

Community-Based Preferences for Economic Incentives to Promote Biodiversity Conservation in a Tropical Rainforest

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ABSTRACT: This paper discusses the study of community's preferences for biodiversity conservation management institution which may motivate them to support conservation efforts in the Okwangwo Division of the Cross River National Park, Nigeria. The empirical data was generated from personal interviews and factors influencing the respondents' choice were examined with the aid of multinomial logit model. The results showed that most of the respondents preferred an institution that has less transaction costs. Respondents' choice of biodiversity conservation institution were influenced by factors such as income from farming activities, income from non-timber forest products, and income from non-traditional employment. This study will contribute to the knowledge of natural resource management policy.

Key words: Transaction costs, Biodiversity, Conservation, Property rights, Nigeria

INTRODUCTION

Governments often use various policy instruments to reduce environmental degradation. For example, command-and-control, i.e. those that provide firms with relatively little flexibility to achieve goals (Harris, 2006), and incentive-based, i.e. those that provide firms with greater flexibility in making sustained environmental progress. The command-and-control set uniform targets with regards to how much firms should emit, i.e. firms are only encouraged to reduce emissions to a regulated level (Spence and Weitzman, 1994). Incentive-based approach provides continuous motivation to encourage polluting entities to reduce releases of harmful pollutants. The use of incentive-based approach results in a lower cost compared to the command-and-control approach (Pigou, 1920; Panyotou, 1994) because firms will reduce their emissions as long as it is financial valuable to do so (Tietenberg and Lewis, 2010; Asafu-Adejaye, 2000). Examples of the incentive-based approaches include: marketable emission permits, taxes, fees, charges, subsidies and tax-subsidy combinations. Economic incentives are compatible with the free market ideologies e.g. privatization of public assets, trade liberalisation, greater decentralisation in decision making and enhance role for the private sector. Developing countries are often encouraged to adopt market based instruments to improve economic well-being. However, there is little empirical evidence on the use of economic incentives in natural resource

management in developing countries (UNEP, 1995; Arntzen, 1992; McNeely, 1993).

Environmental goods and services are often classified as public good which is characterised by non-rivalry, i.e. consumption of the good by one person does not reduce the quantity available for others. Public goods are also non-excludable, i.e. no one can be excluded from environmental benefits. This often results in market failures, i.e. under-pricing of environmental asset. Inappropriate valuation of natural resources may often contribute to environmental degradation. In order to reduce environmental degradation most government in developing countries have often established national parks. They often use public property rights to justify the management of the parks. Property rights over land may be used as an instrument to promote biodiversity conservation (Libecap, 1989; Eggertsson, 1990), because it is important in setting the incentive structure in economic production. Property rights over land often reflect conflicting economic interests and bargaining strength of affected individuals (Libecap, 1989; Platteau, 2006). It can influence individual's behaviour with regard to exploitation and nature conservation. Undefined property rights may result in open access and overexploitation of natural resources. This may risk to making biodiversity conservation unsustainable. Well defined property rights may serve as an incentive for biodiversity conservation. Public property rights restrict individual's access

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to resources in national parks, thus, risking to reducing livelihoods of individuals who once depend on the area for sustenance. This often generates conflict between biodiversity conservation efforts with local subsistence demands (Shyamsunder and Kramer, 1996). Experience has shown that this type of biodiversity conservation management has not been effective in practice e.g. the denial of local communities right to use Mount Kenya Forest failed to stop illegal forest utilisation. Biodiversity conservation which focuses mainly on disincentives may not win the support of local communities because it tends to weaken their livelihoods. To minimise transaction costs associated with biodiversity conservation such as, negotiation cost and cost of conflicts with local resident, there may be a need to modify public property rights over land to incorporate incentives that may encourage more people to support nature conservation. In bargaining over the modification of property rights, the positions taken by bargaining parties are modelled by their expected gains, as well as by the actions of other parties (Libecap, 1989). Every governance structure has a transaction cost (North, 1990; Stavins, 1994; Coase, 1937) and individuals who are affected by the structure will need to make investment to enable them fit into the structure. The study reported in this paper is to examine the local community's preferences for biodiversity conservation management institutions and its determinants.

