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PUBLIC WILLINGNESS TO PAY FOR PERCEIVED ECOSYSTEM SERVICES IN RUBBER AGROFORESTRY SYSTEMS IN EDO AND DELTA STATES, NIGERIA

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ABSTRACT

In this study, contingent valuation method using the payment card method was adopted to elicit willingness to pay (WTP) for ecosystem services obtainable in a Rubber agroforestry system (RAS) in Edo and Delta State. The value obtained from the study provided monetary estimate of ecosystem services derivable from RAS. The hypothesis tested was that there was no significant relationship between the respondent socio-economic variables and their willingness to pay for ecosystem services in RAS. A multi-stage sampling procedure was used in this study. Data was obtained with a structured and pre-tested questionnaire administered interpersonally to the respondent and also focus group discussion to validate the respondent's response. One hundred and twenty (120) copies of questionnaire were administered in each State making it a total of 240 questionnaires administered for the study. The result revealed that 191 respondents (79.6 %) were willing to pay amounts ranging from ₦ 100 to ₦1000 monthly. The modal value was ₦200 with the highest response (38.08 %). An individual monthly WTP of ₦334.4 and ₦337.9 (₦360 = $1) in Edo and Delta State were obtained in the study area. These values resulted into an aggregate of ₦2,413,810,220.8 and ₦1,384,846,318.9 in Edo State and Delta State respectively. These amounts represented the monthly monetary values of the ecosystem service derived in a Rubber Agroforestry System (RAS). Farming experience and attitude of RAS farmers are some of the socio-economic variables by which the monetary values of ecosystem service in RAS can be predicted as revealed by the multiple regression analysis. Thus, this study has been able to provide additional information for the private land users and public policy makers on the non-market environmental benefits of alternative land use options.

Keywords: Ecosystem services, regulatory services, Willingness to pay, non-market benefits, Rubber agroforestry system

INRODUCTION

Rubber (*Hevea brasiliensis* Muell Arg.) is a quick-growing tree that is widely distributed within the rainforest agro-ecological zone of Nigeria extending from Ogun, Oyo, Ondo, Edo, Delta, Imo, Abia, Akwa-Ibom, Cross Rivers, Rivers, Bayelsa, Anambra to Taraba States (Aigbekhaen and Nwagbo, 1999, Aigbekaen, *et al*., 2000). The tree rarely exceeds 25 m in height in plantations and up to 40 m for wild trees (Boedt, 2001). In Nigeria, cultivation of Rubber has been on the decline since 1970s, according to Michael (2006), the estimated rate of decline is 50 % (248,900 ha – 154,000 ha), the reasons for the decline were attributed to poor plantation management, unstable market prices, over dependence on petroleum revenue and lack of access to farm credit which made many local farmers to pay less attention to their plantations.

Thus, to accommodate this recent production and economic upturn in the industry, the need arose to diversify sources of revenue as this will ensure sustainable cultivation of Rubber by the smallholders and maximum utilization of their land area. Hence, to revamp the production of Rubber, Rubber agroforestry systems (RAS) was designed, which is the deliberate integration of high value trees, arable crops and animals into Rubber plantations. This RAS makes maximum use of resources, serves as a source of revenue for farmers especially during the gestation period of Rubber and provides a buffer against Rubber price instability in the international market. In addition, RAS enhances resilience and farmers are now in a better position to minimize crop failures and environmental shocks (Asaah *et al*., 2014) which makes the system profitable and environmentally sustainable (Asaah *et al*., 2014; Esekhade *et al*., 2014). Thus, all these conditions and processes are ecosystem services provided by the natural environment, according to Summers *et al*., (2018) natural ecosystems provide services to humans that make life possible. However, changes in climate, pollution, overexploitation, land use change and urbanization could result to loss of this ecosystem. According to MEA (2005), 60 % of ecosystem services assessed globally are either degraded or being used unsustainably, the reason being that most of the products and services derived from the forest and other alternative land use are being described as public goods (Coull and Valatin, 2008). It becomes imperative that economic valuation analytical tool should be employed to assess the benefit of forest conservation as well as how these benefits are distributed among the stakeholders and this can provide useful information for decision-makers for deciding between alternatives or preferred combinations of possible interventions in improving their wise use and management (Barbier 2007). Hence, attaching a monetary value on a public good will provide an incentive for people to produce and conserve it. Various approaches have been used to attach monetary values to non-market goods and services of the forest by economists (White and Lovett, 1999). Prominent among the stated preference method is the contingent valuation method (CVM) which is a means of quantifying public preference and willingness-to-pay (WTP) for forest goods and services or willingness to accept compensation for losing access to the forest goods and services.

