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THE USE OF TOBIT MODEL IN EVALUATING PROSPECTIVE PARTICIPATORY FINANCING OF REHABILITATION OF IBADAN URBAN FOREST RESERVES

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ABSTRACT

This study evaluated the factors that affect public willingness to participate financially in the rehabilitation of Ibadan urban forest reserves. A one limit Tobit model was used to analyse data obtained from a multi-stage randomly sampled 397 residents of Ibadan metropolis. The results show that 90% of the respondents were willing to contribute funds to the project. Furthermore, the model reveals that a change in the independent variables would lead to a greater change (77%) in the probability of contributing money, relative to change (23%) in the amount of money to be contributed. Willingness to participate financially in rehabilitation of Ibadan urban forest reserves was found to be positively influenced by the variables: being employed ($p < 0.01$), having trees in the residence ($p < 0.01$), and being a past beneficiary of the forests ($p<0.05$). The results confirm the need to make the urban forest more directly beneficial to the public in order to harness the funds which the public is willing to contribute to its rehabilitation.

INTRODUCTION

Ibadan metropolis, comprising five local government areas namely: Ibadan North, Ibadan North-West, Ibadan North-East, Ibadan South-West and Ibadan South-East, used to have four forest reserves viz:. Oke-Aremo, Ogunpa Dam, Eleyele and Alalubosa forest reserves. They were constituted over a forty-year period (1916 to 1956) to provide fuelwood and building poles for the metropolitan population. They were also to provide watershed protection for Ogunpa dam, Alalubosa Lake and Eleyele dam (Popoola and Ajewole; 2001, 2002). Currently, Alalubosa and Oke-Aremo reserves have been dereserved given way for various infrastructural developments in the metropolis, while Eleyele is a patch of highly degraded forest. Ogunpa dam Forest Reserve suffered similar fate, leaving only a small preserved area; the Agodi gardens which serves as recreation forest cum zoological garden.

The government of Oyo State recently made some efforts to rehabilitate the Agodi gardens in order to resuscitate the recreation functions of the forest. However, sustained government funding of conservation programmes has often met with set-backs. The reasons for this include competing demands for government funds and the little immediate direct money-benefits of conservation projects. These obviously constrain the flow of funds to conservation projects, and therefore call for the development of innovative funding mechanisms. Popoola (2004) observed that funding of reforestation projects is fast becoming a low priority issue of governments in most states of Nigeria bringing about ridiculously low budgetary allocations which are never released on time. Participatory funding of conservation which is the focus of this study can be a potent machinery for conservation projects, since it engenders a sense of ownership in the minds of the members of the public. The objective of this study therefore is to determine the factors that affect public willingness to contribute financially and the prospective contributory amount for the rehabilitation of Ibadan urban forest reserves.

DATA COLLECTION AND ANALYSIS

Data and Sampling Procedure

The data for this study were obtained from a questionnaire survey of 400 residents of Ibadan metropolis, using the payment card contingent valuation method. The questionnaire which was designed in line with Hoehn (1992) and Hanemann (1994) elicited the respondents' willingness to contribute financially to rehabilitation of the degraded forests of the metropolis. Data on the respondents' socio-economic characteristics were also collected. In all, 397 were successfully retrieved and used for the analysis. Multi-stage random sampling procedure was adopted in collecting the data. The metropolis was stratified into two: (i) neighbourhood; comprising the residents who live in areas within 1 km radius of each urban forest reserve, and (ii) non-neighbourhood; comprising residents living outside 1km radius of each forest reserve. The neighbourhood stratum was further stratified into four cells, where the non-neighbourhood stratum was stratified to five. Names of major streets in each of the resulting nine cells were collected from the Metropolitan Planning Authority. Using a table of random numbers, two streets were picked from each of the nine cells.

Twenty five respondents were sampled in each of the two selected streets of four cells in the neighbourhood stratum, while 20 respondents were drawn from each of the two selected streets of the five cells in the non-neighbourhood stratum. This gave a sample size of 400 respondents. Due to incomplete information in 3 of the questionnaire, they were discarded. The effective sample size used in the subsequent analysis was 397.

