Journal of Economics and Behavioral Studies
Vol. 5, No. 9, pp. 588-602, Sep 2013 (ISSN: 2220-6140)

Analyses of Socioeconomic Factors influencing on-farm Conservation of Remnant Forest Tree Species: Evidence from Ghana

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Abstract: The contribution of remnant trees in traditional agro forestry systems in recent times has attracted significant attention from policy makers, stakeholders, and academicians due to their important role in conserving biodiversity within agricultural systems, reserves of genetic resources and provision of other important environmental services. The study seeks to determine socioeconomic factors influencing farmers' decision to maintain remnant trees in agricultural landscape. Data was solicited from 220 households in three rural communities through structured interviews and on farm visitations. We employed Poison and Negative Binomial Regressions to determine factors influencing rural farm households' decision to retain remnants forest tree species in agro ecosystem. The regression results indicated that the key factors strongly affecting farmers' on-farm conservation decision to retain remnant forest trees in agricultural landscape were age, gender, years of schooling, religion, land tenure, farmers' perceptions to current environmental problems, distance to farm land, erosion and the size of the landholdings. The study recommends that forest governance with focus on collaborative forest resource management and equitable distribution of benefits generated from extraction of forest resources should be given high impetus in policy formulation. The needs and concerns of forest fringe communities should feature paramount in this regard.

Keywords: *on-farm conservation, remnant tree diversity, traditional agro forestry system*

1. Introduction

On-farm conservation of forest tree genetic resource is seen as potential compliment to ex-situ conservation in safeguarding or protecting forest trees genetic material, particularly high valued commercial timber species for future generation. This is seen in the light of numerous advantages over conventional methods of conserving plant material in agro ecosystem (Smale et al., 2002; Long et al., 2000). The traditional agro forestry systems or practice whereby rural farmers intentionally allow remnant timber tree species on their landholdings to provide specific environmental, economic and cultural services (Anyonge and Roshetko, 2003) have been identified as one of such on-farm conservation options to protect timber species which are very rare in most Ghana's forest reserves (Robiglio et al., 2011). Ghana has over 20 high value commercial timber tree species that attract premium prices on the international market. However, due to high demand for such species this has led to overexploitation and concomitant reduction in numbers in most protected forest reserves. Moreover, the method of round log extraction in the country focuses on selective harvesting, which targets high quality merchantable matured trees to the detriment of poor quality, low value trees with crooked and malformed boles (e.g., Merry and Carter, 2001). These phenomena can erode the genetic base of these tree species or promotes dysgenics for the future generation (Snook, 1996). Additionally, mature timber tree species are the main sources of seed and pollen (Lourmas et al., 2007). The most serious challenge facing the conservation of forest tree genetic resource in the country is the current pace of deforestation and forest degradation. In contrast, the traditional smallholder agro forestry systems hold reserves of rich genetic resource of forest tree species and contain more timber trees than the remaining natural forest outside forest reserves (Robiglio et al., 2011).This is stemmed from the fact that farmers' on-farm conservation decision is such that only high quality trees with desired attributes to provide varieties of products and services are usually left on the farmland during the land clearing phase of farm development for crop production (Anyonge and Roshetko, 2003). In addition, because of the benefits the farmers derive from forest trees on farmland and as a component of agriculture fields, which invariably contains cash and food

crops, smallholder farmers take the necessary precautionary measures to protect these forest tree species (Degrande et al., 2006; Dumenu, 2010).

Furthermore, over period of generations most rural farmers have acquired body of indigenous knowledge associated with their uses and management (e.g. Jackson, 2007). This enhances on-farm conservation effort of these native forest tree species. Biologically, remnant forest trees on farmlands environment or agricultural landscapes act as sources of seed and pollen , habitat for dispersers and provide necessary condition for ecosystem functioning through nutrient recycling and moisture conservation as well as facilitate natural regeneration (Heitz-Sierfert et.,1996; Nepstad et al., 1991; Estrada et al., 1993; Greenberg, 1989; Nadkarni and Matelson, 1989; McClanahan and Wolfe, 1993).The remnant trees serve as the link between fragment forests and agro ecosystem, thus facilitating natural regeneration in the event of abandonment of the agricultural fields (Nepstad et al., 1991; Guevara and Laborde, 1993; Guevara et al., 1986). Nonetheless, for protection and conservation purposes, Ghana's forests are divided into off-reserve and on-reserve areas. The protected area or on-reserve consists of 266 pockets forest reserves, 216 occur in the high forest timber-production zone. However, many of these forest reserves were in a totally or partially degraded state, when inventory was conducted to ascertain stock levels in the 1999s (Hawthorne and Abu-Juam, 1995; FAO, 2001).The off-reserve areas characteristically consist of mosaic agriculture fields, patches of secondary forest, cocoa farms, food crop farms, fallow farm lands and homestead (Kotey et al., 1998; Dumenu, 2010). To the best of our knowledge, studies (e.g., Gauchan et al., 2005; Smale et al., 2002; Wale, 2010; Asrat et al., 2010; Birol and Smale, 2007) that have analyzed behavioral factors affecting on-farm conservation decision of rural farmers particularly crop genetic resources, none have linked it to the underlying courses for farmers to retain remnant population forest tree species in agricultural landscape. The objective of this paper was to determine socioeconomic factors influencing rural farmers' on-farm conservation decision of remnant forest tree species in agricultural landscape in Ghana. The rest of the paper is structured as follows. Section two presents the Theoretical and Conceptual framework. Section three presents the Materials and Methods. Section four presents the Empirical Results and Discussions. Section five presents the Conclusions and Recommendations.

