



Using Choice Experiment to Estimate the Value of Sustainable Rattan Resource Management in Cambodia

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Received 12 December 2012 Accepted 30 January 2013 (*Corresponding Author)

Abstract Rattan, which accounts of approximately USD 1.5 million of total revenue in Cambodia, plays a crucial role in national and international trade for poverty reduction and conservation. Prek Thnot community, Kampot province was selected for implementing sustainable rattan management approach 5 years ago including nursery management, enrichment planting and the development of a harvesting plan. Interviews with 324 families who have a forest dependence revealed that rattan is one of the top three options for their livelihood improvement. The objective of this research is to establish the marginal utility of each attribute for sustainable rattan management. It was also used to estimate the payment of each activity for sustainable management and productions. The results revealed that 93% of local communities were willing to pay a tax fee through a revolving fund for managing natural resources at their communities and only 7% rejected the payment because they felt they did not gain profit from their contribution. All attributes were found to be statistically significant at 1 and 5 percent except the benefit sharing from Reduced Emissions from Deforestation and Degradation (REDD+), meaning that local community are still not expected to get benefit from REDD+ or they did not well educated on REDD+ in Cambodia. The marginal of willingness to pay of sustainable rattan management shows that they are willingness to pay more for increasing endangered species and recovering rattan resources in their communities through conservation and enrichment planting at degraded forest and over rattan harvesting areas. Hence, it can be stated the local community are well prepared for participating rattan management activities and these results should be contribute to the making decisions by stakeholders at the community of defining a new policy to be implemented by considering important on biodiversity before implementing any activities.

Keywords choice experiment, choice modeling, endangered species, rattan coverage, harvesting plan

INTRODUCTION

Forest products account for approximately 5% of Cambodia's Gross National Product (GDP) and 72% of the workforce is engaged in agriculture and forestry activities (FA, 2008; FA, 2010). Non-Timber Forest Products (NTFPs) is the secondary in importance and contributes to livelihood development and poverty reduction in the country with the total of approximately 70-90% of households involved in collection and trade in forest products and NTFPs and the total income of NTFPs is about USD 300 to USD 400 annually (McKenney et al, 2004). Rattan is one of the top three of NTFPs in Cambodia with value of approximately USD 1.5million (Davies and Mould, 2010; WWF, 2010) and according to Forestry Statistics (2007), the main trading of NTFPs in Cambodia, including resin, rattan and bamboo. During the last decade, the rattan trade has decreased dramatically because of land conversion, over harvesting and unsustainable management (Vuthy and Hourt, 2006). Thus, the sustainable management of this resource is widely considered to be a good strategy to both biodiversity conservation and livelihood improvement for the benefit

of the development of Cambodian economy. WWF Cambodia has selected this area for the piloting a sustainable rattan productions program. It guides policy makers or stakeholders to learn local community preferences and needed before implementing projects or activities. Main activities contributing to sustainable rattan management are harvesting techniques and harvest planning, enrichment planting native and economical rattan species in the community land and species conservation in the sustainable harvesting areas by increasing endangered species. The three year rattan harvesting plan was approved by the government in 2010 and stock, yields and location of rattan harvested has been shown in the harvesting plan. Based on Prek Thnot community protected areas roles and regulations, 5 percent of total value from selling rattan should be paid to a community trust fund for the benefit of their community development and biodiversity conservation. Approximately 0.7 USD for 100 rattan canes has to be paid for community revolving fund when they harvested rattan in sustainable management. The amount of money of local communities who is willing to pay for biodiversity conservation and their livelihood development is from the fee for harvesting rattan in their community land.

The application of non-market valuation technique to estimate benefits of alternative environment management has been limited in Cambodia. The choice experience (CE) method, a state preference technique has been commonly applied in developing countries and recently, it has been introduced in Cambodia. CE methods could also be useful in designing policies and implementation of rural development project (Kohlm, 2001). The work of Ratanak and Yabe (2009) in Monduliri province is one of a handful of studies employing the CE method to assess the effect of environmental services on ecotourism development and management.

OBJECTIVE

The conditional logic model as an experimental method has been used to establish the marginal utility of each attribute for sustainable rattan management. It is also used to estimate the payment of each activity for sustainable rattan management and productions. The data used in the empirical policy evaluation literature came from a survey to collect information on household behaviors before and during the project implementation.

METHODOLOGY

Choice models applied to non-marketed goods assume a specific continuous dimension as part of the framework by using a discrete choice. They were inspired by the Lancasterian microeconomic approach (Lancaster, 1966), in which individuals derive utility from the characteristics of the goods, and the first study to apply choice models to non-market valuation was Adamowicz et al. (1994) and Adamowicz et al., (1998). Recently, choice models have frequently been applied to the valuation of non-market goods.