The Analytical Model

Participatory financing is conceptualised to involve a two step simultaneous decision by respondents. This entails:

i. whether or not to participate in financing the scheme; and
ii the amount of financial contribution the decision maker is willing to make after the initial decision has been made.

The Tobit model (a hybrid of probit and multiple regression models) is appropriate in capturing such a decision process (Tobin; 1958).

Model Specification

The one-limit Tobit model for this study is specified as follows:

$C = C^* = X_i\beta + e_i$ if $X_i\beta + e_i > 0$

$= 0$ if $X_i\beta + e_i = \leq 0$ ..... equation (1)

Where;

i	=	1, 2... n observations.
X_i	=	the vector of explanatory variables.
C	=	limited dependent variable
C*	=	continuous dependent variable which is observed only when it is positive.
β	=	vector of unknown coefficients
e_i	=	error term ; ~NI$(0,\sigma^2)$

McDonald and Moffit (1980) argued that the Tobit coefficients do not correctly measure the regression coefficients for observations above the limit. Therefore the Tobit coefficients have to be decomposed in order to isolate the probability of participating financially and the amount which the prospective participant will like to contribute to rehabilitation of Ibadan urban forest reserves. The procedure for the decomposition according to McDonald and Moffit (1980) is as follows:

The expected value of *C* in the model is;

$EC = X\beta F(z) + \sigma f(z)$,..... equation (2)

Where $z = X\beta/\sigma$,

f(z) = the unit normal density,

F(z) is the cumulative normal distribution function.

σ = standard error of estimate of the dependent variable C.

X and β are as previously defined in equation (1).

Furthermore, the expected value of *C* for those willing to participate in contributing funds to rehabilitation of the degraded Ibadan urban forest reserves (i.e. prospective contributory amount) is given as

$EC^* = X\beta + \sigma f(z)/F(z)$..... equation (3)

Consequently, the basic relationship between the expected value of all observations; *EC*, the expected value conditional on willingness to contribute funds to rehabilitation of the degraded Ibadan urban forest reserves; EC^* (i.e. the expected contributory fund), and the probability of contributing; *F(z)* is

$EC = F(z)\, EC^*$ ..... equation (4)

If we consider the effect of a change in the i^{th} explanatory variable 'X' on *C*:; the disaggregation of C is given as:

$$\delta EC / \delta X_i = F(z)(\delta EC^* / \delta X_i) + EC^*(\delta F(z) / \delta X_i) \quad \text{..... equation (5)}$$

Equation (5) shows the total change in C being disaggregated into two parts: (1) the change in C of those that are willing to contribute money (expected value of amount to be contributed weighted by the probability of contributing money), and (2) the change in the probability of contributing money weighted by the expected value of the amount of money to be contributed.

As the independent variable $X_{ichange}$ in the probability of contributing funds to rehabilitation of Ibadan urban forest reserves changes is;

$$\delta F(z) / \delta X_i = f(z)\beta_i / \sigma \quad \text{..... equation (6)}$$

And the change in contributory amount with respect to a change in an explanatory variable among the participants is

$$\delta E(C^*) / \delta X_i = \beta_i \{1 - zf(z) / F(z) - f(z)^2 / F(z)^2\} \quad \text{..... equation (7)}$$

β and σ were obtained from the maximum likelihood estimates (MLE) and used to compute each of the terms in equations (5) (6), and (7). LIMDEP (version 7) was employed in running the analysis for the maximum likelihood estimates (MLE) of the Tobit coefficients, while SAS (version 8) was used to write the program for the decomposition of the MLE.

