International Scholars Journals

International Journal of Agroforestry and Silviculture ISSN 2375-1096 Vol. 5 (4), pp. 305-310, April, 2017. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Economic evaluation of benefits derivable from agroforestry based green growth practices in Ogun State, Nigeria

Okojie LO*, Abiola MO and Sanusi RA

Department of Agricultural Economics and Farm Management, Federal University of Agriculture, P. M. B. 2240, Abeokuta, Ogun State, Nigeria.

Accepted 12 March, 2014

Payments for environmental services (PES) especially for agro-forestry based green growth practices are considered a potential drive towards achieving a green economy in developing countries. This paper investigates the economic valuation of benefits derivable from agro-forestry based green growth practices in Ogun state, Nigeria. The environmental functions of the agro-forestry taungya sites valued were carbon sequestration, clean air, reduction of downstream flooding, and maintenance of soil fertility. The multi-stage sampling procedure was applied. The methodology involved descriptive statistics, contingency valuation method and the binary choice logit model. The proportion of respondents willing to pay for environmental service benefits resulting from green growth provided by taungya Agro Forestry (AF) system was much higher than those that were not. The log of bid offered had a negative and significant effect (P< 0.05) on the likelihood of the bid acceptance in the Willingness To Pay (WTP) valuation. This agrees with economic theory of demand with respect to the higher the price, the lower the demand. Income had the expected positive and significant effect (P<0.10) on the WTP for the environmental benefits of AF. The contact with extension agents had a positive and significant (P<0.01) relationship with the WTP for the environmental benefits of AF in the study area. The need to involve the international community in cost sharing for promotion of green growth through AF for increased benefits to all was highly embraced as the variable was positive and significant (P<0.05). Policy formulations involving moderate pricing in the payment for environmental services, enhanced income to the populace and improvement in extension contact in the study area need to be put in place. Dialogues on cost sharing with the international community on the burden of promoting agro-forestry practices, essential to green growth is imperative. These will go a long way in enhancing the derivable environmental benefits of agro forestry.

Keywords: Environmental benefits, valuation, green growth, cost sharing, willingness to pay.

INTRODUCTION

Green growth can be defined as a means to foster economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies on (OECD, 2011). The concept of green growth has become an issue of policy debate in recent years. During the recent global financial crisis, the United Nations (UN) General Assembly and its several agencies underscored that the crisis represented an opportunity to promote green economy initiatives which include using agro-forestry strategy as part of the stimulus packages being put in place to support the recovery (UNCSD, 2012).

*Corresponding author E-mail: lukeokojie@yahoo.com
Tel.: +2347038236215

Agro-forestry is a component of green growth practices. Agro-forestry is a concept of integrated land use that combines elements of agriculture and forestry in a sustainable production system (Noble and Dirzo, 1997). The integration of trees, agricultural crops, and animals into an agro-forestry system has the potential to enhance soil fertility, reduce erosion, improve water quality, enhance biodiversity, increase aesthetics, and sequester carbon (Garrett and McGraw, 2000). The organic matter derivable from agro-forestry practice through the cultivation of annual agricultural crops along with forest tree species can help to minimize pollution through minimal fertilizer usage, while enhancing farm output. Such green growth drivers of agro forestry - crop rotation, conservation tillage, raising animals on pasture and natural fertilization, raising agricultural crops with forest plantations, help to sustain farm productivity without having a negative effect on the environment. Agro-forestry improves and preserves the land and so ensures ecological stability necessary for enhanced food security and farmers' wellbeing.

In Nigeria, several studies have been carried out to evaluate the various land use practices in order to determine the agro-forestry models suitable for each geo-political zone. Adesina (1999) estimated the potentials of agro-forestry in the mitigation of CO_2 emission in the country. Farmers in Urhobo land area of the Niger Delta practiced integrated farming that uses palm trees alongside other crops to maintain soil fertility (Aweto 2000). Odurukwe (2004) asserted that a large majority of households in Abia State, Nigeria were aware on the environmental benefits of cultivating annual agricultural crops along with forest tree species.