Theoretical and Conceptual framework: The farmers' choice decision to maintain specific types of tree species on their farmland or landholdings are influenced by their preferences for bundle of attributes or morphological characters found in such trees that provide ecosystem services to meet the farm household basic needs. The decision to select one species of tree against myriad of other tree species available on their farmland can be considered under general framework of utility maximization. Thus, farmers will choose a tree to maintain or conserve on their farmland, when they derive maximum benefit or utility from doing so against alternative options. The study draws its theoretical foundation from consumer choice model (Lancaster, 1966; Micheal and Becker, 1973) and the conceptual framework is based on econometric models of random utility (McFadden, 1974; Asrat et al., 2010; Deressa et al., 2008). Assuming a farmer has two or more unique forest tree species on his farmland to select from and maintain as remnant forest trees after clearing of virgin forest for agricultural activities, the farmer's choice decisions can be denoted as Y_i and Y_j ,whereas the utilities derive from these two options are represented as U_i and U_j respectively. The random utility functions are as follows:

$$U_i = \beta_i X_i + \varepsilon_i \; ; \; U_j = \beta_j X_j + \varepsilon_j \qquad (1)$$

Where X(s) are vectors of farmers' socioeconomic and farm characteristics as well as their perception to climate change and general environmental related issues. These factors are assumed to influence farmers' choice decision making process with the aim of retaining specific tree species with certain attributes or characteristics on their farms to provide the needed ecosystem services or products they so desired. The β (s) in the utility models represent the parameter estimates and, ε (s) are error terms. The error terms are assumed to be identically and independently distributed (iid) random variable with zero means and variance σ^2. In the event that an individual farmer decides to select tree *i* instead of *j* the relationship between the utility function becomes:

$$U_i(\beta_i X_i + \varepsilon_i) > U_j(\beta_j X_j + \varepsilon_j) \qquad (2)$$

This presupposes that the individual farmer derives greater utility from tree *i* than tree *j*. The probability that individual farmer will choose *i* over alternative option *j* is expressed as:

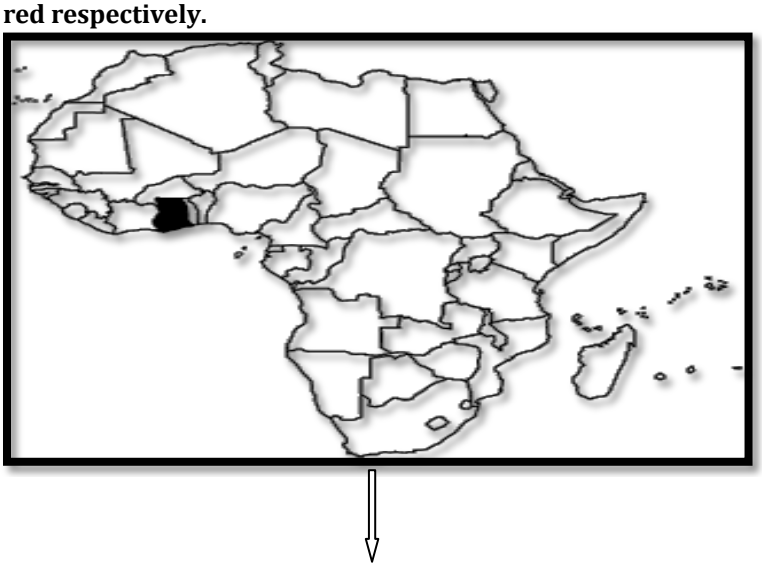
$$P\{\beta_i X_i + \varepsilon_i > \beta_j X_j + \varepsilon_j ; \forall i \neq j\} \quad (3)$$
$$P(\beta_i X_i - \beta_j X_j + \varepsilon_i - \varepsilon_j > 0 \mid X)$$
$$P(\beta^* X + \varepsilon^* > 0 \mid X = F(\beta^* X)$$