The stakeholder analysis, participatory tools and quantitative surveys underpinned all the discussion of impacts, ensuring that differences between stakeholders identified and distribution of costs and benefits assessed. The experimental design for both questionnaires were created using a main effect orthogonal statistical design generated using SPSS19. The alternatives for each choice set were generated using a cycled design from the original fractional factorial design. In the researcher selected questionnaire, a blocking strategy was used to reduce the number of choice tasks given to each respondent. In the respondent selected questionnaire prepared experimental designs were used as templates as shown in Table 1. Respondents were advised that they could choose to include any number or type of attributes in their choice decision. The one-on-one interview survey took place at 4 villages in Prek Thnot community was conducted between March and April of 2012 with the total of 324 local community participants from local community, local authorities include forest administration, park ranger and commune council. At first, respondents received general information about the characteristics and management of community with posters, maps, and photos of main rattan activities including rattan harvesting technique, nursery management, rattan enrichment planting and large water birds and mammals captured by camera-

traps in the national park. Following this, the second part of the survey included choice modeling questions. The five attributes with four levels use to create choice sets using a 4⁵ orthogonal main effects design (Louvier et al., 2000), which produced 25 choice sets that were blocked into 5 versions of 5 choice sets (see Table 1). Finally, the questionnaire elicited information about non-attribute variables such as sex, age, education, income, attitude, perception and the main threat of biodiversity conservation.

The choice Modeling (CM) technique requires respondents to choose only one among three options from each of several sets. The resulting statistical model predicts choice behavior as a function of the attributes and level that identify the different choice set. According to Lancaster (1966), CM is consistent with Lancaster’s theory in which consumption choices are defined by the utility or value that is derived from the attributes of a particular good and random utility theory, which describes discrete choices in a utility. The relationship of this variable can be introduced by assuming that the relationship between utility and characteristics follows a linear path, and by assuming that the error terms are distributed according to a double leg distribution; the choice probabilities have a convenient closed-form solution known as the multinomial logit model (MNL). The conditional logit model used in this study is presented below. Because CE involves selection of a substitute policy from several alternatives on the basis of the random utility model (Ben-Akiva and Lerman, 1989), it can be expressed in equations, as shown below: When the *i*-th respondent selects *j* from the set of alternatives, *C*, the utility *u_{ij}* can be defined by Eq. (1):

$$u_{ij} = v_{ij} + \varepsilon_{ij} \tag{1}$$

where *v_{ij}* denotes the observable portion of the utility and *ε_{ij}* indicates error term. When the *i*-th respondent selects *j*, the utility *u_{ij}* of the selected alternative *j* is higher than the utility *u_{ik}* of the other alternatives, and its probability can be defined by Eq. (2):

$$\begin{aligned} \pi_{ij} &= \Pr(u_{ij} > u_{ik}; \forall k \in C) \\ &= \Pr(v_{ij} + \varepsilon_{ij} > v_{ik} + \varepsilon_{ik}; \forall k \in C) \\ &= \Pr(v_{ij} - v_{ik} > \varepsilon_{ik} - \varepsilon_{ij}; \forall k \in C) \end{aligned} \tag{2}$$

If this equation is subjected to total differentiation, deeming the utility level unchanged (*dv* = 0) and fixing the attribute *x_k* (other than attribute *x_j*) also at the initial level, the amount of WTP for one unit increase of attribute *x_j* can be defined as follows in Eq. (3):

$$MWTP_{x_j} = \frac{dp}{dx_j} = - \left(\frac{\partial v}{\partial x_j} \right) / \left(\frac{\partial v}{\partial p} \right) = - \frac{\beta_j}{\beta_p} \tag{3}$$

In this way, MWTP following a change in the alternative policy’s level can be calculated.

The Attributes with four levels such as Non Rattan Coverage (RC), Sustainable Rattan Harvesting (SRH), Forest Management for REDD+ Benefit from government or donors, Increase Endangered Species Conservation (IESC) and the price. The attributes for the C option were coded with zero values for each of the attributes and the alternative specific constants (ASC) were equal to 1 when either A or B option was selected. The Choice data of the conditional logit model and marginal effects were analyzed using LIMDEP 8.0 NLOGIT 4.0 (Greene, 2002).

Table 1 Attributes and levels used in the choice models

Attributes	Levels			
	Basic Level	Level 1	Level 2	Level 3
Rattan Coverage (RC)	0 Seedling	10,000 Seedlings	15,000 Seedlings	20,000 Seedlings
Sustainable Rattan Harvesting(SNH)	500,000 canes	19 million canes	23 million canes	28 million canes
Forest Management for REDD+ Benefit (FMRB)	0%	20%	30%	40%
Increase Endanger Species Conservation (IESC)	5 species	10 species	15 species	20 species
Price	USD30	USD50	USD70	USD90