The important roles that agro forestry strategy plays in driving green growth manifests through the cultivation of agricultural crops with protected forest crops to conserve biodiversity. In addition, agro-forestry provides connectivity by creating corridors between habitat remnants which may support the integrity of these remnants and the conservation of area-sensitive floral and fauna species. Agro forestry helps in this biological diversity by providing ecosystem services such as erosion control and water recharge, soil improvement and nutrient recycling and in this direction; it helps in preventing the degradation and loss of surrounding habitat.

Agro forestry in the greening process plays a global function of sequestering carbon. Several studies have been made along this line to quantify the global carbon sequestration rate of agro-forestry ecosystems. Dixon (1995) estimated a total of 585–1,215 million ha of land in Africa, Asia and the Americas under agro-forestry and a global potential to sequester 1.1–2.2 Pg of carbon (vegetation and soil) over 50 years. In spite of the many acknowledged benefits of agro-forestry through the cultivation of annual agricultural crops along with forest tree species and the provision of environmental goods,society's willingness to pay for agro-forestry ecosystem services is yet to be fully explored. There is the need therefore for adequate information and data gathering on the economic and monetary values of the environmental benefits of agro-forestry. This will serve as an input to developing an appropriate payment schemes for the environmental benefits of agro-forestry towards achieving a green economy.

The complexity of the current threats to agro forestry notwithstanding, the use of innovative market and policy mechanisms can internalize the true economic and monetary value of the ecosystem as a productive natural asset that provides goods and services at different levels to promote sustainable development and investment. Mechanisms that combine social, economic and environmental benefits are necessary to encourage sustained investment for the success of a green economy. Agro forestry in promoting green growth readily falls among these mechanisms. It is in this perspective; this paper seeks as its major objective to derive the monetary value of the environmental benefits associated with agro forestry in its promotion of green growth. The specific objectives however covered the socio-economic characteristics of the respondents and the determinants of their willingness to pay for ecosystem services provided by the AF driven green growth.

METHODOLOGY

Study Area

The study area is Ogun State in South Western Nigeria. The state was created on February 3rd, 1976 from the old western region. It is neighbored by Oyo, Ondo, Lagos, Edo and Delta States. It is situated within the tropics and derives its name from the "River Ogun". The state lies between longitude 2^02^1 and 3^055^1 and latitude 7^001^1 and 7^018^1. It is approximately 1.9 percent (16,762 $km^{2)}$ of Nigeria's 923,219km^2 land area of which over 70 percent is suitable for arable crop production. It is located in the moderately hot, humid tropical climatic zone of south western Nigeria. It has a tropical climate with two distinct seasons - the rainy and the dry season. The three main vegetation types in the study area are the tropical rainforest, guinea and derived savannah. It is made up of 20 Local Government Areas spread across the four main agricultural zones of the state- Egba, Ijebu, Remo, and Yewa/Awori. The overall population of the state is 3,728,098 (National Population Commission, 2006).

Data Sources and Collection

The research data were obtained through primary source with the aid of a well-structured questionnaire from the public. A pre-test open ended format contingent valuation survey was carried out in the study area to know the

actual bid amounts that will be elicited in the dichotomous-choice contingent valuation method cross sectional survey. Data were collected on the socio-economic characteristics of the respondents, the willingness to pay of the respondents (WTP) for carbon sequestration, clean air, reduction of downstream flooding, and maintenance of the soil fertility.