MATERIALS & METHODS

Okwangwo Division (OD) of Cross River National Park is located in the Cross River State in tropical rainforest of the south-eastern Nigeria and covers an area of 1000 Km². The OD plays an important role in the protection of fisheries, watersheds and climatic stability, ecotourism and preservation of genetic resources (Coldecott *et al.*, 1990). Mammals found in the OD include antelopes, chimpanzees, high forest monkeys, buffaloes, high forest elephants, manatees, and wild pigs. Others are baboon, leopards and gorillas. The park is a centre of endemism for frogs, birds and four primates, including the endangered Cross River Gorilla – *Gorilla gorilla diehli* (Oates *et al.*, 1990; White, 1990). It is claimed (Chukwuone and Okorji, 2008) that the OD has the highest diversity of primate species recorded at any single site in Africa. The OD is surrounded by 66 villages and subsistence agriculture is the main stay of the economy of these villages. Crops cultivated in the area include banana, plantain, cocoa, sweet potatoes, cassava, and yam. Livestock reared include poultry, cattle, sheep and goat. The local people also engage in gathering, trapping and hunting of non-timber forest products such as bush mango (*Irvingia gabonensis*), afang – a leafy wild vegetable (*Gnetum*

africanum Welw), fuelwood and game animals such as deer, antelopes, and wild pigs. Cash income for household financial requirements is mainly generated from the sale of livestock, crop products and non-timber forest products (Ite, 1995; Ezebilo and Mattsson, 2010). Some of the people engage in non-traditional (formal) employment such as teaching, nursing and catering for their livelihood. Presently, local residents are not allowed access to resources in the OD and this have often generated conflicts between the local residents and the park managers. Local residents are often of the opinion that the OD have been part of their land and that they need to be compensated for a reduction in livelihoods.

The data originated from a standardized face-to-face interview conducted in 2008. Prior to the main survey a pre-test survey was conducted in 2007. Findings from the pre-test prompted some changes in the questionnaire such as, the wording of the hypothetical biodiversity conservation institutions. The survey was conducted with the help of two assistants. They were recruited and trained for two days. Three villages from the 66 villages located within the catchment area of the OD were randomly selected for the survey. The villages comprised of Bukalom, Butatong and Wula in the Boki Local Government Area of Cross River State. Every other house along the street was visited in each of the villages. If a house was not occupied, then it was omitted and the next house was visited. The respondents alternated between the eldest male and the eldest female in each selected household. If the gender of the eldest in a household did not coincide with the respondents' selection method, then a member of the opposite gender was interviewed and the respondent's gender was alternated again from there on. Interviews were conducted in the Boki language. A total of 150 respondents were interviewed in the study area (50 respondents in each village).

The motivation about the study was described to the respondents and they were asked about their age and total annual income. Furthermore, they were asked about their income from farming activities and whether they were native to the area. Respondents were asked about their income from non-timber forest products and whether they were member of any environmental group. Three potential biodiversity conservation management institutions (A, B, C) were described to the respondents and they were asked to choose the institution which they prefer. The potential biodiversity conservation management institutions were:

- A was about the integration of public property rights over land with provision of infrastructure such as health care services and vocational training centre.
- B was about the integration of public property

rights over land with access to non-timber forest products in the OD under the supervision of the national park officials.

➤ C was about the integration of public property rights with communal property rights, i.e. allocating the local residents a piece of land outside the park where they may establish community forest for their own use.

Choice, ranking and rating are elicitation formats used in conjoint analysis applied to environmental valuation. Economists tend to prefer ordinal measures, because they conform to the random utility theory (Roe *et al.*, 1996; Holmes and Boyle, 2001; Champ *et al.*, 2003). Since, respondents were required to choose biodiversity conservation management institution alternative which they prefer. A rational respondent would choose one alternative over the others if the expected utility of one exceeds the other; thereby maximizing his/her utility (Deaton and Muellbauer, 1980; Hanley *et al.*, 2007). In this case, a rational respondent would prefer one institution over the other if and only if the transaction cost is lower than the other. The logit model can be used to estimate a utility maximization problem where the respondent is assumed to have preferences defined over a set of institution alternatives:

$$U_j = \beta_j X_i + \varepsilon_j \quad (1)$$

where, U_j is the utility of institution j , X_i a vector of attributes which characterize the i -th respondent, β_j

represents parameters to be estimated and ε_j is the disturbance term. The disturbance terms are assumed to be independently and identically distributed. If the respondent's choice is alternative institution j , we assume that the utility from alternative j is greater than the utility from other alternatives:

$$\forall k \neq j \quad U_{ij} > U_{ik}, \quad (2)$$

where, U_{ij} is the utility to the i th respondent of institution j , and U_{ik} the utility to the i th respondent of institution k . If each institution is considered as a possible decision choice by the respondent he/she is expected to choose the alternative that has higher expected utility among the alternatives. The i th respondent's decision may, therefore, be modelled as maximizing the expected utility from a given institution by choosing the j th regime from among J discrete choice available is:

$$\text{Max}_j E(U_j) = f(X_i) + \varepsilon_{ij} \quad j = 0, \dots, J \quad (3)$$