The Empirical Tobit Model

In evaluating the determinants of participatory financing of rehabilitation of Ibadan urban forest reserves, an empirical censored Tobit model comprising 24 socio-economic regressors was specified. These include income (which is made up of four dummy variables; no income, low income, medium income, and high income), age (which consists of five dummy groups; 15-24, 25-34, 35-44, 45-54, 55 and above), education (also comprising four dummy variables; illiterate, primary education, secondary education and tertiary education), employment, gender, marriage, proximity of the residence to the urban forest reserves, ethnicity, duration of residence in the study area, awareness of the existence of the urban forest reserves, being a past beneficiary of the urban forest, having interest in planting trees, having trees in one's residence and having interest in joining organisation that will mobilise for the rehabilitation project. Each of the variables; income, age and education was divided into different classes in order to capture the possible effect of each of the classes within each of the partitioned variables. For instance, different income groups have varying financial empowerment, so also do different age groups have varying interests and financial empowerment. Similarly people with different levels of education do often have different perspectives or dispositions to certain issues. With the exception of the variable – duration of residence in the study area- all other variables are dummy.

RESULTS AND DISCUSSION

The results of the empirical models are presented in Tables 1 and 2. The Maximum Likelihood Estimate (MLE) coefficients of the Tobit regression are as shown in Table 1 from which can be observed that only 21 regressors, excluding the constant, were used to run the Tobit analysis. The remaining three variables were used as control. Thus illiteracy was used as control for the education variables, no income for the income variable and age class 1 (age range 15-24) was used as control for the age variables Furthermore, the results in Table 1 also show that 7 regressors were found to have significant influence on public willingness to finance the rehabilitation of the degraded urban forest reserves. These are age class 2: comprising 25-34 years group, ($p<0.1$), employment ($p<0.1$), medium income ($p<0.05$), marriage ($p < 0.1$), being a past beneficiary of the urban forest reserves ($p < 0.05$), having trees in the respondent's residence ($p < 0.05$) and having interest in joining the mobilising organisation ($p < 0.1$).

Using only the significant regressors to run the empirical model gave the result in Table 2. The results indicate that age class 2 which was initially significant ($p < 0.1$) in Table 1 was no loger significant in this new model. It is also observed that the level of significance of some of the variables has increased. For example, the significance of "employment" increased tremendously from $p < 0.1$ to $p < 0.01$, while "having trees in the residence" and "interest in joining the mobilising organisation" had their levels of significance increased from $p < 0.05$ and $p < 0.1$ to $p < 0.01$ and $p < 0.05$ respectively.

Table 1: Maximum Likelihood Estimate (MLE) Coefficients of the Tobit Regression

Variable		Coefficient	Standard Error	Normalised Coefficient	P[|Z|>z]
Constant		12.2376	37.4053	.327	.7435
GENDER	X_1	-.1195	.1095	-1.092	.2749
PROXIMITY	X_2	-.0007	.0642	-.010	.9919
AGE CLASS-2	X_3	-30.8837*	18.3253	-1.685	.0919
AGE CLASS-3	X_4	20.0260	21.9517	.912	.3616
AGE CLASS-4	X_5	39.8836	29.7034	1.343	.1794
AGE CLASS-5	X_6	-28.9399	36.2782	-.798	.4250
EMPLOYMENT	X_7	40.3546*	23.3851	1.726	.0844
HIGH INCOME	X_8	40.2607	30.7903	1.308	.1910
MEDIUM INCOME	X_9	-60.6047**	26.3183	-2.303	.0213
LOW INCOME	X_{10}	19.9859	17.9421	1.114	.2653
MARRIAGE	X_{11}	-.3446*	.1987	-1.734	.0830
PRIMARY EDUCATION	X_{12}	20.3956	30.6962	.664	.5064
SECONDARY EDUCATION	X_{13}	-17.1378	18.6970	-.917	.3593
TERTIARY EDUCATION	X_{14}	-3.2060	18.1986	-.176	.8602
ETHNIC	X_{15}	-.1292	.1315	-.982	.3259
DURATION	X_{16}	-.0396	.07693	-.515	.6069
AWARENESS	X_{17}	13.6434	28.4329	.480	.6313
PAST BENEFICIARY	X_{18}	61.7564**	30.9161	1.998	.0458
INTEREST IN TREE PLANTING	X_{19}	-.0447	.1065	-.420	.6746
TREES IN RESIDENCE	X_{20}	41.7955**	18.9607	2.204	.0275
INTEREST IN ORGANISATION	X_{21}	-.3300*	.1774	-1.860	.0629
Sigma		175.4192***	7.6130	23.042	.0000

*: significant at 10%, **: significant at 5%, ***: significant at 1%

Table 2: McDonald and Moffit Decomposition of the Empirical Tobit Model for Prospective Participatory Financing of Rehabilitation of the Ibadan Urban Forest Reserves.