A rubber agroforestry system is an alternative land use system that contributes more than two or more services to the ecosystem, thereby maintaining ecosystem stability. These services derived in a RAS are not limited only to provisioning services (provision of Rubber either in the form of latex or coagula within its rotational age, employment, tree products) but also regulating services. However, little is known about other ecosystem services in a system; hence this study is therefore very essential, as the need arises to provide information on public willingness-to-pay for Pay For perceived Ecosystem Services in Rubber Agroforestry systems (RAS) in the study area. Furthermore, the research will serve as additional information for the decision and policy makers in designing and implementing ecosystem services payment policy.

MATERIALS AND METHODS

Study Area

The study area was the south-south agro-ecological zone of Nigeria which lies between 05^{o} 04' E and 06^{0} 43'E and latitudes 05^{0} 44'N and 07^{0} 34'N in Edo State to longitudes 5^{o} 00' and 6^{o} 45'E and latitudes 5^{o} 00' and 6^{o} 30'N in Delta State of the Greenwich Meridian. The study was conducted in two States, namely; Edo and Delta, these States are known for large-scale Rubber production. The climate of the zone is essentially tropical climate, generally characterized by alternating wet and dry seasons with mean annual rainfall ranging from 2000 mm to 2500 mm.

Sampling procedure

Multi-stage sampling technique was used to select respondents for this study. In the first stage, two States were purposively selected based on their scale of Rubber production. The second stage involved a purposive selection of two Local Government Area (LGA) where Rubber Agroforestry System was practiced in each State. The third stage involved purposive selection of two (2) communities in each L.G.A while in the fourth stage, a snowball approach

was used in the selection of RAS farmers giving a total of 240 respondents (Table 1).

Sources of Data

The study employed the use of primary data and also reviewed some secondary data on Rubber (*Hevea brasiliensis*) cultivation in diversified tree-based system. The primary data was obtained with the use of a structured questionnaire. The data was collected in February, 2018. To facilitate the collection of the data for this study, the services of Rubber Research Institute of Nigeria (R.R.I.N.) extension agents was engaged. These extension agents were trained to acquaint them with the content of the questionnaire and how the information will be obtained.

The questionnaire had four (4) parts. Section A bothered on the elicited information on bio-data and socio-economic characteristics of the respondents. Section B bothered on the farm characteristics of the respondents, Section C bothered on the people's perception of ecosystem services in a Rubber Agroforestry System while Section D focused on contingent valuation survey (CVS) and value elicitation procedures. The monetary value elicitation procedure that was used is payment card system. The information obtained from the questionnaire was used to evaluate the economic vis-à-vis monetary values of the ecosystem services provided by the Rubber Agroforestry Systems (RAS).

Analytical procedure

The socio-economic data gathered from the interview were encoded in Microsoft Excel program and processed using statistical package for social science (SPSS). Descriptive statistical tools such as frequencies and percentage were used to summarize the variables of interest. Multiple linear regressions were used to find out some of the socio-economic factors affecting WTP for ecosystem service in a Rubber Agroforestry system. The model specifications are as follows;

$$WTP = f(X_1+X_2+X_3+\ldots\ldots+X_n + e) \ldots\ldots\ldots [1]$$

Where,

WTP = Willingness to pay

X_1 = Gender, X_2 = Frequency that farmers have contact with extension officers, X_3 = member of Rubber cooperative, X_4 = Income, X_5 = Education level, X_6 = RAS farmers, X_7 = Household size, X_8 = Farming experience, X_9 = Average distance to farm. e = error term

Three functional forms were tried in order to choose the one with the best performance.

Linear: $WTP = bo + b_1 X_1 + b_2X_1 + \ldots. + b_nX_n + e$

Semi-log: $WTP= Lnb_o+b_1LnX_1+b_2LnX_2+\ldots. + b_nLnX_n + LnEd$

Double log: $LnWTP = Lnb_o+b_1LnX_1+b_2LnX_2+\ldots. + b_nLnX_n + LnEd$

Where,

b_o= Constant, $b_1b_2\ldots b_n$ = Regression coefficient for WTP, e/Ed = Residual or error term, Ln=Natural logarithm.

The one with the highest coefficient of multiple determination (R^2) was chosen because the higher the R^2 the better the fit/model.

Table 1: Sampling Plan for Data Collection

State	LGA	No. Respondent	Total
Edo	Ovia South West	60	
	Ikpoba Okha	60	120
Delta	Ndokwa West	60	
	Aniocha South	60	120
Total			240

RESULT

The distribution of respondent's willingness-to-pay (WTP) for ecosystem services in a Rubber Agroforestry System (RAS) in Edo and Delta State (Table 2) showed that 79.58 % of the total respondents were willing to pay for ecosystem services derived in a RAS. This percentage ranged from 80 % (Edo State) to 79.2 % (Delta State). The Willingness-To-Pay elicited values of the respondents ranged from ₦100 to ₦1000, with ₦200 having a wider acceptability (Table 3).

