

1 **Assessment of farm households' willingness to participate in** 2 **reforestation projects in Ghana: Implications for Policy**

3 **Abstract**

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

14 **Keywords:** Willingness to accept, tree planting, socioeconomic factors,
15 ecosystem services

16

17 **1. Introduction**

18 Tropical forest is disappearing at alarming rate through deforestation and
19 forest degradation emanating from anthropogenic disturbances. Globally
20 5.2 million hectares of forest per year were lost in the period 2000-2010
21 [1]. However, in Africa between the same periods an estimated annual rate
22 0.49% of total forest area was also lost through deforestation and forest
23 degradation [2]. Ghana at the beginning of the 19th century had 8.2 million

24 hectares of high forest, by 1990 it was estimated that only 21% of original
25 area covered by forest remained [3]. The average annual rate of forest
26 cover lost through deforestation and degradation in the country between
27 2000 and 2010 was approximately 2% of total forest area [4]. However,
28 **deforestation and forest degradation** have been implicated to be the major
29 sources of green house gas (GHG) emission. Deforestation and forest
30 degradation constitute 17% of overall anthropogenic GHG emission
31 globally [5]. This is a quite substantial amount, thus, addressing the issues
32 of deforestation and forest degradation will go a long way to mitigate **GHC**
33 emissions as well as accompanying global warming and climate change.
34 Biologically, forests serve as sink for carbon dioxide storage or
35 sequestration. However, most of the deforestation and forest degradation
36 occur in the tropical regions of developing countries. In view of that,
37 United Nations Framework Convention on Climate Change (UNFCCC) in
38 2007 through Bali Action Plan proposed important policy packages and
39 incentive mechanisms for Reducing Emissions from Deforestation and
40 Forest Degradation (REDD+), and to promote conservation through
41 sustainable forest management and enhanced carbon stock in the
42 developing countries [6]. In addition, within the framework of Kyoto
43 Protocol under Clean Development Mechanisms (CDM) developing
44 countries like Ghana stands to benefit from certify carbon emission offsets
45 through agroforestry projects that will facilitate sustainable development
46 and reduce vulnerability of greater majority of rural farmers whose
47 livelihood directly depends on rigors of climate change effect. Ghana can

48 take advantage of this market to restore most of the degraded forest
49 reserves and to create numerous job opportunities. This paper looks at the
50 issues of compensation as motivational tool to facilitate the promotion of
51 reforestation of degraded forest reserves and reduce deforestation in Ghana.
52 In addition, the study seeks to provide baseline information as to level of
53 compensation that can be paid to landowners in rural farming communities
54 with ample expanse of land who wants to participate in tree planting
55 activities under CDM initiatives. The objectives of this paper were to
56 determine socioeconomic factors that influence farmers' (or landowners)
57 decision to accept compensation to engage in tree planting activities and to
58 assess the level of compensations landowners or famers are willing to
59 accept in order to apportion parcel of their landholdings for tree planting
60 activities in Ghana.

61 2. Material and Methods

62 2.1. Study area and Data collection

63 This study was conducted in 2010 in the neighboring Akrobi, Droboso and
64 Awisa rural communities of Wenchi Municipal District (7°34'38''N,
65 01°55'45''W), Brong Ahafo Region of Ghana. The average altitude of the
66 study area is approximately 30 meters above sea level and the topography
67 is generally undulating terrain with gentle slopes of inclination less than
68 1%. Wenchi District records mean annual precipitation of about 1270mm
69 and mean maximum temperature of about 30.9°C. The soils in the district
70 are predominately savannah ochrosols and interspersed with lithosol.

71 Ecologically, greater proportion of the district consists of dry semi-
72 deciduous forest formations especially in the southern section, whilst at the
73 north of the district, the vegetation constitutes of mainly a mosaic of gallery
74 forest and forest patches with characteristics of wooded savannah grassland
75 [7].