Sampling Procedure and Size

The sample size used for this study was 160 households. Multistage sampling technique was used for the sample survey. At stage one, two Agricultural Development Project zones (Ijebu east and Ilaro agro-forestry taungya sites) were purposively selected out of the four ADP zones in Ogun State.At stage two, 50% of the blocks were selected from each zone i.e. three blocks from Ijebu east and two blocks from Ilaro to give a total of five blocks.At stage three, four cells each per block were randomly selected to give twenty cells. At stage four, eight households were selected from each cell, which gave a total of one hundred and sixty (160) households from the study area

Analytical Technique

A combination of analytical tools was employed during the course of this study. These include descriptive statistics, the dichotomous-choice contingency valuation method, and the binary choice logit regression model. The descriptive analysis was used to depict the socio-economic characteristics and it involved the use of tables, frequency and percentage proportions while the dichotomous-choice contingency valuation method that terminated into the logit model was used to assess the willingness to pay of the respondents. The maximum likelihood estimate of the logit regression model provided the coefficients necessary to compute the monetary value of the environmental benefits as expressed by the WTP. The logit regression model is based on Hanemann (1984) Approach as also used by Turcin and Giraud (2001), Okojie, L.O. (2007) and from Cooper and Loomis (1992) which is as follows:

$$P_i = \frac{1}{[1+e^{-(\alpha+\beta xi)}]} \quad \text{.....(1)}$$

Where:

Pi = Respondents acceptance probability to the bid offered.

B*i*= Vector representing the coefficients of all covariates including that of the bid (B*i*)

X*i* = Vector representing all covariates including that of the bid (X_1)

X_1 = Bid offered to the respondents, which is what they are willing to pay (naira)

X_2 = Respondents Income (Naira)

X_3 = Educational level attained (Years)

X_4 = Household size (No)

X_5 = Sex dummy (1 = if male, 0 = female)

X_6 = Cost sharing dummy (1 = Support for developed countries sharing from the cost of green growth practices in developing countries, 0 = If not)

X_7 = Farmers years of experience (1 =If less than 10 years, 0 = If more than 10 years)

X_8 = Contact with extension agent (1 = If yes, 0 = If not)

X_9 = Immigrant status dummy (1 = If migrant, 0 = non migrant)

The Cooper and Loomis (1992) procedure for the determination of mean WTP is as follows:

$$P^{-} = 1/|\beta| * \ln (1+ \exp^{a}) \quad \text{.....(2)}$$

Where:

P^{-} = restricted mean WTP

a = intercept

β = coefficient of bid

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents considered were gender, age, income, educational leveland the WTP. The respondents were predominantly male (75%) while the female gender had (25%) proportion. The proportion of farmers between the ages of 40-49 years was 42.5% which constituted the largest percentage (table 1). The proportion of respondents earning between 10000 – 30000 Naira per month was 33.7%. The respondents consisted of 29.3% proportion that had primary education, 30.6% secondary education, and 18.1% tertiary level of education. Farmers without formal education occupied a proportion of 21.8%. Furthermore, 68.75% of the respondents were willing to pay for the environmental benefits elicited, while 31.25% were not willing to pay for the environmental benefits elicited.

The CVM tool of WTP was assessed based on whether the respondents were living around or far away from the taungya agro forestry sites. The environmental functions of the agro forestry taungya sites valued were carbon sequestration, clean air, reduction of downstream flooding, and maintenance of the soil fertility. The actual Dichotomous-Choice Contingency Valuation Method (DC – CVM) which terminated into the logit regression was used to assess the environmental benefits of agro-forestry driven green growth from the people living around and far away from the taungya plantations in the study area. The environmental benefits include carbon sequestration, reduction of downstream flooding, maintenance of the soil fertility and clean air. The relationship between the acceptance probabilities to the bid offered (WTP) for attaining the environmental benefits derivable from AFthat promotes green growth and the covariates were examined (table 2). Five variables significant were the bid offered, household size, contact with extension agent, income and the cost sharing dummy. The likelihood ratio

Table 1. Socio-Economic Characteristics of the Respondents.

