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Research Article

Assessing Land Owner Farmers Willingness to Participate in Reforestation Project in Ethiopia

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ABSTRACT

Converting farmlands to forest program could significantly contribute to the conservation of forest in areas where forests are facing increasing deforestation and degradation. While such reforestation project provides wide range of ecological benefits, they also reduce the amount of arable land available to the farmer. To balance ecological benefit and farmers opportunity cost, it's is reasonable to compensate farmers in the form of monetary payment (Dollar amount) per hectare of reforested land. This study examined landowner's willingness to participate in reforestation project in Ethiopia. The amount deemed acceptable by farmers and socio-economic factors that influence farmers WTA were investigated. To this end 100 farm households were surveyed from Gimbo district, Kafa zone, Ethiopia. The result shows that 64% of respondents are willing to participate in the reforestation project. With 2020 average exchange of (36ETB/USD), the respondent's lower and upper limits WTA were found to be $55.55 and $277.7. The average amount of compensation requested per ha of land was found to be around $92. The Tobit regression model indicates that land size, coffee production, number of livestock, use of forest products, family size and education were the main factors influencing respondents WTA. The study recommends direct regulatory PES scheme as one possible alternative for forest conservation and restoration in kafa biosphere region.

Keywords: Willingness to accept; Payment for ecosystem services; Reforestation; Tobit model

INTRODUCTION

Forest ecosystem performs multitude of ecological functions including mitigation of green house (carbon sequestration), nutrient cycling, protection of water for household and hydroelectric uses, protection of biodiversity, and improvement of air quality and preserves natural scenic beauty [1-3]. In addition forest ecosystem provides an important contribution to the livelihood of the peoples living in the forest area. The forest is important source of timber products such as firewood, charcoal, bamboo and a variety of non-timber products like wild coffee, wild honey, spices, herbs and medicines [4-6].

In spite of the aforementioned local, regional and global benefit of forest ecosystem the forest resource did not received effective care and conservation across the globe. The world has lost substantial portion of its forest resource due to deforestations and forest degradation. The world has lost 198 million ha of forest since 1990 [7]. After 1990 the forest resource of the world increased due to reduction of deforestation in some countries and increase of forest areas.

Conversely in Ethiopia the loss of forest dramatically increased since 2000's. From 2002 to 2019 Ethiopia has lost 72,500 ha of humid primary forest and 410,000 ha of tree cover. Oromia and SNNPR are the top two regions who were responsible for 82% of all the forest loss. Before 50 years over 40% of the country's land is covered with forest currently only 3% of land is covered with forest resource. Most of the remaining forest is located in south west Ethiopia in Kafa and Sheka biospheres [8].

The kafa zone which is designated as biosphere by UNESCO is home for last montane rainforest in Africa. It is the birth place of wild coffee (coffee Arabica). It contains more than 5000 species of wild coffee. The forest is also rich in biodiversity. The forest contains around 106 species of woody plants, 100 species of birds, and more than 48 mammalian species. The forest in kafa provides an important contribution for more than 600,000 peoples living in the region. It provides wild coffee, spice, herb, medicine, timber products and wild honey with unique quality and flavor [9,10]. Its sustainable management supports the life of thousands and grants the sustainability of a very large tract of forest area. However this forest is being dramatically reduced as result of dependence on

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wood for energy and construction as well as conversion of forest to arable land by the local population. In the last 50 years Kafa lost more than 40% of its forest resource due to deforestation [11-13].

This signifies the urgent need for conservation of the existing forest resource and restoration of the lost forest area. Restoration can be achieved by designing effective community based reforestation program. Such project will guarantee the genetic exchange within the forest site, and also secure the provision of ecosystem service vital to the local community such as land conservation, improving water quality, timber, medicine and various forest products [9,10,14]. The reforestation project has global significance by mitigating greenhouse gas emission and reducing global warming [15,16].

But such reforestation projects require converting household farmer's arable land to forest. This puts financial pressure on farmers as they entirely depend on their land for living. There is a need to balance ecological benefit gained and economic loss incurred by farmers in providing ecosystem services.

Due to this the land owner farmers deserves to receive direct payment for scarifying their land to provide ecosystem service. The payment for environmental service (PES) argues that those who contribute to generate environmental service should receive payment from those who benefit from the environmental service [17-19]. Accordingly the farmers deserve the payment not as subsidies but as a fair payment for the value of environmental service.

