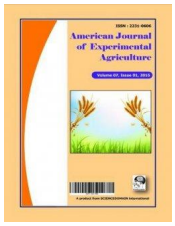

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Assessment of Farm Households' Willingness to Participate in Reforestation Projects in Ghana: Implications for Policy

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

This study examines the socioeconomic factors that influence farmers' willingness to accept monetary compensation to engage in tree planting and to evaluate realistic payment of incentives. Contingent Valuation method was employed to elicit bids levels of 200 farm households in Ghana. The empirical results of a Generalized Linear Model reveal that age of the household head, household size, education, perception to climate change, distance to the farmland, farm size, off-farm work and quantity of maize sold annually significantly influenced households' decision to accept compensation to engage in tree planting activities. These results have implications for forest management in developing countries.

Keywords: Willingness to accept; tree planting; socioeconomic factors; ecosystem services.

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1. INTRODUCTION

Tropical forest is disappearing at alarming rate through deforestation and forest degradation emanating from anthropogenic disturbances. Globally 5.2 million hectares of forest per year were lost in the period 2000-2010 [1]. However, in Africa between the same periods an estimated annual rate 0.49% of total forest area was also lost through deforestation and forest degradation [2]. Ghana at the beginning of the 19th century had 8.2 million hectares of high forest, by 1990 it was estimated that only 21% of original area covered by forest remained [3]. The average annual rate of forest cover lost through deforestation and degradation in the country between 2000 and 2010 was approximately 2% of total forest area [4]. However, deforestation and forest degradation have been implicated to be the major sources of green house gas (GHG) emission. Deforestation and forest degradation constitute 17% of overall anthropogenic GHG emission globally [5]. This is a quite substantial amount, thus, addressing the issues of deforestation and forest degradation will go a long way to mitigate GHC emissions as well as accompanying global warming and climate change. Biologically, forests serve as sink for carbon dioxide storage or sequestration. However, most of the deforestation and forest degradation occur in the tropical regions of developing countries. In view of that, United Nations Framework Convention on Climate Change (UNFCCC) in 2007 through Bali Action Plan proposed important policy packages and incentive mechanisms for Reducing Emissions from Deforestation and Forest Degradation (REDD+) and to promote conservation through sustainable forest management and enhanced carbon stock in the developing countries [6]. In addition, within the framework of Kyoto Protocol under Clean Development Mechanisms (CDM) developing countries like Ghana stands to benefit from certify carbon emission offsets through agroforestry projects that will facilitate sustainable development and reduce vulnerability of greater majority of rural farmers whose livelihood directly depends on rigors of climate change effect. Ghana can take advantage of this market to restore most of the degraded forest reserves and to create numerous job opportunities. This paper looks at the issues of compensation as motivational tool to facilitate the promotion of reforestation of degraded forest reserves and reduce deforestation in Ghana. In addition, the study seeks to provide baseline information as to the level of compensation that can be paid to landowners in rural farming communities with ample expanse of land who wants to participate in tree planting activities under CDM initiatives. The objectives of this paper were to determine socioeconomic factors that influence farmers' (or landowners) decision to accept compensation to engage in tree planting activities and to assess the level of compensations landowners or famers are willing to accept in order to apportion parcel of their landholdings for tree planting activities in Ghana.

2. MATERIALS AND METHODS

2.1 Study Area and Data Collection

This study was conducted in 2010 in the neighboring Akrobi, Droboso and Awisa rural communities of Wenchi Municipal District (7°34´38´´N, 01°55´45´´W), Brong Ahafo Region of Ghana.The average altitude of the study area is approximately 30 meters above sea level and the topography is generally undulating terrain with gentle slopes of inclination less than 1%. Wenchi District records mean annual precipitation of about 1270 mm and mean maximum temperature of about 30.9°C. The soils in the district are predominately savannah ochrosols and interspersed with lithosol. Ecologically, greater proportion of the district consists of dry semi-deciduous forest formations especially in the southern section, whilst at the north of the district, the vegetation constitutes of mainly a mosaic of gallery forest and forest patches with characteristics of wooded savannah grassland [7].

A multi-stage random sampling technique was employed to select three (3) farming communities from eleven (11) farming communities and then finally 220 farm households were selected for interview. The number of households interviewed in each village are as follow; Akrobi (n=100), Droboso (n=70) and Awisa (n=50). The interviews and administering of questionnaires were limited to the household heads (i.e., the male-headed, or de facto or de jure household heads). The Contingent Valuation section of the questionnaire, hypothetical market detail discussion was conducted to explain to the respondents (landowners /farmers) the pros and cons for accepting compensation to engage in tree planting on at least a hectare of their land estate for period of 10 years.