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

87 **2.2 Analytical model and Statistics**

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

$$\begin{aligned}
 &91 \quad WTA = \alpha + \beta_1 \text{Age} + \beta_2 \text{Gender} + \beta_3 \text{Household Size} + \beta_4 \\
 &92 \quad \text{Education} + \beta_5 \text{Perception to Climate Change} + \beta_6 \text{off farm work} + \beta_7 \text{Farm} \\
 &93 \quad \text{size} + \beta_8 \text{Distance to farm} + \beta_9 \text{Quantity of maize sold} + \varepsilon \quad (1)
 \end{aligned}$$

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

101 3. Empirical Results and Discussions

102 3.1 Willingness of rural farmers (Landowners) to accept compensation

103 The lowest bid recorded in the study was GHS 20.00(\$ 14.04) per annum
 104 and this constitutes just 0.45% of the total respondents. Conversely the
 105 extreme values or outliers above GHS 200.00(\$140.35) per annum
 106 benchmark was approximately 5% of the total respondents interviewed in
 107 the survey (Table 1).The bids from these group of individuals farmers may
 108 be considered as invalid outlier bids or protest bids. In general protest bid
 109 or invalid bid constitute 5% - 10% of the total samples [10].This makes the
 110 results from this study more reliable and consistent, since the observed
 111 variation in outlier or protest bids in the sample falls within this range. The
 112 deviation from stated willingness to accept from true values may be caused

113 by a number of factors, notably, biasedness due to the questionnaire or the
114 vehicle of payment [10].

115 **Table 1:** Willingness to accept (WTA) in Ghana Cedi (GHS) and US\$
116 equivalent indicated by 220 farmers for engaging in voluntary tree planting
117 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

118 * Dollar to Ghana Cedi exchange rate is based on interbank exchange rate of June,
119 2010(GHS1.425 = \$1.00) Mean: GHS 96.00 (\$67.37); SD: GHS 104.31(\$73.20); Min:
120 GHS 20(\$14.03); Max: GHS 940(\$659.64);

121 However, other factors such as loss aversion and endowment effect where
 122 people resist changing what they considered to be their own have been
 123 proposed [11]. Nevertheless, at least four highest bids classes were
 124 observed in the sample. The bids levels which recorded highest frequencies
 125 of respondents were GHS 50 (\$35.09), GHS 60 (\$42.11), GHS 70 (\$49.12)
 126 and GHS 100 (\$70.18) per annum and these constitute 10%, 24.54%,
 127 25.45% and 10.45% respectively of the total 220 respondents interviewed
 128 in the study. The true arithmetic mean value for WTA which can serve as a
 129 basis for policy formulation can be computed from these four classes of bid
 130 levels. Thus, the realistic monetary compensation is approximately GHS 70
 131 (\$49.12) per annum per hectare of land area converted to forest tree
 132 plantation. However, the overall actual mean of WTA based on 220
 133 respondents was GHS 96(\$67.37) this exclude opportunity cost of the land
 134 (Table 1).These mean values of WTA monetary compensation per hectare
 135 of reforested or afforested land per annum in this rural communities were
 136 slightly lower as compared to similar projects elsewhere [12, 13]. The
 137 observed variations in payments for ecosystem services in these examples
 138 attest to the fact that the magnitude of the monetary compensation should
 139 be evaluated on its own merit taken into account the local context,
 140 opportunity cost of land and for that matter the standard of living as well as
 141 transaction cost emanating from administrative and technical related issues
 142 [14]. However, the average bid values recorded in these three case study
 143 communities were within the range of spot price (4.66 Euros/tCO₂) for
 144 CERs on international market [15, 16]. This is based on the assumption that

145 a hectare of forested land through afforestation/reforestation can
146 sequester at least 5-11 metric tons of CO₂ per hectare per year depending
147 on the productivity of the study area [17].