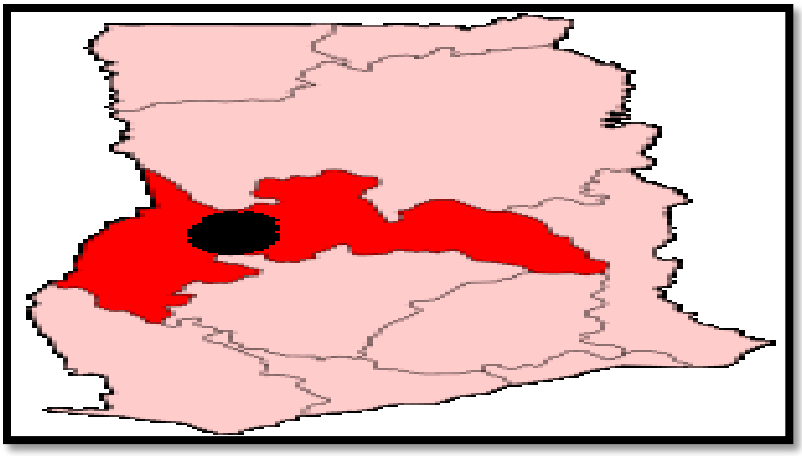
Where P is the probability function, $\beta^* = \beta_i - \beta_j$ is vector of indeterminate parameter and $\varepsilon^* = \varepsilon_i - \varepsilon_j$ random disturbance term and $F = \beta^* X$ is cumulative distribution function (Green, 2000).The cumulative distribution function (F) can be estimated econometrically from various known models. However in this study, we employed count model within the family of Poisson regression models due to the discrete nature of the dependent variable (Cameron and Trivedi, 1998). The ordinary least square estimator is inappropriate under this circumstance.

2. Methodology

Study sites: The study was carried out in dry-semi-deciduous forest ecological zone in Wenchi Municipal District (latitude 7°34´38´´N, longitude 01°55´45´´W), Brong Ahafo Region of Ghana within three case study communities (Akrobi, Droboso and Awisa) (Figure 1).

Figure 1: **Map showing the locations of Wenchi District and Brong Ahafo region shaded in black and red respectively.**





Topographically, the district is composed of lowlands and hills. The Wenchi district has average altitude of approximately 30 meters above sea level. Wenchi District has bimodal rainfall pattern, with the peak of the rain season occurring between June and July. The area records mean annual rainfall of about 1500mm and mean maximum temperature of about 30.9^{o}C (Swaine, 1992). The soils in the district are predominately forest ochrosols and interspersed with lithosol (Brammer, 1962). These soils have low clay content, fertility and subject to drought (Ahn, 1970). Geologically, the area is underlain by varieties of rock types including granite, sandstone, Precambrian schists, shale, quartzite and gneiss (Hall and Swaine, 1981; Swaine, 1992, 1996). Ecologically, greater proportion of the district consists of dry semi-deciduous forest formations especially in the southern section, whilst due north of the district the vegetation constitute mainly a mosaic of gallery forest and forest patches with characteristics of wooded savannah grassland (Afikorah-Danquah, 1997). Based on population and housing census of 2000, Wenchi District has population of approximately 166,641 people (Ghana Statistical Service, 2005).The predominant ethnic group in the district is Akan speaking natives (Bono including Banda) constituting 62.7% and to lesser extent settler farmers of Mole-Dagbon (15.4%) and Gurma (4.3%), and the rest from other various ethnic minority groups in the country (Ghana Statistical Service, 2005). The major occupation of the district and the case study communities is farming and major crops grown are maize, yam, plantain, cassava and coco yam and vegetables being minor crops. Acquisition of land for agriculture activities is mainly through communal or customary system of tenure arrangement and to lesser extent from other forms of land tenure systems (Kassaga and Kotey, 2001).

Data collection: Primary data was collected mainly through interviews of individual farm household head using a structured interview questionnaire and by conducting focus group discussion. Before the commencement of the survey in the selected communities, initial consultations were made with government representatives and the traditional rulers within the communities to get their approval and backing. A multistage random sample technique was employed to select three villages from total of 12 well defined communities and subsequently 220 households. The total household sampled were apportioned as follow; Akrobi (n=100), Droboso (n=70) and Awisa (n=50) based on demographic and physical characteristics of the chosen villages. However, within each household the interviews and the administration of the questionnaires were limited to male-headed, de facto or de jure household heads to generate socioeconomic data for the analyses. Moreover, pre-testing of the test instruments were conducted to evaluate whether the test items are able to elicit the expected information and in addition to give hand-on training to the enumerators to maintain consistency and reliability of the data.

