele) by Development Agent (DA) of respected kebeles. Deep literature review, descriptive statistics, binary logistic regression model were analyzed t to see the relationships between explanatory variables and the level of farmers' participation in participatory natural management.

Descriptive statistics of the study showed that most (90%) of respondents claimed soil erosion are the major causes of land degradation, while most (82%) of lowland respondents claimed that deforestation is the cause of land degradation in the zone. The study also showed that 97% of the respondents are agreed to participate in participatory natural resourcemanagement. More than 90% of respondents order the problem of the area in the following ways: These are Food shortage, lack of clean and sufficient water, shortage of animal feed, lack of infrastructures (like road, school, hospital, electricity, etc), epidemic diseases, lack of market for their product, etc.

The binary logit regression analysis results of the study indicated that among the 11 hypothesized explanatory variables included in the model, 7 were found to have a significant influence on the farmers' decision to participate in participatory natural resource management programs. In this regard, the results confirmed that variables like gender, agricultural labor force, extension service, farm size, slope, level of education, and productive safety net program were key factors affecting the farmers' decision to participate in participatory natural resource management programs. Particularly Farm size, agricultural labor force, agricultural extension services, access to credit, educational status, and safety net program indicated positive influence, while gender and slope indicated a negative influence.

The study reviewed countries that have good experiences and could be a good lesson for Ethiopia in general and our study in particular in payments for ecosystem services such as East African countries, China, Costa Rica, and Ecuador. Introducing PES in watersheds in the zone, REDD+ Project and Forest Management, and Introducing PES in Water Supply of towns in the North Shewa of Oromia regional state were identified as a suitable sustainable financing mechanism for participatory natural resource management in the North Shewa of Oromia regional state.

Our finding indicates more effort is needed for raising farmers' awareness through delivering information on the importance of participatory natural resource management programs. The study also recommends that similar research should be conducted in other watersheds to validate the findings of this study and a more in-depth study should be done by incorporating other variables such as farmers past experiences and farmers' trust to government policy, to further enhance the identification of factors that affect farmers' participation in participatory natural resource management programs to improve the prediction of the level of their participation.

Finally, we strongly recommend developing action plans and the steps that are necessary for water-related or forest-based PES are important for sustainable financing mechanisms for participatory natural resource management in the study area.

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Confilict of Interest

We the authors of this manuscript declarethat there is no conflict of interest among researchers and ensure thatwe are responsible for any conflict of interest that may arise

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