148 **3.2 Empirical results of determinants of willingness to accept** 149 **compensation**

150 The results suggest that older farmers are more likely to overstate the bid
151 level of WTA and age increases the mean WTA by factor of 1.2%. This
152 finding is consistent [18]. The perception to climate change and its impacts
153 on agriculture production have strong influence on most farmer decision to
154 participate in tree planting exercise. Farmers' perception to climate change
155 was found to be positive and significantly ($P<0.001$) associated with WTA
156 [19]. Education was positively associated with farmers WTA. Education
157 has been reported to influence significantly tree planting and conservation
158 by farmers [8, 20, 21]. Education enhances the farmers' access to
159 information and increases their willingness to engage in tree planting
160 activities [22]. Moreover, educated individuals are more willing to pay for
161 improvement in the status quo of environmental services [23]. Education
162 captures degree of awareness to environmental issues and farmers who are
163 educated are more likely to subscribe to the programme [23]. Gender
164 related issues are very important particularly in conservative rural
165 communities of Ghana. Gender defines access to resources especially
166 property rights on land and trees. Women are often constrained in term of
167 resources as compared to their male counterparts [24]. Gender was

168 significant ($P < 0.001$) and positively correlated with the farmers' WTA
 169 compensation to engage in tree planting. This result is not surprising since
 170 a greater proportion of the household head interviewed in these three
 171 communities were generally male [25]. The positive association of gender
 172 and tree planting is not uncommon [26]. However, other studies have
 173 reported negative association between gender and tree plantation
 174 development [27, 28]. Off-farm work usually implies allocation of surplus
 175 labour to other productive venture in order to generate additional income to
 176 supplement returns from main on-farm production activities of the
 177 household. Diversion of a household's surplus labour to alternative on-farm
 178 activity such as tree planting will depend upon the level compensation.
 179 Hence, the bid levels for individual farmers who engaged in off-farm
 180 working activities will be invariably higher as turned out in this study. It
 181 was observed that off-farm work was significant ($P < 0.001$) and positively
 182 related to WTA [29]. The annual quantity of maize sold by the individual
 183 farm household depends on the farm size, family size and other
 184 endogenous factors. The main source of income for the most of the farmers
 185 in the three communities is maize production. The quantity of maize sold
 186 annually by each farm household was found to be significant ($P < 0.001$)
 187 and negatively associated with WTA. This result suggests that household
 188 which produced and sold large quantity of maize on the market were
 189 reluctant to accept compensation to go into tree plantation establishment.
 190 Distance to the farm holdings and the farm size are two biophysical
 191 parameters considered in the analyses to assess their influence on farmers'

192 WTA compensation to engage in tree-growing activities. These two
 193 variables were all found to be significant ($P<0.001$) and positively related
 194 to WTA. These results were consistent with studies that examined the
 195 adoption of innovative agroforestry related technologies [27, 30]. However,
 196 in another related studies distance from homestead to land holding or
 197 farmland was found to be negatively related smallholders willingness to
 198 plant tree [28]. The result of this study indicated that household size
 199 negatively influences the household head decision to participate in the tree
 200 planting exercise. This may due the fact that individual farmers with large
 201 household size tend to increase their food production capacity to ensure
 202 food security and in effect channel their labour into food crop production
 203 [31].

204 **Table 2:** Generalized Linear Model (GLM) regression estimates of
 205 socioeconomic factors influencing farmers' willingness to accept (WTA)
 206 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%

4. Conclusions 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 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

226 the hands of matured male within the household. Age of the household
 227 heads is another important variable that need to be factored into
 228 socioeconomic evaluation of the project. Finally, the understanding of the
 229 interplay between socioeconomic and biological interface is very important
 230 at the project planning and the implementation stages, for instance in these
 231 communities maize production is the main stay of their economy which
 232 contributes substantial amount to annual income of the households. Hence,
 233 any tree planting activities in such communities should be able to come up
 234 with agroforestry system that integrates maize production, whilst tackling
 235 pertinent issues under CDM initiative.