Empirical model and statistics: The relationship between individual farmer's decision to conserve remnant tree species, farm, household characteristics and perception to issues related to climate change and environment in general were estimated triple hurdle regression models. The models that describe the effect of socioeconomic factors and perception to climate change on farm household head decision to retain remnant tree species were specified as Poisson regression models. Let Y be a random variable representing the number of tree species selected and maintained on the farm estate after clearing by the individual farmer.

Y follows a Poisson distribution with parameter μ if it takes integer values y = 0, 1, 2...n and with probability function described as follows (Sokal and Rohlf, 1981; Cameron and Trivedi, 1998):

$$\Pr\{Y = y\} = \frac{e^{-\mu}\mu^{y}}{y!} \quad (4)$$

for μ > 0. The mean and variance of the above distribution is equivalent to

$$E(Y) = \mathrm{var}(Y) = \mu \quad (5)$$

The operation models for above analyses are specified as follows:

$$y = e^{\beta_0 + \beta_1 \mathrm{age} + \beta_2 \mathrm{Gender} + \beta_3 \mathrm{YearsofSchooling} + \beta_4 \mathrm{Religion} + \beta_5 \mathrm{Tenure} + \varepsilon} \quad (6)$$

$$y = e^{\beta_0 + \beta_1 \mathrm{Mitigation} + \beta_2 \mathrm{NGO} + \beta_3 \mathrm{Protectionofyoungsaplings} + \beta_4 \mathrm{Climatechange\&Deforestation} + \varepsilon} \quad (7)$$

$$y = e^{\beta_0 + \beta_1 \mathrm{Distance} + \beta_2 \mathrm{Erosion} + \beta_3 \mathrm{FarmArea} + \beta_4 \mathrm{Landholdings} + \varepsilon} \quad (8)$$

Equations (6) and (7) explain the effect of household characteristics and perception to climate change on the choice processes of the household head. However, in the case of equation (8) it was estimated as negative binomial regression model to determine the effects of farm characteristics on choice decision making process of the household head. Negative binomial estimation was employed in this instance due to over-dispersion of some of the independent variables and problem with heteroscedasticity (Walter, 2007). Here the β (s) and the ε (s) in the models are parameter estimates and random error terms respectively. The detail descriptions of the explanatory variables are given in Table 1.

Table 1: Variables, Measurements, Hypothesized sign, and Descriptive statistics of sampled farm households

Variable	Variable definition /rational	Measure	Hypothesized Sign	Mean	S.D.
Age	This is age of the household head either de facto or de jury. Older generation possesses body of indigenous knowledge related to use and importance of certain trees species. Hence, will conserve remnant trees on their farms considered to be beneficial.	Years	+	44.89	11.83
Gender	This measure of social role with respect to access to resource. Generally male headed households are resource endowed. Thus, male headed household will readily maintain and protect trees on their landholdings or farmland.	Male =1 Female=0	+	0.47	0.50
Years of Schooling	This is number of years the household head spent at school. Educated individuals are more enlightened and aware of the importance of trees in maintaining ecosystem	Years	+	6.94	5.62

	integrate.				
Religion	There is relationship between religion and respect for nature and conservation. Hence, religious individuals will maintain remnant tree species on their farmland. (Yes =Moslem, Christianity, Traditional ;Other religion = No)	Yes = 1 No = 0	+	0.92	0.28
Tenure	Households who have rights and ownerships to land will maintain trees on their landholdings or farm land. Since they will have tenure right to the trees at the time of maturity. (Yes=Communal/Title deed; No= lease/Share cropping/Rent)	Yes=1 No =0	+	0.80	0.40

Table 1: Continued

Variable	Variable definition/rational	Measure	Hypothesized Sign	Mean	SD
Mitigation	This variable explains whether a household will voluntarily plant trees on their landholdings to mitigate climate change. Thus, household that supports tree planting initiatives will presumably maintain remnant old trees on their farms or landholdings.	Yes=1 No= 0	+	0.89	0.31
NGO	Household interaction with environmental Non Governmental Organizations (NGOs) will enhance their understanding or perception of the importance of trees in the environment. Such households will maintain trees on their landholdings or reduce deforestation.	Yes=1 No= 0	+	0.96	0.19
Protection of young timber tree saplings	This variable captures whether or not a household will protect saplings of timber tree species they found on their farm or landholdings in the absence of tree tenure. Hence, household which will invariably protect young important timber trees species will leave remnant adult trees on their land.	Yes=1 No = 0	+	0.99	0.28
Climate Change & deforestation	Farmer perception or awareness of the link between deforestation and climate change will cause them to maintain trees on their land.	Yes =1 No = 0	+	0.97	0.64