RESEARCH METHODOLOGY

Over the past decades incentive based reforestation projects (PES) have received great deal of attention as a natural resource management approach. For example Cost Rican PES which launched in 1997 by channeling more than 200 million dollar, successfully conserved more than 700,000ha of forest. In spite of this huge potential PES (incentive based conservation strategy) is not available in most of African countries in general and in Ethiopia in particular.

This paper desires to look at the issue of compensation as a motivational tool to facilitate the reforestation of degraded forest and reduction of deforestation in kafa biosphere. Applying such reforestation program in Kafa zone would provide wide range benefits as it is the place of special importance to billions of peoples around, as it is the origin of coffee. High rate of successful conservation is also possible as the people of Kaffa developed centuries of experience in forest conservation.

As far as the researcher knowledge is concerned no study has been conducted on PES scheme for conserving and restoring forest resource in Kaffa zone. This study will utilize contingent valuation method to examine household's willingness to participate in the forest conservation program. To estimate the amount of compensation, willingness to accept (WTA) can be used as proxy economic measures of environmental, as the land owner farmers are the seller of ecosystem services.

Based on the perspective of welfare loss (opportunity cost of land) in developing countries like Ethiopia and underdeveloped regions like kafa WTA is recommended as reference for the compensation standard than WTP. Accordingly the study desires; 1) Explore household's willingness to participate in reforestation project by providing one ha of their land, 2) Determine the amount of compensation they need to scarify their land, and 3) Determine socio-economic factors influencing farmers willingness to accept.

Payment for environmental service and contingent valuation method

Ecosystem service indicates wide range of benefits the natural environment provides for human beings. The benefits can be direct or indirect. For example the natural environment directly provides food, water, timber and other products and indirectly contributes in regulating air quality, in improving water quality, reducing natural disasters, and plays significant role in soil formation and nutrient cycling.

Payments for ecosystem services (PES) occur when the beneficiaries or users of an ecosystem service make payments to the providers of that service. It is based on the twin principle that those who benefit should pay for those who contribute to provide these services. For example downstream water users should pay for upstream land owners who conserve forest. In practice, this may take the form of a series of payments in return for receiving a flow of benefits or ecosystem services [17,18]. The mechanism seeks to create strategy to arrange financial transactions between service provider and user based on both parties interest. This process would internalize what would be otherwise an externality.

In recent years there has been a rapid spread of payment for environmental services schemes. The Kyoto Protocol and the introduction of reduction of emission from deforestation and degradation (REDD+) have brought Payment for environmental service to worldwide forums. Following this incentive for maintaining the provision of ecosystem services has been applied in different countries with different systems.

Payment for environmental services can be accomplished through different systems. Among others, regulatory systems of payments for ecosystem services, mitigation banking approaches and endangered species act. Payments for environmental service are provided for the following bundles of services: Carbon sequestration and storage, reforestation, Biodiversity protection, Watershed protection, and Landscape beauty (for example, for ecotourism). Regulatory payment for reforestation is applied in countries like Costa Rica, Mexico and Australia.

Concerning the service buyer, in user-financed PES programs in which service providers are paid by service users, and government-financed PES programs in which providers are paid by a third party, typically a government [18,19]. User- financed PES programs are preferred in most situations because they are most likely to be efficient as service users provide not only financing but also information on what services are most valuable, can readily observe whether they are receiving the desired service, and have a strong incentive to ensure that payments are used effectively. However the practicability of user financed PES programs are less likely.

Conversely government financed PES programs are applied in wide range of areas but they are criticized for being less efficient because of lack of direct information on service value or on whether services are being provided, and need to respond to numerous pressures that are often unrelated to the program's objectives.

The objective of a contingent valuation could be to determine the maximum amount that a user would be willing to pay to the suppliers of ecosystem service or the minimum compensation that

sellers would accept to undertake new set of activities. To date, the vast majority of CV-PES has focused on estimating the buyers' willingness to pay (WTP) for improved environmental services; only a few examine service providers' willingness to accept (WTA) payments to modify their behavior or undertake specific activities.