where, $E(U_{ij})$ is the expected utility of alternative j

to the i th respondent, and f_j is a function of the respondent's attributes (X_i). The probability of choosing alternative j from among J alternative choices is equal to the probability that the expected utility from alternative j is greater than the expected utility from any other alternative. The multinomial model for institution choice specifies the relationship between the probability of choosing option Y_{ij} and the set of explanatory variable (Greene, 2003) as:

$$\Pr(Y_{ij} = j) = \frac{\exp(\beta_j X_i)}{\sum_{k=0}^J \exp(\beta_k X_i)} \quad (4)$$

where $\Pr(\cdot)$ is the probability that the i th respondent most prefers the j th institution. Normalization of the alternatives by one of the categories ($B_k = 0$) yields the multinomial logit model as:

$$\Pr(Y_{ij} = j) = \frac{\exp(\beta_j X_i)}{1 + \sum_{k=1}^J \exp(\beta_k X_i)} \quad (5)$$

The log-likelihood function for the multinomial logit model is:

$$\ln L = \sum_{i=1}^n \sum_{j=0}^J d_{ij} \ln \frac{\exp(\beta_j X_i)}{\sum_{k=1}^J \exp(\beta_k X_i)} \quad (6)$$

Where $d_{ij} = 1$ if the respondent i chooses alternative j

and $d_{ij} = 0$ otherwise (Greene, 2003). Since the coefficients of such models are not directly interpreted, marginal effects (δ_j) were estimated to express the probability of change in alternative institution arrangement with respect to each independent variable, measured from the mean of the variable.

$$\delta_j = \frac{\partial P_j}{\partial X_i} = P_j \left[\beta_j - \sum_{k=0}^J P_k \beta_k \right] = P_j \left[\beta_j - \bar{\beta} \right] \quad (7)$$

Based on the data collected the multinomial logit model was used to examine factors which might have influenced the respondents' choice decisions. This is presented in Table 2. The means and standard deviations for the variables included in the analysis is reported in Table 1.

Table 1. Data summary

Variable	Description	Mean	Std.Dev
Inst	Respondent's preferred institution (A = 2, B = 0, C = 1)		
Inc ntr	Respondent's income from non-traditional employment in Nigeria Naira (NGN)	81310.0	95246.5
Inc ntf	Respondents' income from non-timber forest products (NGN)	18216.7	26320.5
Inc farm	Respondents' income from farming (NGN)	58806.7	67658.3
Age	Respondent's age (years)	46.9	13.3
Native	Native to the study area (Yes = 1, No = 0)	0.9	0.3

Income from non-traditional employment = annual disposable income – (income from farming and non-timber forest products). Ninety percent of the respondents were native to the study area and the average age of the respondents was 47 years.

RESULTS & DISCUSSION

All individuals who were selected for the survey responded to the interview. This showed that the respondents were interested in this type of study and may be willing to participate in activities which may promote biodiversity conservation. Ninety percent of the respondents who belonged to an environmental group preferred institution A. The result of the respondents' choice of biodiversity conservation management institution is presented in Fig. 1.

The result in Fig. 1 shows that most of the respondents (59%) preferred institution A. The possible reason may be that institution A may give them the opportunity to have access to more livelihood alternatives with less transactions costs. For example, introduction of vocational training centre to the area may provide the respondents more opportunity to acquire new skills such as, food processing skills. This activity may not require much interaction with the national park managers, hence may result in less transaction costs. Another possible reason may be that respondents prefer to reduce the frequency of negotiation with OD managers for economic activities such as,

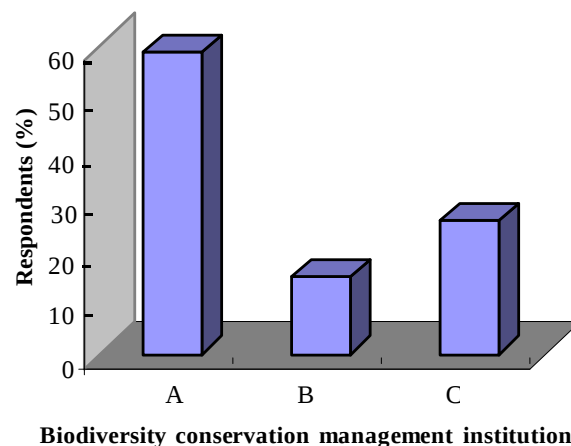


Fig. 1. Respondents' preference for biodiversity conservation institution

extraction of non-timber forest products. The results in Fig. 1 shows that more of the respondents preferred institution C (26%) compared with B (15%). This may suggest that more of the respondents may have preference for biodiversity conservation management institution which does not involve much negotiation and policing from national park officials. For example, institution B requires negotiation with regard to how, when and where to collect non-timber forest products. It also requires negotiation about the quantity of non-timber forest products to collect and how it should be distributed among individuals (respondents). Institution C requires negotiation with the OD managers mainly about the size of land for the community forest. Institution B may require more interaction with the OD managers to reduce the tendency of opportunistic behaviour and also for the managers to honour the contractual agreement. To examine factors which might have influenced the respondents' choice the marginal effect multinomial logit model was estimated, as shown in Table 2.