Table 1: Continued

Variable	Variable definition /rational	Measure	Hypothesized Sign	Mean	S.D.
Distance	This is distance from homestead to the landholding or farm. Most farmers with their farms far away from their home maintain remnant trees on their land to provide shade from rains, scotching sun and as cooking place as well as for resting during the day	Kilometers	+	3.67	1.82
Erosion	This is captured as the nature of the slope of the farm. Flat land will have limited erosion problems as compared to steep angle farmland. Farmers working on sloppy land or environment will maintain trees to control erosion on their farms.	Yes=1 No =0	+	0.95	0.22
Farm area	This is total land area under cultivation of various farm enterprises.	Hectare	+	5.17	3.40
Land holdings	This is total land estate of the household both fallowed (uncultivated) and cultivated land	Hectare	+	16.04	10.73

The y(s) in the models denote the count numbers of remnant forest tree species found on individual household farm land. All the statistical analyses were run in Eviews-7 for Windows with Poisson and Negative binomial link using Newton-Raphson algorithm and Quasi Maximum Likelihood Estimator (with Huber/White standard error and covariance).

3. Results and Discussion

Influence of socio-demographic characteristics on forest resource management: Socio-demographic analyses of the area indicate that the average age of the household head interviewed was 44.89 years (see Table 1) with most of them predominately male. This is not surprising given the cultural dynamisms of most rural communities across tropical Africa including Ghana; males are usually considered the head of both nuclear (elementary) and the extend family. Thus, major decisions that will affect the very foundation of the family is the prelude or reserve of the male and even under condition of de facto and de jury household ;the mature male is usually given the opportunity to express his opinion on major issues. This is seen as invariably indirect way of making decisions and choices in the absence of male-headed household. Gender, environment and resource governance are of significant importance in male dominated society. This has tremendous influence on natural resource allocation particularly land tenure related issues and property rights in the rural communities. Social differentiation with respect to gender is profound particularly on farm production activities and choice of crops for cultivation. In addition, it defines the social roles and responsibilities within the farm household and the rural communities at large. Education is one of the important socio-economic variables considered in the analyses as to how it affects decisions and choices of the household head in relation on-farm natural resources utilization, conservation and management. In this study, it was observed that amongst 220 household heads, 71(32.2%) have had virtual no formal education and as much as 28(12.7%) had attained only primary school level education. However, 95 (43 %) have had junior high school education as compared to 22(10 %) of secondary school education and relative lower proportion of tertiary education 5(2.3%). The aforementioned educational attainment indicators amongst the respondents in the three rural communities falls within the national range for this District based on population and housing census of 2000(Ghana Statistical Service, 2005). The considerable high levels of illiteracy amongst the three rural communities are of great concern and it has serious policy implications on livelihood improvement

interventions vis-à-vis sustainable environmental and forest management as well as dissemination information.

Nevertheless, naturally rural farmers possess proven adequate indigenous ecological knowledge of trees on their farm that are useful in making choice decisions for retention of selected trees species to meet household basic needs(IDS, 1979; Sillitoe, 1998). By this action of indirect domestication of remnant tree species; the rural farmers affect on-farm diversity and genetic constitution of tree species in agricultural landscape (e.g. Acharya, 2006). One of the pertinent issues or questions that came up during the focus group discussion involving farmers, opinion leaders and other stakeholders is who should be responsible for the conservation tree species on both agriculture landscape and on-forest reserve? This thought provoking question elicited various responses among the respondent. 15% of respondents had the view that conservation and management of forest tree resources should be solely responsibility of Forestry Services Division (FSD) of Ghana Forestry Commission (GFC), and 51% of the respondents consider the community involvement in tree conservation as being paramount. This is seen in the light of the proximity of the communities to forest natural resources. However, 20% had opinion that landowners whose land contains most forest resources particularly trees should be mandated to manage and conserve these resources. The rest of the respondents consider institutions such as District Assembly (9%) and the local Chief of the area (Traditional authority) (5%) should be given legal backing to manage and conserve forest tree resources in both agricultural landscape and in the forest reserves.