Average WTP for ecosystem services across different socio-economic strata

From the study, the average WTP for the perceived ecosystem services across different socio–economic strata are depicted in (Table 4). From the pooled result in Edo and Delta States, the WTP by males (₦53,700) was higher than the WTP by females (₦11,700). The highest WTP value (₦23,400) was observed among respondents within the ages of 46 – 55 years. For household size while family size of 5 - 8 members had the highest (₦45,800) average WTP for ecosystem services. Interestingly, respondents with secondary education had the highest (₦21,200) average WTP for ecosystem services. Also, the highest average WTP value (₦21,000) was elicited from respondent earning between ₦50,000 to ₦100,000 in both Edo and Delta States.

Mean and aggregate estimate WTP values of ecosystem services in a RAS

The mean monthly amount and total monthly WTP for ecosystem services derived in a Rubber agroforestry system in the study area was ₦336.1 and ₦32,100 in Edo and Delta States respectively (Table 5 and 6). This resulted into a monthly aggregate estimate value of ₦2,413,810,220.8 and ₦1,384,846,318.9 for the ecosystem services derived in a Rubber agroforestry system in Edo and Delta State respectively (Table 6).

Mode and time of payment

From the result in Table 7, it was observed that voluntary donations (64.4 %) and yearly (58.12 %) payment of ecosystem services in a RAS were the preferred mode of payments in the study area. The lowest response was direct taxation (15.8 %) and weekly (2.62 %) payment of ecosystem services in a RAS.

Table 2: Percentage distribution of respondents on willingness to pay (WTP) for ecosystem service functions in RAS

States		Yes	No	Total
Edo	F	96	24	120
	%	80	20	100
Delta	F	95	25	120
	%	79.17	20.83	100
Total	F	191	49	240
	%	79.58	20.42	100

Table 3: Percentage distribution of Respondents individual elicited WTP value for Ecosystem Service functions in RAS

Respondent		0	₦100	₦200	₦500	₦1000	Total
Edo State	F	11	15	38	18	14	96
	%	11.46	15.63	39.58	18.75	14.58	100
Delta State	F	10	23	29	18	15	95
	%	10.53	24.21	30.53	18.95	15.78	100
Total	F	21	38	67	36	29	191
	%	10.99	19.90	35.08	18.85	15.18	100

Table 4: Average WTP across different socio-economic data in the study area

Variables	Average WTP (₦)		
	Edo State	**Delta State**	**Pooled**
Gender			
Male	29100	24600	53700
Female	3000	8700	11700
Age (years)			
Below 35	4700	2000	6700
36 – 45	7700	6100	13800
46 – 55	10700	12700	23400
56 – 65	8000	8500	16500
Above 65	700	1700	2400
Marital Status			
Single	5500	3300	8800
Married	24900	27000	51900
Widow(er)	1700	1800	3500
Household size			
1 – 4	7400	8700	16100
5 – 8	23700	22100	45800
9 – 11	1000	500	1500
Education			
No education	6400	2300	8700
Primary education	4800	5400	10200
Secondary education	11900	9300	21200
OND	7200	11600	18800
HND/B.Sc.	1800	3500	5300
Religion			
Christian	28700	26100	54800
Muslim	3400	6000	9400
Income (₦) monthly			
Below ₦50000	4900	8600	13500
₦ 50001 – ₦ 100000	10200	10800	21000
₦ 100001 – ₦ 150000	5000	2900	7900
₦ 150001 – ₦ 200000	5300	3000	8300
₦ 200001 – ₦ 250000	1200	1100	2300
Above ₦ 250001	5100	6000	11100

Table 5: Estimated monetary values of ecosystem services in the study area.