Variable	Coefficient	Normalised Coefficient	P-Value	Mean of X	Total change $\delta EC^* / \delta X_i$	Change in the contributory amount $\delta EC^* / \delta X_i$	Change in the probability of contributing finance $\delta F(z) / \delta X_i$
Constant	-3.8933	-.128	.8981		-0.1639	-0.5138	-0.0019
EMPLOYMENT X_7	51.0099***	2.626	.0086	-1.8493	2.1486	6.7377	0.0255
MEDIUM INCOME X_9	-.3890**	-2.158	.0310	-4.9221	-0.0164	-0.0515	-0.0002
MARRIAGE X_{11}	-.3344*	-1.857	.0633	-4.5603	-0.0139	-0.0436	-0.0017
PAST BENEFICIARY X_{18}	67.2513**	2.209	.0272	-1.5980	2.8327	8.8828	0.0337
TREES IN RESIDENCE X_{20}	52.4528***	2.853	.0043	-2.0201	2.2093	6.9279	0.0263
INTEREST IN ORGANISATION X_{21}	-.3780**	-2.098	.0359	-4.2638	0.0160	0.0502	0.0002
Sigma	179.45***	7.7861	23.05	.0000			

*: significant at 10%, **: significant at 5%, ***: significant at 1%
z = -1.73, f(z) = 0.04, F(z) = 0.90

Table 2 also presents McDonald and Moffit decomposition of the significant regressors which was carried out to evaluate the change in the probability of contributing money as well as the change in the amount of money respondents are willing to contribute to the rehabilitation of the degraded Ibadan urban forest reserves, that may be occasioned by the change in any of the significant regressors.

Following McDonald and Moffit (1980), the value of F(z) which equals 0.90, implies that 90% of the observations have non–zero willingness to contribute money to rehabilitation of the degraded Ibadan urban forest reserves. In other words, 90% of the respondents are willing to contribute money to rehabilitation of the degraded Ibadan urban forest reserves. In order to evaluate the prospective participatory financing of the degraded Ibadan urban forest reserves at this point requires finding the value of equation 8 below;

$\alpha = [1 - zf(z)/F(z) - f(z)^2/F(z)^2]$, ... equation 8

Putting in the required parameters;
$\alpha = 0.23$

The implication of the above is that 23% of the change in willingness to contribute money to the rehabilitation of the degraded Ibadan metropolitan forest reserves owing to change in the independent variables will be generated by change in the amount of money to be contributed while 77% will be generated by a change in the probability of contributing money. In essence, this implies that a change in independent variables will lead to greater change (77%) in the probability of contributing money, relative to a change (23%) in the amount of money to be contributed.

From Table 1, it can be observed that only 21 independent variables were used to run the model. The remaining three variables were used as control, viz: the variable illiteracy was used as control for the educational variables, no income was used as control for "income" and lastly the variable 15-24 years as control for age, since all these are categorical variables. This procedure is consistent with Gujarati (1985). Table 2 shows an intercept value of -0.1639 which is the autonomous total change in willingness to contribute money to the rehabilitation of Ibadan degraded urban forests; decomposed to -0.5138, the autonomous change in the amount of money respondents are willing to contribute to the project and 0.0019, the autonomous change in the probability of contributing money to the project.