Nevertheless, these results have policy implications to current emerging or contemporary issues of legality related to sustainable forest management and governance (Ghana Forestry Commission, 2009). The high proportion individuals in favour of local communities and landowners participation in forest tree conservation alongside FSD provides the impetus or credence to government objectives of enhancing forest governance through collaborative forest management involving all these stakeholders (see Dadebo and Shinohara, 1999). In Ghana, forest land and tree tenure systems consist of customary and legal institutional arrangements that facilitate individual access and right to land, and its endowed natural resources particularly timber tree species (Dadebo and Shinohara, 1999; Acheampong and Marfo, 2011). Land and tree tenure are important factors that affect the conservation forest tree genetic resources (FAO, 2003). In the case study areas several usufructory rights exist in relation to forest land and tree tenure, these are more complex in off-forest reserve particularly in agricultural landscape within the rural communities (Damnyag et al., 2012). The farm household heads interviewed reveal that 62% have right to own land for agriculture productive activities under communal tenure system, 18% have title deed indicating direct land ownership,13% have access to land through lease arrangement and 7% through traditional share cropping. However, none of the respondents interviewed rent land for agriculture purposes in the study area. In the case of tree tenure, 10% indicated that FDS should have some legal rights to on-farm timber tree species, as against 65% for the landowner. However, 5% voted for District Assembly and 20% for the Chief (Local Traditional Authority) respectively. These results on tree tenure contravene the forest resource law, which maintains that timber trees and forest lands should be vested in the president in trust for the recognize land owning communities (GoG, 1962; Boakye and Baffoe, 2006). Hence, the legal exploitation of trees occurring naturally or planted for commercial purposes is vested in the state, and it is a statutory or criminal offence to harvest without prior authorisation or permission from the state.

However, this law has recently been amended to give room to forestation, reforestation and the development of private timber plantations (Agidee, 2011). In principle, FDS and Ministry of Land and Forestry have the exclusive right to timber trees on communal lands or stool lands on the behalf of the Government of Ghana. Moreover, these institutions determine who should have legal right to extract timber; and in addition fashioned out policies and laws related to forest management as well as enforcement of these laws and policies. The observed high level of communal tenure system of right and ownership to land makes it more imperative for the establishment of participatory forest resource management body at the rural community level. This is evident in the context whereby land is communally owned; usually community members would have open access to resources of the land, in this case forest tree resource. Nevertheless, in most forest rural communities there exist traditional sets of rules to enforce the management and utilization of forest resources (FAO 2003). In line with this observed land tenure dynamisms and to improve forest governance; FSD introduced limited collaborative forest management approach with major decisions still centralized

(Kotey et al., 1998; Agyenim-Boateng et al., 2002; Colfer, 2005; Opoku, 2006; Tropenbos-International, 2005). However, tenure insecurity has been implicated as one of the major root causes of illegal forest tree extraction in both on-reserve and off-forest reserve in the country (Acheampong and Marfo, 2011).

Thus, within the context of aforementioned results any top-down policy arrangement related to forest management is bound to fail without the involvement of the local rural communities. Moreover, in Ghana local forest communities over the years continue to be marginalized in decision-making process involving forest resource management in the forest sector (Ayine, 2008; Opoku, 2006).The stickiest issue is the unfair distribution of revenue accruing from timber extraction. If the results from this study are anything to go by, the current policy regime which allocates more revenue (royalties) from logging to District Assembly (55%) and to lesser extent office of the administrator of stool land (25%) and the local authorities (20%) to the detriment of true landowners and local communities at large need to be reviewed (see e.g. Opoku, 2006; Agidee; 2011). However, there is the need to recognize forest fringe communities' rights, equitable distribution of royalties and access to forest resources will foster sustainable forest resource management. This is paramount under emerging issues of verification systems and legality within the framework of Voluntary Partnership Agreement (VPA) with the EU under the Forest Law Enforcement, Governance and Trade (FLEGT) (Hansen, 2011).

Effect of Household Characteristics on farm conservation of remnant trees: The results of two Poison regression models and the varied negative binomial count model are presented in the Table 2. Altogether, 4 out of the 5 socioeconomic variables significantly explained household choice decision to conserve specific remnant forest tree species with desired inherent attributes on their landholdings. Age has a positive effect on household heads decision to retain bundle of tree species with certain unique characteristics on their farmlands, at the 1% significance level. This suggests that age strongly influence choice decisions making process of the either male-headed, de facto or de jury households. This result is consistent with various studies on rural farm household choice decision process involving on-farm conservation of plant genetic resources and adoption of agro forestry related technology (e.g., Gauchan et al., 2005; Ansong and Roskaft, 2011; Warriner and Moul, 1992).

Table 2: Parameter estimates of the Poisson and Negative Binomial models of socioeconomic and farm characteristics affecting on-farm conservation of remnant forest tree species.