2.2 Analytical Model and Statistics

The bid levels of willingness to accept (WTA) were regressed on sets of socioeconomic variables [8]. The specification of the empirical model is as follows:

$$WTA = \alpha + \beta_1 Age + \beta_2 Gender + \beta_3 Household\ Size + \beta_4\ Education + \beta_5 Perception\ to\ Climate\ Change + \beta_6 off\ farm\ work + \beta_7 Farm\ size + \beta_8 Distance\ to\ farm + \beta_9 Quantity\ of\ maize\ sold + \varepsilon \quad (1)$$

Where WTA denotes the monetary amount that rural farmers/landowners are willing to accept as compensation for apportion test part of their land estate for tree planting project for period not less than 10 years. The β(s) are the coefficient of explanatory variables, α denotes constant term, and ε denotes the error term. The parameter estimates in model (1) were obtained using Generalized Linear model in E-views version 7 statistical package [9].

3.EMPIRICAL RESULTS AND DISCUSSION

3.1 Willingness of Rural Farmers (Land-owners) to Accept Compensation

The lowest bid recorded in the study was GHS 20.00($14.04) per annum and this constitutes just 0.45% of the total respondents. Conversely the extreme values or outliers above GHS 200.00($140.35) per annum benchmark was approximately 5% of the total respondents interviewed in the survey (Table 1). The bids from these group of individuals farmers may be considered as invalid outlier bids or protest bids. In general, protest bid or invalid bid constitute 5% - 10% of the total samples [10]. This makes the results from this study more reliable and consistent, since the observed variation in outlier or protest bids in the sample falls within this range. The deviation from stated willingness to accept from true values may be caused by a number of factors, notably, biasedness due to the questionnaire or the vehicle of payment [10].

However, other factors such as loss aversion and endowment effect where people resist changing what they considered to be their own have been proposed [11]. Nevertheless, at least four highest bids classes were observed in the sample. The bids levels which recorded highest frequencies of respondents were GHS 50 ($35.09), GHS 60 ($42.11), GHS 70 ($49.12) and GHS 100 ($70.18) per annum and these constitute 10%, 24.54%, 25.45% and 10.45% respectively of the total 220 respondents interviewed in the study. The true arithmetic mean value for WTA which can serve as a basis for policy formulation can be computed from these four classes of bid levels. Thus, the realistic monetary compensation is approximately GHS 70 ($49.12) per annum per hectare of land area converted to forest tree plantation. However, the overall actual mean of WTA based on 220 respondents was GHS 96($67.37), this exclude opportunity cost of the land (Table 1). These mean values of WTA monetary compensation per hectare of reforested or afforested land per annum in this rural communities were slightly lower as compared to similar projects elsewhere [12,13]. The observed variations in payments for ecosystem services in these examples attest to the fact that the magnitude of the monetary compensation should be evaluated on its own merit taken into account the local context, opportunity cost of land and for that matter the standard of living as well as transaction cost emanating from administrative and technical related issues [14]. However, the average bid values recorded in these three case study communities were within the range of spot price (4.66 Euros/tCO2) for CERs on international market [15,16]. This is based on the assumption that a hectare of forested land through afforestation/reforestation can sequestrate at least 5-11 metric tons of CO_2 per hectare per year depending on the productivity of the study area [17].

3.2 Empirical Results of Determinants of Willingness to Accept Compensation

The empirical results in Table 2 suggest that older farmers are more likely to overstate the bid level of WTA and age increases the mean WTA by factor of 1.2%. This finding is consistent [18]. The perception to climate change and its impacts on agriculture production have strong influence on most farmer decision to participate in tree planting exercise. Farmers' perception to climate change was found to be positive and significantly (P<0.001) associated with WTA [19]. Education was positively associated with farmers WTA. Education has been reported to influence significantly tree planting and conservation by farmers [8,20,21]. Education enhances the farmers' access to information and increases their willingness to engage in tree planting

Table 1. Willingness to accept (WTA) in Ghana Cedi (GHS) and US$ equivalent indicated by 220 farmers for engaging in voluntary tree planting on one hectare of their land holdings

WTA			
Ghana cedis (GHS)	**US dollars($) equivalent**	**Number of respondents**	**Percentage of respondents (%)**
20	14.04	1	0.45
30	21.05	1	0.45
40	28.07	2	0.91
50	35.09	22	10.00
55	38.60	2	0.91
60	42.11	54	24.54
65	45.61	10	4.54
70	49.12	56	25.45
80	56.14	18	8.10
90	63.15	2	0.91
100	70.18	23	10.45
140	98.25	3	1.36
150	105.26	5	2.27
160	112.28	4	1.82
170	119.30	1	0.45
180	126.31	1	0.45
200	140.35	5	2.27
>200	>140.35	10	4.54