236 **References**

- 237 [1] FAO, Global forest resources assessment 2010 main report,2010a
 238 FAO Forestry Paper 163.
- 239 [2] FAO, State of the world's forests. Food and Agriculture
 240 Organization of the United, 2011.
- 241 [3] Dadebo, M. A., and T. Shinohara, Forest resources and timber
 242 production of Ghana. Current instruments for sustainable
 243 development, Journal of Forest Research, 1999, 4, 1-12.
- 244 [4] FAO, Global tables. Trend in extent of forest 1990- 2010.Global
 245 forest resources assessment 2010.Food and Agriculture
 246 Organization of United Nations (FAO) Rome, 2010b.
- 247 [5] Intergovernmental Panel on Climate Change (IPCC),Climate change,
 248 The physical science basis. Contribution of working group I to the
 249 fourth assessment report of the intergovernmental panel on
 250 climate change. Cambridge, UK, Cambridge University Press,
 251 2007.
- 252 [6] United Nation Framework Convention on Climate Change
 253 (UNFCCC), 2007, *Bali Action Plan. Report of the conference of*

254 *the parties on its thirteenth session, held in Bali from 3 to 15*
 255 *December 2007.* unfccc. int/ resource /docs /2007/cop 13
 256 /eng/06a01.pdf. Accessed 16th May, 2012.

257 [7] Afikorah-Danquah, S. Local resource management in the
 258 forest-savanna transition zone: The case of Wenchi district, Ghana,
 259 IDS Bulletin, 1997, Vol. 28 No. 4.

260 [8] Grala, K.R., J. P. Colletti, and C. W. Mize, Willingness of Iowa
 261 agricultural landowners to allow fee hunting associated with in-
 262 field shelterbelts, Agroforestry Systems, 2009, 76, 207-218.

263 [9] IHS Incorporated Irvin California USA, 2011, E-Views, IHS
 264 Global Incorporated. <http: //www.
 265 eviews.com/general/prices/prices.html> Accessed on 10th June,
 266 2013.
 267

268

269

270 [10] Mitchell, R.C., and R. T. Carson, Using surveys to value
 271 public goods: The Contingent valuation method, Washington, D.C.,
 272 Resource for the Future, 1989.

273 [11] Kahneman, D., I. Ritov, and D. Schkade, Economic
 274 preferences or attitude expression? An analysis of dollar responses
 275 to public issues, Journal of Risk and Uncertainty, 1999, 19, 1-3.

276 [12] World Bank, Economic incentives for SFM and landscape
 277 restoration .PROFOR, 2004, 1(2), 1-7.

278 [13] Jindal, R., B. Swallow, and J. Kerr, 2008, Forestry-based carbon
 279 sequestration projects in Africa: Potential benefits and challenges,
 280 Natural Resources Forum, 2008, 32(2), 116-130.

281 [14] Van Kooten, G.C., A perspective on carbon sequestration as a
 282 strategy for mitigating climate change. Choices, 2008, 23(1), 24-27.

283 [15] GDF Suez International Power, 2012, *Carbon offsetting markets*
 284 *(Post-2012).*< WWW.tgo. or. th/download