Variables	Coefficient	Std. Error	z-Statistic	Prob.
	Household Characteristics			
Age	0.010874	0.001930	5.635735***	0.0001
Gender	0.053836	0.073587	0.731597^{ns}	0.4644
Years of Schooling	0.029202	0.005906	4.944919***	0.0001
Religion	0.092014	0.038475	2.391536**	0.0168
Tenure	0.085020	0.021898	3.882547***	0.0001
Log likelihood	-404.3243			
	Farmers' Perceptions			
Mitigation	0.119709	0.040716	2.940140***	0.0033
NGO	0.437771	0.205742	2.127768**	0.0334
Protection of young tree saplings	0.229785	0.081504	2.819323***	0.0048
Climate Change & Deforestation	0.112706	0.099092	1.137390^{ns}	0.2554
Log likelihood	-400.3375			
	Farm Characteristics#			

Distance	0.036379	0.021049	1.728258*	0.0839
Erosion	0.784155	0.108128	7.252081***	0.0001
Farm area	0.003503	0.015998	0.218980^{ns}	0.8267
Landholdings	0.007159	0.003567	2.007311**	0.0447
Log likelihood	-491.8214			

NB/ ns: Nonsignificant, Z-tests significant at *P*<0.1(*), *P*<0.05(**), P<0.01(***) percent level. # Farm characteristic was estimated as Negative Binomial Count Model. Farmers' perceptions and household characteristics were specified Poisson Regression Model.

Age has direct link to experience and acquisition of traditional or local body of knowledge over time horizon from field practice, particularly related ecophysiology and morphology of selected remnant trees and their impact on agronomy of cultivated crops of the farm household (Sinclair and Walker 1998, 1999; Richard 1989). Education attainment of the household head was captured as years of schooling in the study. This variable is positive and significantly related (*P*<0.001) to number of remnant forest tree species maintained in on-farm agro ecological systems by rural farm household. Years of schooling has direct association with choice decision processes in many instances (e.g. Nkamleu, 2005; Rahm and Huffman, 1984) and invariably affects on-farm conservation plant genetic resources (Gauchan et al., 2005). However, religion explained household head decision to retain number of remnant forest tree species on their farmland. The link between religion and conservation in rural communities is very profound to the extent that people have reverence to certain tree species (Asare et al., 2009). Moreover, in some communities the relationship between conservation of biodiversity and religion precipitate itself in the form establishment of scared groves and strip of forest reserves along revering courses (Ntiamoa-Baidu, 1995). Asare et al. (2009) reported that it is taboo in some rural communities to fell trees like *Chlorophora excelsa* and *Ceiba pentandra*, and as a result these tree species receive high level of protection. Nevertheless, the association between environmental conservation and religion has been well documented (Eneji et al., 2012; Dorm-Adzobu et al., 1991). For instance, in the culture of Akan tribes of Ghana, the souls of every native of a township are believed to be preserved in clay pot and mounted on *Alstonia boonei* and placed in the center of the town or village for occasional libation and sacrifices to be performed during festive seasons by the traditional priest. The Akan name of *Alstonia boonei* is "*Nyame Dua*" which is literally translated as God's tree.

The role of land and tree tenure systems cannot be overemphasized particularly in rural agrarian societies of tropical Africa and for that matter Ghana. In this work, we observed significant positive association (*P*<0.001) between land tenure system of the case study communities and on-farm conservation of forest remnant tree species. Based on the analysis, individuals with tenure rights through communal land tenure system showed high likelihood or propensity to retain tree on their landholdings, contrary to migrant non-native farmers without title to the land such as shared-croppers and lease holders. The positive association observed between land tenure and on-farm conservation of remnant forest tree species is consistent with other studies (e.g. Pattanayak et al., 2003; Nkamleu, 2005; Gebreegziabher et al., 2010; Degrande et al., 2006).

Farmers' perception to current environmental issues on-farm tree management: In this study, we tested whether current euphoria surrounding global warming and concomitant accompanying climate change has strong influence on farmers' conservation decision? It is generally known that rural farmers over generations have acquired body of traditional knowledge, when man began to practice sedentary agriculture. Psychologically, perception and knowledge have direct influence on individual choice decision process. One of the questions we evaluated in empirical analyses was whether farm households will voluntary plant trees in agriculture landscape to mitigate against erratic and unpredicted pattern of rainfall emanating from climate change or otherwise. This was specified as dummy variable. Thus, "mitigation" as variable significantly (*P*<0.01) explains household decision to maintain remnant tree in agricultural landscape (Table 2). This result suggests that individual households that are willing to engage in voluntary tree planting exercise are more likely to maintain remnant forest trees species on their farmland. Moreover, farm households that have had some form of interactions or dealings with Non Governmental Organizations (NGOs) involved in environmental conservation education and related areas showed more likelihood to conserve remnant forest trees on their farmland or landholdings.