The study area and data collection

The kafa zone is located in south western Ethiopia, in southern nations, nationalities and people's regional state. The kafa zone has a total area of around 10,000 km^2 and around a million habitants. Subsistence farming plays a major role for local livelihoods. The peoples in the region mainly live from subsistence farming, like other parts of Ethiopia coffee is the main source of income for farmers in the region. Honey production using traditional technique also plays significant role in the life of farmers. Livestock production also play major role in the life of small holder farmers in kafa zone. The most common livestock is cattle followed by poultry, sheep and goat. The forest resource plays significant role for the livelihood of the community by providing wild coffee, wild honey, timber, medicine and wood materials for building and other related uses.

Kafa is home for last montane rainforest in Africa. It's known for its rich biodiversity including wild coffee. It also contains more than 106 species of woody plant, 100 species of birds and more than 44 mammalian species. The regions altitude ranges from 1400 to 1600m above sea level, with mean annual rainfall of 1584mm. The area is characterized by a long rain season that extends from march through October. The average maximum and minimum temperatures are 27.10 and 11.8^{0}c.

Kafa zone is administered by the regional government in association with 10 administration sectors called weredas, 250 rural kebeles and 25 urban towns. This study will be conducted in kafa zone particularly in Gimbo District. A multistage random sampling technique was employed to select four farming communities from twelve farming communities and then finally 100 farm households were selected for interview.

The number of households interviewed in each village are as follow; Beka (18), Obera (18), Dara (28), and Agama (36). Questioners were prepared and distributed to respondents to collect data on socio-economic variables and on their willingness to participate in the reforestation project. In the contingent valuation section of the questioner, hypothetical market detail was conducted to explain the respondent land owners the advantage and dis advantage for accepting compensation to engage in tree planting project on at least a hectare of their land at least for period of ten year.

Analytical model

The tobit model, also called a censored regression model, is designed to estimate linear relationships between variables when there is either left- or right-censoring in the dependent variable (also known as censoring from below and above, respectively). Censoring from above takes place when cases with a value at or above some threshold, all take on the value of that threshold, so that the true value might be equal to the threshold, but it might also be higher. In the case of censoring from below, values those that fall at or below some threshold are censored [20].

A simple Tobit model was used to model farmers WTA using maximum likelihood estimation procedures. Tobit model constitutes the basic structure of the models with limited dependent variable that derive from the qualitative variables models, in the sense where one should model the probability for the variable to belong to the interval in which it is observed.

Accordingly WTA belongs to the interval (0 - ∞) as there exists no negative compensation and this justifies the use of censored regression model. The choice is dichotomous: either the respondent agrees to participate, WTA > 0 or he does not accept WTA = 0. The Tobit model was largely applied to the studies of technologies adoption or participation to conservation programs a number of studies applied tobit model in assessing farm households willingness to accept in various conservation programs. Among others Jones Abrefa Danquah et al. [15] and Moukam et al. [16] utilized WTA for assessing households willingness to participate in forest conservation programs.

$$WTA = \alpha + \beta ixi + \mu i = xi\phi + \mu i \quad \text{.....} \quad (1)$$

Where, xi is a row vector of explanatory variables that determine the respondent's WTA or to participate to the reforestation program, a column vector of the parameters to be estimated, μi an error term with a normal distribution N (0,1) and with:

$$WTA = \{WTAI^*, IF\ WTA > 0\}\ OR\ \{0, IF\ WTA \le 0\} \quad \text{.... (2)}$$

WTA ∗ follows a normal distribution and is a latent variable representing the observed WTA of individual '. The tobit model is composed of two parts: a continuous part corresponding to a linear regression and a discrete part related to the censored point, equal to zero in this case. The probability that WTA ∗ takes a negative or a value equal to zero is given by:

$$\Pr ob(WTA \le 0) = \phi\left(-\frac{xi\phi}{\alpha}\right) = 1 - \phi\left(\frac{xi\phi}{\alpha}\right) \quad \text{.....} \quad (3)$$

And the probability for WTA* to take on positive value is

$$\Pr ob(WTA \le 0) = 1 - \phi\left(-\frac{xi\phi}{\alpha}\right) = \phi\left(\frac{xi\phi}{\alpha}\right) \quad \text{.....} \quad \text{. (4)}$$

Empirical model

The dependent variable is willingness to accept which takes any positive value if the farmer is willing to participate in the reforestation project and value zero if the farmer is not willing to participate. Explanatory variables included in the model are described below in Table 1.