Marginal effects are the probability of change in favour of a specific institution with respect to each independent variable, measured from the mean of that variable. A positive or negative sign of marginal effects indicate an increase or decrease in the probability of preferring a given institution under consideration. It was observed that there were some statistically significant variables that provide predictive information on the respondents' preferred institution. Overall, the coefficient associated with income from non-traditional employment provided the most predictive power whether the respondents prefers institution B, or C. The coefficient associated with income from farming and income from non-timber forest products were found to be more relevant in determining the respondents'

Table 2. Factors influencing respondents' preferences for biodiversity conservation management institution

Variable	A		B		C	
	Coeff.	Marginal eff.	Coeff.	Marginal eff.	Coeff.	Marginal eff.
Constant	0.255	0.224	0.198	0.184	-0.453	-0.408
Incntf	-0.651	0.000	-0.355	0.000	0.421	0.000**
Incntf	-0.685	0.000	-0.880	0.000*	0.156	0.000***
Inc farm	-0.408	0.000	-0.118	0.000	0.159	0.000**
Age	0.003	0.003	-0.001	0.001	-0.002	0.002
Native	-0.199	-0.033	-0.409	0.333	0.258	0.232
Number of observations	138					
Log likelihood function	-137.940					
Restricted log likelihood	-147.734					
Chi-squared	19.587					

*** Significant at 1% level, and ** significant at 5% level, * significant at 10%.

Coeff. = Coefficient, Marginal eff. = Marginal effect

preference for institution C. All the explanatory variables with regard to the respondents' preference for institution A were not statistically significant.

The coefficient associated with the respondents' income from non-traditional employment has a positive and statistically significant impact on preference for institution C. This suggests that respondents who have more income from non-traditional employment preferred C. However, increase of income from non-traditional employment by one unit (NGN 1) has no effect on the respondents' preference for C. A possible reason may be that respondents who have more income from non-traditional employment often have more formal education. Formal education provides them the opportunity to infer the future benefits of community forest, e.g. access to forest products at less transactions costs. The coefficient associated with the respondents' income from non-traditional employment has a negative and statistically significant effect on the respondents' preference for institution B, i.e. the respondents who have less income from non-traditional employment preferred B. The marginal effect shows that a decrease in the respondents' income from non-traditional employment has no effect on the respondents' preference for B. A possible reason may be that the respondents who have less income from non-traditional employment may need to earn additional income to meet their livelihood needs. This additional income often comes from non-timber forest products. Institution B may provide them with access to non-timber forest products at less investment cost.

The coefficient associated with income from non-timber forest products has a positive and statistically significant impact on the respondents' preference for institution C, i.e. the more the income from non-timber forest products the higher the probability of choosing institution C. The results showed that an increase in

income from non-timber forest products by one unit (NGN 1) has no effect on the respondents' preference for C, i.e. it is not likely that respondents who have more income from non-timber forest products will fall to prefer alternative C. A possible reason may be that individuals (respondents) often support institutions that will benefit them at less transactions costs. Institution C may provide the respondents with continuous access to non-timber forest products at less transaction costs (e.g. negotiations and monitoring). The coefficient associated with income from farming has a positive and statistically significant impact on the respondents' preference for institution C, i.e. respondents who have more income from farming activities preferred C. If the respondents' income from farming increases by NGN 1, it is not likely that the respondents may fall in preferring institution C. A possible reason may be that respondents who earn a lot of income from farming should have more resources to invest in other livelihood alternatives to reduce the risk associated with farming activities (e.g. transaction costs). The diversification of income generating activities may give them the opportunity to have a sustained livelihood, because farming activity is often seasonal.

The coefficients associated with the respondents' age, and origin was not statistically significant.

CONCLUSION

Many management institutions for biodiversity conservation are often available but natural resource management is often more sustainable when local communities are involved. This is because economic activities of local communities often have effect on the natural environment. This study has focused on the involvement of local residents to choose biodiversity conservation management institution which may motivate more of the people to support primary objectives of national park managers (e.g. biodiversity con-

servation). The study showed that most of the respondents preferred regime that combine biodiversity conservation with provision of infrastructure. Respondents' choice of biodiversity conservation institution were influenced by factors such as income from farming, income from non-timber forest products and income from non-traditional employment, respectively. Biodiversity conservation management institution which is adopted for conservation should be specific to local condition and flexible in order to accommodate future changes in the area.

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