Environmental NGO(s) activities significantly (P<0.05) explain household decision to maintain trees in agricultural landscape. The results of proxy analyses or indirect observation of farmers' perceptions of environmental issues on conservation decision are consistent with other studies regarding perceptions on technology adoption in agriculture (Adesina and Baidu-Forson, 1995; Adesina and Zinnah, 1993) .Thus, positive perception or values about environmental issues and for that matter forest conservation management enhances rural farmers' acceptance of conservation activities (Ansong and Roskaft, 2011). One of the perception variables considered in the analysis was whether farmer will protect young tree saplings of natural growing commercial timber tree species on their farms, knowing that they have no tenure right to such tree species. A relatively high proportion (95%) of the respondents indicated their willingness to protect young saplings of commercial timber species on their land estate. This explanatory variable was positively and significantly (P<0.01) related to farmers' decision to maintain remnant forest trees on their land (Table 2). This is result is contrary to general view that tree tenure insecurity contributes to illegal logging and deforestation (Acheampong and Marfo, 2011; Odoom, 2005; Damnyag et al., 2012).

Effect of farm characteristics on-farm conservation of remnant trees: In this study, the distance from homestead of rural household to the farm land or land holdings is an explanatory variable that significantly (P<0.10) influence rural households decision to conserve remnant forest trees species (Table 2). This result is consistent with other studies elsewhere regarding on farm conservation of plant genetic resources and tree planting decision (Mekonnen and Damte, 2011; Degrande et al., 2006). Environmental conservation which particularly concerns control and management of soil erosion is one of the main motivational factors. Erosion has significant and positive (P<0.001) impact on-farm conservation of remnant forest tree species. Similarly, Gebreegziabher et al. (2010) reported that household tree planting decision is determined by ecological benefits notably soil conservation. Land holding of individual farmer has positive and significant influence on household decision to maintain on-farm remnant forest trees (P < 0.05). This result suggests that individuals with large landholdings have high propensity to retain more diversity of remnant forest trees species. This is obvious from agronomic point of view, given that trees on farmland tend to occupy available space and cast shade that could lead to low crop productivity. These losses, however, could be compensated for under the situation of ample tract of land. Nevertheless, Asrat et al. (2010) and Gebreegziabher et al. (2010) have reported a link between the size of landholding and the tree planting decision of household.

4. Conclusion and Recommendations

The study seeks to determine socioeconomic factors influencing farmers' decision to maintain remnant trees in agricultural landscape in Ghana. Data was solicited from 220 rural households in three rural communities through structured interviews and on farm visitations. We employed Poison and Negative Binomial Regressions to determine factors influencing rural farm households' decision to retain remnants forest tree species in agro ecosystem. The regression results indicated that the key factors significantly influencing farmers' on-farm conservation decision to retain remnant forest tree in agricultural landscape were age, gender, years of schooling, religion, land tenure, farmers' perceptions to current environmental problems, distance to farm land, erosion and the size of the landholdings. The results have the following policy implications to agro forestry practice and on-farm conservation forest tree genetic resources in the country.
The involvement of local community in collaborative or participatory platform for resource management and reforestation in general featured paramount and hence, should be given impetus in policy formulation. This should be done in line with rights of forest fringe communities. Moreover, issues of land and tree tenure as well as equitable distribution benefits derive from extraction of forest resource vis-ä-vis good forest governance should also be reassessed.

It is obvious from the study that farmers' perception to contemporary issues related to climate change and environmental management explain their choice decision to maintain remnant forest tree species in agricultural landscape. Thus, given mass education to rural communities on current environmental challenges will address some level of systemic and endemic problems of deforestation and forest degradation confronting most tropical countries; including Ghana. Moreover, NGO(s) operating in these communities could be resourced to play a major role in this all important agenda. In addition, it is gratifying to note that biophysical characteristics of the landholdings of the households are strong explanatory variables affecting

on-farm conservation decisions of remnant tree species in the case study communities. Nevertheless, judicious identification of these tree species through participatory ethno botanical research will facilitate accelerated domestication of these tree species for improved agro forestry practices. The culture and belief systems of the rural communities are very important, which often are ignored by most policy makers. Most policy makers consider generic and borrowed idea from elsewhere as panacea in addressing fundamental problems of environmental and resource management. Often than not, policy makers do not take cognizance of the fact that religion plays a major role in the behavioral pattern of individual, particularly in tropical Africa, including Ghana where nature and belief systems are integrated. In brief, for pilot projects regarding on-farm conservation of forest tree genetic resources, the target group should be middle age farmers who have usufructory right through communal land tenure system. Further, the low levels of formal education in these rural communities and elsewhere need to be addressed if Ghana will meet millennium development goals.

Acknowledgement: The authors thank Masters Kwamina Ernest Frimpong and Kwame George Frimpong for conducting the enumeration or interviews on the field and to Lydia Bosoma-Yeboah Danquah (Mrs.) for data processing. Thanks also go to various Honorable Assembly Members for acting as facilitators in the communities where the study was conducted, notably Boachie. Financial support for this research work came from Academy of Finland.

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