Accordingly the estimated model will be:

$$E(WTA) = \alpha + \beta 1 gender + \beta 2 age + \beta 3 family + \beta 4 edu + \beta 5 land + \beta 6 training + \beta 7 coffee + \beta 8 livestock + \beta 9 UFP + \beta 10 income + Ui$$

RESULTS

Socio-economic characteristics of participants

Among the total respondents 61% where male, while the remaining 39% are females. When we look the age structure of respondents the majority (50%) are in range value of 30 to 50 years old. The remaining 26% and 23% respondents represent below 30 years old and above 50 years old age structure. The highest educational

Table 1: Description of variables to be used in the model.

Variables	Description
Sex	Sex of household head (Dummy):1 if male 0 if female
Age	The age of household head (continuous)
Fam SZ	Family size (continuous)
Edu	Education level of respondent (Dummy): 0 if illiterate, 1 if primary, and 2 if secondary
Land SZ	Farm size (continuous)
Training	Training (Dummy): 0 if not trained and 1 if trained
Coffee pr	Annual coffee production (continuous)
Livestock	The number of cattle, sheep and goats (continuous)
User fp	Use of forest product (Dummy): 0 if not user and 1 if user
Income	Annual income of farm household (continuous)

enrollment secondary school (16%), followed by primary school (43%), and illiterate (41%). Among the total respondents 37% respondents have more than eight members in their family, 32% have from 5 through 8 members in their family and the remaining 31% have below 5 members in their house hold.

From investigated households 67% uses a variety of forest products like wild coffee, wild honey, spices and timber products, and 59% of respondents received training concerning the necessities of conserving natural resource and biodiversity. The average annual income of the respondents was around 6980 ETB ($194) the conversion to USA dollar was based on the 2020 average exchange (36ETB/USD). Majority of the respondents 40% and 42% own 3ha and 2ha of land respectively. Most of respondents produce coffee and keep livestock's on their land. On average the small holder farmers harvest up to 2 quintal of coffee per year.

Farmer's willingness to participate in reforestation project

Among the total respondents 64% of respondents expressed their willingness to participate in the reforestation project by receiving compensation for providing a hectare of their land. While the remaining 36% refused to accept compensation to take part in the reforestation project. Concerning the amount of compensation requested by the household wide range of variation is observed between minimum values of $56 ha/year and a maximum values of $277. The average compensation requested by land holders is found to be $92.

Majority of the respondents (17%) requested $139 and the same number of participants also requested $167 per ha of land. Higher level of compensation is demanded by those households who produce high quantity of coffee and keeps large number of livestock's (cattle's and sheep). The minimum levels of compensation demanded were found to be $56 (Figure 1).

Econometric results of factors determining the farmer's WTA for reforestation program

The result of censored tobit regression model is presented below in Table 2. According to the result family size, land size, coffee production, training, number of livestock, use of forest product and education were found to be significant variables affecting household's decision to participate in reforestation project.

The coefficient of family size was found to be negative and significant at one percent. The negative sign indicates that as the number of individuals in a given household increases the household head is less likely to participate in reforestation project. As the number of children's increases the demand for land rise as parents desire to inherit arable land to their children's. The variable farm size was found to be positive and significant (at one percent). Households with larger family size are more likely to subscribe to the reforestation project. As the proposed reforestation project demands small holder farmers to scarify one ha of their land, farmers with larger land size will be more willing to participate in the conservation activity than farmers with small land size.

The quantity of coffee produced annually was found to be significant (p>0.005) and positively related to WTA. This result is not surprising as the reforestation project can't hinder the production of coffee. It is fact that coffee can grow even in dense forest (wild coffee), so the supposed reforestation can allow farmers to harvest coffee in reforested area. Conversely the number of livestock was observed to be negative and significant (p>0.010). Unlike coffee which can sustainable grow in forest, keeping livestock demands clearing of forest. Farmers with large number of livestock resource are less likely to subscribe to the program as the supposed reforestation project reduces the available grazing land.