States	No. of Respondent	Total WTP (₦)	Mean WTP (₦)
Edo	96	32,100	334.4
Delta	95	32,100	337.9
Total	191	64,200	336.1

Table 6: Mean and Aggregate Estimated Values of ecosystem services in a Rubber agroforestry system

State	No. of Respondent	Total WTP (₦)	Mean WTP (₦)	Population	Aggregate
Edo	96	₦32,100	₦334.4	7,218,332	2,413,810,220.8
Delta	95	₦32,100	₦337.9	4,098,391	1,384,846,318.9
Total	191	₦64,200	₦336.1	11,316,723	3,803,550,600.3

Table 7: Mode and Time of Payment

Mode of payment	Edo State		Delta State		Pooled	
	F	%	F	%	F	%
Direct taxation	8	8.33	21	22.11	29	15.18
Maintenance levy	22	22.92	17	17.89	39	20.42
Voluntary Donation	66	68.75	57	60	123	64.4
Total	**96**	**100**	**95**	**100**	**191**	**100**
Time of Payment						
Weekly	1	1.04	4	4.21	5	2.62
Monthly	17	17.71	23	24.21	40	20.94
Quarterly	19	25	16	16.84	35	18.32
Yearly	59	61.46	52	54.74	111	58.12
Total	96	100	95	100	191	100

DISCUSSION

The high percentage distribution observed in the respondent's Willingness-To-Pay (WTP) for ecosystem services in a Rubber Agroforestry System (RAS) which was elicited through optimal bids could be attributed to the fact that the study focused on Rubber farmers who have direct benefits from the ecosystem services provided by the system and also proximity to their RAS farm. This result is in agreement with the findings of Adekunle *et al.* (2012) that recorded 90.3 % of respondent's readiness to pay for conservation of urban trees. Optimal bids were used in this study and the values ranged from ₦100 to ₦1000, with a wider acceptability of ₦200. This result could be attributed to the fact that the amount (₦200) is easier to contribute than the other high values stated in this study. In addition, people are not always willingly to pay more for indirect or public goods and services. This finding is in consonance with Ajewole (2001) and Adekunle *et al*., (2008), who reported in a similar study that ₦100 was the respondent's wider acceptability, the reason being that they were low income earners with the perception that forest and its related products are perceived as public goods and services.

The average WTP for the perceived ecosystem services across different socio–economic strata were gender biased, the reason being that the study targeted cash crop farmers that deal solely on the cultivation of Rubber who derive direct benefits from the farming system. This finding is in line with Adekunle *et al.,* (2008) who recorded a higher average WTP values among male respondents in UNAAB urban community. However, my finding was in contrast to Adekunle and Agbaje, (2012), who reported a negligible difference in the average WTP by male and female respondents in UNAAB urban community.

Following that the species in focus has a rotation age of 40 years, it is expected that the highest WTP values will be farmers within the range of 46 – 55 years that are most likely to engage in the cultivation of Rubber with most of them being married. In farming practice, household size is an important determinant; it is assumed that the larger the family size of a farmer, the income spent on labour and maintenance of their farm land will be minimal. Furthermore, respondents with lower income had a higher average WTP value, this result shows that formal education contributed to the high average WTP value observed in the study.

Education plays vital in enhancing people willingness to contribute towards the sustenance of forest ecosystem services in the society, according to Adekunle and Agbaje, (2012).

The mean monthly amount and total monthly WTP for ecosystem services derived in a Rubber agroforestry system represent the monetary estimates of ecosystem service functions of the Rubber agroforestry systems in the study area. The economic implications of these findings are that apart from provisioning services obtained from RAS, other services such as regulating services can also be derived from the system. Hence the need for decision makers to enact laws for the payment of indirect services obtained from the forests. The result from this study corroborates with that of Ajewole (2001) who recorded an aggregate estimates value of between 155.5 and 240.9 million naira as the amount residents of Ibadan (Nigeria) are willing to pay for environmental services of urban forests. Voluntary donations and payment of ecosystem services in a RAS were the preferred mode of payments in the study area, this response rate could be attributed to the fact that the study focused on crop produce and the services obtained within the RAS.

Multiple regression analysis (linear, semi-log and double log function equations) was used to determine the socio-economic variables that contribute to the monetary estimate of ecosystem services derived from the Rubber agroforestry systems in the study area. The three equations were tested to determine the equation that had highest prediction using coefficient of determination. The result from the study showed that the linear log function had the best performance having recorded the highest coefficient of determination (R^2 = 0.528) out of the 3 regression models tested, this indicates that the independent variables accounted for 52.8 % of the variation in the dependent variable (WTP). Furthermore, the respondents' years of farming experiences and attitude of RAS farmers had significant ($P<0.05$) relationships with their WTP for ecosystem services. This is an indication that WTP for ecosystem services by the farmers can be influenced positively by the years of farming experience and the benefits derived from RAS.

CONCLUSION

This study has shown sufficient evidence that with appropriate economic tools; monetary values can be attached to non-market forest goods and services. This will mitigate issues arising from market failure and externalities. It was observed from the study that respondents in both States valued the ecosystem benefits from RAS and were willing to pay to sustain the services derivable from RAS practices in other to benefit continuously from the ecosystem services provided by the Rubber Agroforestry System.

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