The results further show that the variable; "employment" significantly ($p < 0.01$) and positively affects both the probability of contributing as well as the amount of money respondents are willing to contribute to the rehabilitation project. The coefficient of the intercept dummy of the respondents who are employed and are willing to contribute finances to rehabilitation of the degraded urban forest reserves is 6.7377. This implies that relative to those who are not employed; the contributory amount to the rehabilitation of the degraded Ibadan urban forest reserves is expected to increase by ₦6.73 for the employed than those who are not employed. Similarly, the coefficient of the intercept dummy for those who are employed but are not willing to contribute finances to the rehabilitation project is 0.0255. This also implies that relative to those who are not employed; the level of autonomous probability (0.0019) of contributing finances will increase by 0.0255, hence having an autonomous probability of contributing finances of 0.0274, as against those who are not employed. Therefore, the probability of an employed person to participate in contributing finances to rehabilitation of the degraded Ibadan urban forest reserves is 2.7%, while that of an unemployed person is 0.19%.

Out of the three variables that represented income, it is only the variable- medium income that has significant ($p<0.05$) though negative influence on the willingness to contribute finances for the rehabilitation of Ibadan urban forest reserves. The coefficient of the intercept dummy of the respondents who are in the medium income category and are willing to contribute finances to rehabilitation of the degraded urban forest reserves is -0.0515. This implies that relative to those who are not earning income; the contributory amount to the rehabilitation of the degraded Ibadan urban forest reserves is expected to decrease by ₦0.05 for those in medium income category than those who are not earning income. Similarly, the coefficient of the intercept dummy for those in the medium income category that are not willing to contribute finances to the rehabilitation project is -0.0002. This also implies that

relative to those who are not earning income; the level of autonomous probability (0.0019) of contributing finances will decrease by 0.0002, hence having an autonomous probability of contributing finances of 0.0017, as against those who are not earning income. The implication of these is that the probability of a person in the medium income category to participate in contributing finances to rehabilitation of the degraded Ibadan urban forest reserves is 0.17%, while that of a person who is not earning income is 0.19%.

The variable "marriage" also has significant ($p<0.1$) but negative influence on willingness to contribute finances to rehabilitation of the degraded Ibadan urban forest reserves. The coefficient of the intercept dummy of the respondents who are married and are willing to contribute finances to rehabilitation of the degraded urban forest reserves is -0.0436. This implies that relative to those who are not married the contributory amount to the rehabilitation of the degraded Ibadan urban forest reserves is expected to decrease by 0.04 Naira, as against those who are not married. Similarly, the coefficient of the intercept dummy for those who are married but not willing to contribute finances to the rehabilitation project is -0.0017. This also implies that relative to those who are not married; the level of autonomous probability (0.0019) of contributing finances will decrease by 0.0017, hence having an autonomous probability of contributing finances of 0.0002, as against those who are not married. The implication of these is that the probability of a married person to participate in contributing finances to rehabilitation of the degraded Ibadan urban forest reserves is 0.02% while that of an unmarried person is 0.19%.

Furthermore, the variable; "past beneficiary" has significant ($p < 0.05$) and positive influence on willingness to contribute finances to rehabilitation of the degraded Ibadan urban forest reserves. The coefficient of the intercept dummy for those who have previously enjoyed some benefits from these reserves and are willing to contribute finances to their rehabilitation is 8.8823. This implies that relative to those that have not previously enjoyed any benefit from these reserves, the contributory amount to the rehabilitation of the degraded Ibadan urban forest reserves is expected to increase by ₦8.89. Similarly, the coefficient of the intercept dummy for those who have previously enjoyed some benefits from the urban forest reserves, but not willing to contribute finances to their rehabilitation is 0.0337. This also implies that relative to those who have not previously enjoyed any benefit from the forest reserves, the level of autonomous probability (0.0019) of contributing finances will increase by 0.0337, hence having an autonomous probability of contributing finances of 0.0356. Therefore the probability of a person who has enjoyed some benefits from Ibadan urban forest reserves is 3.56%, while that of a person who has not previously enjoyed any benefit from these reserves, to contribute finances to their rehabilitation is 0.19%.