Variables	Frequency		Percentage
Gender			
Male	120	75	
Female	40	25	
	160	100%	
Age			
Less than 30	23	14.375	
30 – 39	35	21.875	
40 – 49	68	42.5	
50 – 59	30	18.75	
60 and above	4	2.5	
	160	100%	
Income			
Less than 10000	31		19.375
10000 – 30000	54		33.75
31000 – 50000	37		23.125
51000 – 70000	25		15.625
71000 and above	13		8.125
	160		100%
Educational Level			
No formal	35	21.875	
Primary	47	29.375	
Secondary	49	30.625	
Tertiary	29	18.125	
	160	100%	
Willingness to Pay			
Yes	110	68.75	
No	50	31.25	
	160	100%	

Source: Computed from Field Survey Data, 2013.

Table 2. Maximum Likelihood Estimations of Responses to Willingness-to-pay (WTP) Questions and Estimation of Mean Willingness-to-pay (WTP).

Variables	Coefficient	T-ratio	Standard error	Marginal effect
Constant	-1.0701	-1.2526	0.85433	
Bid	-0.095**	-2.36	-0.39450	
Household size	-0.21301***	-4.4297	0.48086E-01	-0.46759E-01
Gender	0.51002	1.0163	0.50182	0.11196
Education	0.17963	0.72422	0.24804	0.39433E-01
Contact with extension agent	1.2902***	2.6078	0.49473	0.28322
Income	0.32254E-05*	1.8936	0.17033E-05	0.70803E-06
Cost sharing	1.1337**	2.4731	0.45840	0.24887
Farming experience	-0.32162E-02	-0.16336	0.19688E-01	0.70602E-03
Immigrant status	-1.356	0.922	0.47592	0.54782

Likelihood Ratio Test = 58.9096
McFadden R-Square = 29.2%
Number of Observation = 160
Mean Willingness to Pay = ₦84.67/ Household/ Month
Dependent Variable is the yes/no responses to the offered bid amounts.
*** Significant at 1%, **Significant at 5%, * Significant at 10%
Source: Computed from Field Survey Data, 2013.

was 58.91 and this shows that all the slope coefficients were significantly different from zero. In other words, the explanatory variables were collectively significant in explaining the WTP.

The log of the offered bid had a negative and significant effect ($P< 0.05$) on the likelihood of the bid acceptance for environmental benefits of agro forestry driven green growth practice. The negative value agrees with

economic theory as the higher the price of the environmental commodity, the lesser will be the demand.
The house-hold size had a negative and significant relationship (P<0.01) with the WTP for the environmental benefits of agro forestry driven green growth practice in the study area. The implication is that as household size increases, the likelihood in the WTP for agro forestry driven green growth practice reduces. This may be due to the fact that as the household size increases, more attention involving increased proportion of income will be given to the welfare of the household, thereby affecting downwards the likelihood in their WTP for AF environmental benefits.
The contact with extension agent dummy had a positive and significant relationship (P<0.01) with the WTP for the environmental benefits of agro forestry driven green growth practice in the study area. This implies that as contact with extension personnel increases to effectively communicate knowledge about sequestering carbon and harvesting other benefits of AF in the study area, the higher the likelihood in the WTP for the environmental benefits of agro forestry driven green growth practice in the study area.This could be in recognition of agro-forestry driven green growth playing a major role in the global carbon cycle, which was brought into the arena of international climate change policy in 1997, where 150 countries negotiated and signed the Kyoto Protocoltothe United Nations Framework Convention on Climate Change (Murray, 2000).
Income had an expected positive and significant effect (P<0.10) on the WTP in the study area. This means as income increases, the greater will be the likelihood in the acceptance probability of the WTP for deriving the environmental benefits derivable AF driven green growth. Therefore as income increases there is a shift to the right in the demand curve for agro forestry driven green growth practice.
The cost sharing dummy had a positive and significant effect (P<0.05) on the WTP in the study area implying the significance respondents attach to the international community participation in sharing the cost of effecting AF practices that propels green economy in rural areas of the developing world. This can be explained from the understanding that environmental goods do not have international borders. Whatever happens in one part of the world will affect other areas.