The utilization of forest product was found to be significant (p>0.0029) and positively related with WTA. Users of forest product well understand the variety of benefits the forest ecosystem provides, due to this they are more willing to participate in the forest conservation practice than non-users. The variables training and education were found to be significant and positive. Both training and education raises the awareness of farmers toward the benefits of environmental conservation, due to these farmers

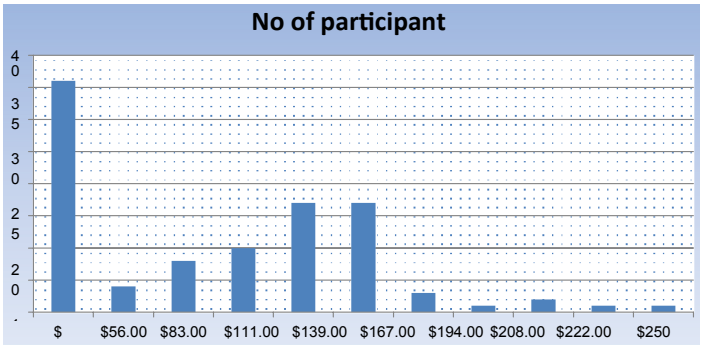

Figure 1: Amount of compensation requested by the land owners per hectare of land/year.

Table 2: Results of tobit model.

WTA	Coefficient	Standard error	T	p>t
Fam SZ	-531	106.4	-4.99	0.000***
Land SZ	.7893	.1119	7.05	0.000***
Coffee pr	429.79	147.84	2.91	0.005***
Training	1665	518.29	3.21	0.002***
Livestock	-1188.24	448.83	-2.65	0.010**
User fp	1260	568.44	2.22	0.029**
Edu	916.52	546.56	1.68	0.097*
Income	-42.16	404.89	-0.10	0.917
Sex	33.28	86.66	0.38	0.702
Age	-8.575	19.53	-0.44	0.662
Cons	484	1435	0.34	0.737
Lr Chi^2 (11)=145	prob>Chi^2=0.000		Pseudo R2=0.11	

who took training and more educated are more willing to accept compensation to participate in the reforestation project.

DISCUSSION AND CONCLUSION

In most of developing countries in general and in Ethiopia in particular, governments fail to design the overall national policies to restore natural forests after long year of depletion or to conserve the remaining natural forest. Instead of only tapping to use non-renewable resources to finance development it is essential to favor environmentally friendly activities. Facing high rate of deforestation which endangered the existence of one of its most important resource, Ethiopia needs to build a strong policy frame work around reforestation. By designing regulatory system of payment's for ecosystem service such as those currently operating in countries such as Costa Rica, Ethiopia can successfully decrease deforestation and gradual regain its forest coverage.

This study investigated household's willingness to accept compensation to participate in reforestation project in Ethiopia. We used a sample of 100 land owner farmer's response to contingent valuation survey in Gimbo district, Kafa zone, Ethiopia. The result shows that 64% of respondents are willing to participate in the reforestation project. The respondent's lower and upper limits WTA were $55.55 (2000ETB) and $277.77 (10,000ETB). The average amount of compensation requested per ha of land was found to be around $92 (3325ETB).

The result indicate that given 10 years contract period 100,000 ha of forest could be successfully conserved by channeling $92 million. The study also found that various socio economic factors like coffee & livestock production, land size, education, family size affected the decision of farmers to participate in the reforestation project. From the perspectives of economic variables the finding indicates that the reforestation project must allow multiple use forestry to provide additional source of income. Households must be allowed to harvest environmentally friendly products in the reforested land.

Increasing the value of forest products like wild coffee, wild honey and spices are sound strategy for the sustainability of the forest ecosystem. Such actions can guarantee the protection of the forest as they generate substantial income for the owners. Concerning awareness there is a need for programs that focus on mass education and training on the importance of planting tree in ecosystem. Beyond this educating household on family planning is very crucial since increasing population is one of the main threats for the forest ecosystem.

As forest resource naturally play most important role policy makers need to recognize the aggregate value of environmental services offered by the forests. To ensure the sustainability of forest resource management the country must develop incentive based innovative mechanisms which can improve the livelihood of the community while conserving the forest. Making small holder farmers the owner of forest and providing direct payment for the environmental services provided by the forests can help Ethiopian to restore its forest resources and to conserve the remaining forest base.

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