** Dollar to Ghana Cedi exchange rate is based on interbank exchange rate of June, 2010(GHS1.425 = $1.00) Mean: GHS 96.00 ($67.37); SD: GHS 104.31($73.20); Min: GHS 20($14.03); Max: GHS 940($659.64);*

Table 2. Generalized linear model (GLM) regression estimates of socioeconomic factors influencing farmers' willingness to accept (WTA) monetary compensation to engage in the reforestation project

Variable	Coefficient	z-Statistics	Prob.
Age	0.012130	19.12473***	0.0001
Perception to climate change	2.588747	87.19825***	0.0001
Distance	0.056453	14.35320***	0.0001
Farm size	0.006307	2.131833***	0.0001
Household size	-0.019844	-5.531469***	0.0001
Off farm work	0.414631	26.93280***	0.0001
Gender	0.205043	13.18395***	0.0001
Education	0.015304	10.66215***	0.0001
Quantity of maize sold	-0.003520	-6.847521***	0.0001

*Note: ***, ** and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Ns represent non-significance at 10%*

activities [22]. Moreover, educated individuals are more willing to pay for improvement in the status quo of environmental services [23]. Education captures degree of awareness to environmental issues and farmers who are educated are more likely to subscribe to the programme [23]. Gender related issues are very important particularly in conservative rural communities of Ghana. Gender defines access to resources especially property rights on land and trees. Women are often constrained in term of resources as compared to their male counterparts [24]. Gender was significant (P<0.001) and positively correlated with the farmers' WTA compensation to engage in tree planting. This result is not surprising since a greater proportion of the household head interviewed in these three communities were generally male [25]. The positive association of gender and tree planting is not uncommon [26]. However, other studies have reported negative association between gender and tree plantation development [27,28]. Off-farm work usually implies allocation of surplus labour to other productive venture in other to generate additional income to supplement returns from main on-farm

production activities of the household. Diversion of a household's surplus labour to alternative on-farm activity such as tree planting will depend upon the level compensation. Hence, the bid levels for individual farmers who engaged in off-farm working activities will be invariably higher as turned out in this study. It was observed that off-farm work was significant (P<0.001) and positively related to WTA [29]. The annual quantity of maize sold by the individual farm household depends on the farm size, family size and other endogenous factors. The main source of income for the most of the farmers in the three communities is maize production. The quantity of maize sold annually by each farm household was found to be significant (P<0.001) and negatively associated with WTA. This result suggests that household which produced and sold large quantity of maize on the market were reluctant to accept compensation to go into tree plantation establishment. Distance to the farm holdings and the farm size are two biophysical parameters considered in the analyses to assess their influence on farmers' WTA compensation to engage in tree-growing activities. These two variables were all found to be significant (P<0.001) and positively related to WTA. These results were consistent with studies that examined the adoption of innovative agroforestry related technologies [27,30]. However, in another related studies distance from homestead to land holding or farmland was found to be negatively related smallholders willingness to plant tree [28]. The result of this study indicated that household size negatively influences the household head decision to participate in the tree planting exercise. This may be due the fact that individual farmers with large household size tend to increase their food production capacity to ensure food security and in effect channel their labour into food crop production [31].

4. CONCLUSION AND POLICY IMPLICATIONS

Based on the above empirical results, in order for the CDM-AR project be successful in these communities and for that matter Ghana in general, it is plausible for the implementing body to give the full revenue generated from sales of Certified Emission Reductions (CERs) less administrative cost to the farmers as incentive package. Moreover, there should be project mixed in the form of multiple use forestry to provide additional sources of revenue from the sale of fruits and nuts through appropriate agroforestry system [32]. One of the interesting findings is the fact the farmers' perception to climate change strongly influence their decision to establish tree plantation as a tool to mitigate climate change. This observation presents bases for a policy instruments that focus on mass education through print and electronic media about the importance of maintaining tree in the ecosystems. In the implementation of CDM-A/R projects at the community level, issues related to gender and resource utilization should be given impetus in the planning phase. Decision making process is usually in the hands of matured male within the household. Age of the household heads is another important variable that need to be factored into socioeconomic evaluation of the project. Finally, the understanding of the interplay between socioeconomic and biological interface is very important at the project planning and the implementation stages, for instance in these communities maize production is the main stay of their economy which contributes substantial amount to annual income of the households. Hence, any tree planting activities in such communities should be able to come up with agroforestry system that integrates maize production, whilst tackling pertinent issues under CDM initiative.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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