CONCLUSION

Agro forestry system through the cultivation of annual agricultural crops along with forest tree species has the capacity of achieving a green economy in an environmentally conscious world. In recent past, the scarcity of hard evidence has hindered the progress of agro-forestry based green growth practice and its acceptance by farmers and policy makers. In an era of environmental consciousness and ecological sustainability, the role of payment for environmental services approach is necessary to help quantify the economic and monetary value of agro-forestry driven green growth so as to achieve an inclusive green economy.

Furthermore, from the result of the findings it was shown that the need to share the cost burden of the environmental benefits of agro-forestry driven green growth practice by the industrialized countries of the world was indicated, thus emphasizing the need for global cooperation and understanding in solving the issue of attaining environmentally sound and sustainable development. The Bali protocol has spelt out what is mandatory in terms of carbon emission the developed country must be burdened with while that of the developing country is voluntary. This paper has shown this arrangement needs to be sustained for such environmental benefits of remaining ecosystems of the developing economies to be kept for global environmental stability. Efforts should also be made to raise the national minimum wage and general income levels. It is only by so doing that investment in conservation and ecosystem payment services can be encouraged and sustained. Positive environmental attitudes can be encouraged through proper environmental education and awareness. In such a way, ethnocentrism that encourages the zeal and selfish interest to protect and invest in green growth drivers only when in areas of indigenous stake holding and carelessness where otherwise will be discouraged. This is especially with respect to whether a respect is an indigene or a migrant in a locality.

REFERENCES

Adesina, F. A. (1999). Potential of agro-forestry techniques in mitigating C02 emissions in Nigeria, some preliminary estimates. Global Ecology and Biogeography 8:163-173.

Aweto, A. (2000). Agriculture in Urhoboland. Paper presented at the Fifth Annual Conference of Urhobo Historical Society, PTI Conference. Effurum, Delta State.

Cooper JC, John Loomis (1992). Sensitivity of willingness-to-pay to bid design in dichotomous choice contingent valuation models. Land Economics 68(2): 211-224.

Dixon RK (1995) Agroforestry system: sources or sinks of greenhouse gases? Agroforest System 31:99–116

Garrett HE, McGraw RL (2000) Alley cropping practices. In: Garrett HE, Rietveld WJ, Fisher RF (eds) North American Agro forestry: An Integrated Science and Practice. ASA, Madison, pp 149–188.

Hanemann, W. M. (1984). Welfare evaluations in contingent valuation experiments with discrete

Murray BC, Prisley SP, Birdsey RA, and Neil Sampson R (2000) Carbon sinks in the Kyoto protocol: potential relevance for US forests. Journal of Forestry 98: 6–11.

National Population Commission (2006).National Population Census.
Noble, I.R, R. Dirzo (1997). Forest as human-dominated ecosystems. Science 277: 522-525.
Odurukwe, S. 2004. Agroforestry in peri-urban cities of Abia State, Nigeria, UM Magazine 8-9.
OECD 2011. Towards Green Growth, OECD, Paris.
Okojie, L.O (2007). Socio-Economic and Environmental Attitudinal Determinants of Rainforest Protection: A Logit Model Analysis. Int. J. Agric. Sci. Science, Environment and Technology, University of Agriculture, Abeokuta, Nigeria. pp 204 – 218.
Responses, Am. J. Agric. Econ. 66:332-341.
Turcin Branka, Kelly Giraud 2001. Contingent valuation willingness to pay with respect to geographical nested samples: case study of Alaskan Stellar Sea Lion, W-133 Western Regional Project Technical Meeting Proceedings.
UNCSD, 2012.United Nations Conference on Sustainable Development Rio+20, Earth Summit 2012.