Having trees in residence as a variable also has highly significant ($p < 0.01$) and positive influence on the willingness to contribute finances to the rehabilitation of the degraded Ibadan urban forest reserves. The coefficient of the intercept dummy for the respondents who have trees in their residences and are willing to contribute finances to the rehabilitation of the degraded forest reserves is 6.9279. This implies that the contributory amount to the rehabilitation project is expected to increase by ₦6.93 as against those who do not have trees

in their residences. Similarly, the coefficient of the intercept dummy for those who have trees in their residences, but not willing to contribute to the rehabilitation of these degraded forest reserves is 0.0263. This implies that relative to those who have no trees in their residences, the level of autonomous probability (0.0019) of contributing finances will increase by 0.0263, hence having an autonomous probability of contributing finances of 0.0282. Therefore the probability of a person who has trees in his residence to contribute to the rehabilitation of Ibadan urban forest reserves is 2.82%.

The last variable in the empirical model- "interest in joining an organisation that will mobilise for the rehabilitation project-" also has significant ($p<0.05$) but negative influence on willingness to contribute finances to the rehabilitation of the degraded Ibadan urban forest reserves. The coefficient of the intercept dummy for those who are interested in joining the organisation and are also willing to contribute to the rehabilitation project is -0.0502. This implies that relative to those who are not interested in joining the organisation, the contributory amount to the rehabilitation project is expected to decrease by ₦0.05, as against those who are not interested in joining the organisation. Similarly, the coefficient of the intercept dummy for those who are interested in joining the organisation but not willing to contribute to the rehabilitation project is -0.0002. This also implies that relative to those who are not interested in joining the organisation, the level of autonomous probability (0.0019) of contributing finances to the project will decrease by 0.0002, hence having an autonomous probability of contributing finances of 0.0017. Therefore the probability of a person who is interested in joining a charitable organisation that will mobilise for the rehabilitation of the degraded Ibadan urban forest reserves is 0.17%, while that of the person who is not interested in joining such an organisation to contribute money to the rehabilitation project is 0.19%.

CONCLUSION

This study has revealed a great potential for non-governmental funding of rehabilitation of the degraded Ibadan urban forest reserves. Though the modal contributory amount of ₦100 per capita appears quite small, it is an amount that appears generally affordable across various socio-economic groups, and its aggregate value if properly harnessed can even be higher than the state's budgetary allocation for the development of the urban forest reserves. Be that as it may, harnessing these funds requires putting in place an effective fund collection mechanism. Some of these mechanisms include lotteries and sales of conservation souvenirs. Since being employed has significant positive influence on public willingness to participate financially in the rehabilitation of the degraded forests, the state can organise lotteries and sales of souvenirs to target different categories of workers. Furthermore, participatory financing of the rehabilitation of Ibadan urban forest reserves should no doubt go side by side with appropriate participatory urban forestry development model which should ensure adequate power devolution and decentralisation that will guarantee optimum benefits for all the stakeholders. This model might be in form of a board or a steering/management committee for mobilisation, collection and management of funds for the implementation of the rehabilitation project. This board that should comprise the

representatives of various segments of the public can have its members drawn from the academia, relevant professional groups, environmental and non-governmental organisations, community based development organisations, the civil service, etc. This board will be responsible for the day to day management of the forest reserves and the funds. In a similar manner, since a high proportion (76%) of the respondents are interested in joining a charitable organisation that will mobilise for the funds, there is a need for a reputable non-governmental organisation to take up the challenge of mobilising or starting a parallel organisation that will be responsible for mobilising of funds for participatory financing of this rehabilitation project from the public.

One important factor that is germane to participatory financing is the need for appropriate and adequate public enlightenment/education on the importance of the urban forest reserves to the socio-economic well-being of the metropolitan residents. To this effect, government needs to embark on result oriented public enlightenment programme about the need to rehabilitate and conserve these urban forest reserves. More importantly, since previous use of the urban forest has significant influence on willingness to participate financially in the rehabilitation of the degraded urban forests, government should manage the urban forests in a way to serve the diverse needs of the public. In this regards, recreation can be one of the principal reasons for the rehabilitation of these forests, and the public should be encouraged to make use of these forests for recreation and other needs. This will no doubt increase the value and the importance of these forests in the minds of the public.

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