- 285 /seminar/presentation/2012/mar/28Feb12/03_Carbonmarket_Post2
286 012.pdf > Accessed on 12th June, 2012.
- 287 [16] Tendances C., *The EU ETS and the economic downturn:*
288 *falling emissions and increasing use of credits*. June 2012, No. 70.
- 289 [17] Sohngen, B., *Analysis of forestry carbon sequestration as a response*
290 *to climate change. Copenhagen Consensus on climate*, 2009.
291 <[http://fixthecclimate.com/uploads/tx_templavoila /AP](http://fixthecclimate.com/uploads/tx_templavoila/AP_Forestry_Sohngen_v.2.0.pdf)
292 _Forestry_Sohngen_v.2.0.pdf >Accessed on 13th June, 2012.
- 293 [18] List, J.A., and J. F. Shogren, 2002, Calibration of willingness to
294 accept, *Journal of Environmental Economics and*
295 *Management*, 2002, 43, 219-233.
- 296 [19] Adesina, A.A., and J. Baidu, Farmers' perceptions and adoption of
297 new agricultural technology: evidence from analysis in Burkina
298 Faso and Guinea, West Africa, *Agricultural Economics*, 1995, 13,
299 1-9.
- 300
- 301
- 302 [20] Owubah, K., D. C. LeMaster, J. M. Bowker, and J. G. Lee, Forest
303 tenure systems and sustainability forest management. The case of
304 Ghana, *Forest Ecology and Management*, 2001, 99 (12), 253-264.
- 305 [21] Glendinning, A.J., J. Mahapata, and C. P. Mitchell, 2001, Modes
306 of communication and effectiveness of agroforestry extension in
307 eastern India, *Human Ecology*, 2001, 29(3), 283-305.
- 308 [22] Amacher, G.S., W. F. Hyde, and M. Rafiq, Local adoption of
309 new forestry technologies: An example from Pakistan's Northwest
310 frontier province. *World Development*, 1993, 21(3), 445-453.
- 311 [23] Lee, J. S., S. H. Yoo, and S. J. Kwak, Public willingness to pay
312 preventing climate change, *Applied Economics Letters*, 2008,
313 17, 617-622.
- 314 [24] Berry, S., Property right and rural resource management: the case of
315 tree crops in West Africa, *Cahiers des Sciences Humaines Orstom*,
316 1988, 24(1), 3-16.

- 317 [25] Degrande, A., K. Schreckenber, C. Mbo, P. Anegbeh, V.
318 Okafor, and J. Kanmegne, Farmers' fruit tree-growing strategies in
319 the humid forest zone of Cameroon and Nigeria, *Agroforestry*
320 *Systems*, 2006, 67,159-175.
- 321 [26] Pattanayak, S.K., D. E. Mercer, E. Sills, and J. Yang, Taking stock
322 of agroforestry adoption studies, *Agroforestry Systems*, 2003,
323 57,173-186.
- 324 [27] Ayuya, O.I., J. K. Lagat, and J. M. Mirona, Factors influencing
325 potential acceptance and adoption of Clean Development
326 Mechanism projects: Case of carbon trade tree project among small
327 scale farmers in Njoro District, Kenya, *Research Journal of*
328 *Environmental and Earth Sciences*, 2011, 3(3): 275-285.
- 329 [28] Zhang, D., and E. A. Owired, Land tenure, market, and the
330 establishment of forest plantations in Ghana, *Forest Policy and*
331 *Economics*, 2007, 9:602-610.
- 332 [29] Rahman, S., Determinants of crop choices by Bangladeshi farmers:
333 A bivariate probit analysis, *Asian Journal of Agriculture and*
334 *Development*, 2008, 5(1):29-42
- 335 [30] Emtage, N.F., and J. Suh, Socio-economic factors affecting
336 smallholder tree planting and management intentions in Leyte
337 province, the Philippines, *Small-scale Forest Economics,*
338 *Management and Policy*, 3(2), 2004, 257-270.
- 339 [31] Adesina, A. A., D. Mbila, G. B. Nkamleu, and D. Endamana,
340 Econometric analysis of the determinants of adoption of alley
341 farming by farmers in the forest zone of southwest Cameroon,
342 *Agriculture, Ecosystems & Environment*, 2000, 100, 17-37.
- 343 [32] Coomes, O. T., F. Grimard, C. Potvin, and P. Sima, 2008, The fate
344 of the tropical forest: Carbon or cattle?, *Ecological*
345 *Economics*,2008, 65, 2007-212.