RESULTS AND DISCUSSION

Table 2 shows the respondent profiles. Almost 55% were male and about 45% were female. The majority of local communities were between the ages of 31-40 years (28.40%) and 41-50 years (25.31%). The lowest percentage was age of under 25 and over 51 years old. A high percentage of respondents were farmers with the total almost 50%, followed by fisherman (28.70%), and government staff (10.80%). The educational level of local community was very low with majority of them being between Grades 1 to 6, which accounted for almost 42%. More than 30% of interviewees were uneducated. Nearly 90% of respondents were under Grade 9. Most of people living in remote areas were strongly dependent on using natural resource as their income was low. Almost 60% of them had incomes between 51 USD to 100 USD and almost a quarter of respondents had incomes below 50 USD. Almost 85 % were below 100 USD. The percentage of local community who were willing to pay for sustainable rattan management and species conservation in the park was nearly 93% (302 respondents) and only about 7% of them were not willingness to pay for these activities because they felt that they did not get any benefit from these activities as shown in Table 3. The amount of willingness to pay for community development was from 1 USD to 7 USD and relied on the number of time rattan was collected. Harvesters always collected rattan in the dry season from January to April and October to December. In the rainy season people rarely collected rattan because they were busy with their agricultural practice. About 30% of people were willing to pay for the community trust fund which was 3 USD per collecting time meaning that they could collect about 600 rattan canes per one time. Meanwhile approximately 21% of them were willing to pay 5 USD. Almost 30% (88 people) of respondents were willingness to pay from 1 USD to 2 USD and only 11% of them preferred to pay between 6 USD to 7 USD.

The ASC found statically significant with positive sign implying that all attributes included in the CE capture all systematic determinant of alternative choice. Most of attributes of major activities contributing to sustainable rattan management were found to be statistically significant at the 1 and 5% level. Table 4 reveals the estimate of coefficients of alternative specific constant; sustainable rattan harvesting; increase endangered species for conservation, and price were statically significant at 1% level, while rattan coverage found statistically significant at the 5% level. Only the attribute of forest management for Reduced Emissions from Deforestation and Degradation (REDD+) benefit was not statistically significance.

Table2 Demographic information of respondents

	Category	Number	Percent (%)
Gender	Male	178	54.94
	Female	146	45.06
Age	Under 25	48	14.81
	26-30	52	16.05
	31-40	92	28.40
	41-50	82	25.31
	51-60	38	11.73
	Over 60	12	3.70
Occupation	Farmer	159	49.07
	Fishermen	93	28.70
	Government Staff	35	10.80
	Student	37	11.42
Education Level	Under 1	108	33.33
	Grade 1-6	135	41.67
	Grade 7-9	53	16.36
	Grade 11-12	20	6.17
	Over Grade 12	8	2.47
Income	Under USD50	80	24.69
	USD51-USD100	193	59.57
	USD101- USD 200	43	13.27
	USD201- USD 300	6	1.85
	USD301-USD400	2	0.62

Source: Survey Data

The marginal willingness to pay for sustainable rattan management is shown Table 5. Interestingly, the results revealed that the local community was willing to pay the most for rattan coverage (rattan enrichment planning) with the total of around 18 US\$ per year; thus, the total amount of financial contributions from villagers for enrichment planting was estimated to be 15,000 US\$ per year if all community members were willingness to pay this amount. Their second preferences were to pay for increasing endangered species for conservation, followed by sustainable rattan harvesting. The positive sign of these attributes indicated that probably the respondents were probably interested in enjoying these activities and the negative sign of price indicated that the price could affect respondents' choice.

Table 3 Willingness to Pay for Sustainable Rattan Management

Category	Number	Percent
WTP	Yes	302
	No	22
Amount of WTP	1	37
	2	51
	3	92
	4	25
	5	64
	6	16
	7	17

Source: Survey Data

Table 4 Conditional logic results

Variables	Coeff.	Std.Err.	T-statistic	P-value
Alternative Specific Constants	1.2149***	0.1345	9.0370	0.0000
Rattan Coverage	0.1097**	0.0556	1.9750	0.0483
Sustainable Rattan Harvesting	-0.0057***	0.0018	-3.2030	0.0014
Forest Management for REDD+ Benefit	0.0010	0.0025	0.4270	0.6690
Increase Endangered Species for Conservation	-0.0135***	0.0050	-2.6860	0.0072
PRICE	-1.7040***	0.1792	-9.5070	0.0000
Parameters	6			
Observations	1620			
Log-likelihood	-1716.98			

Note: ***, **, * indicate statistical significance at 1%, 5%, 10%

Source: Survey Data

Table 5 MWTP of sustainable rattan management from multinomial logit modeling

Variables	Attribute	MWTP (USD)
ASC	Alternative Specific Constants	71.2969 (44.9447, 97.6491)
BRC	Rattan Coverage	18.6929 (7.8031, 29.5826)
BSRH	Sustainable Rattan Harvesting	-0.3345 (-0.6873, -0.0183)
BFMRB	Forest Management for REDD+ Benefit	0.0587 (-0.4313, 0.5487)
BIESC	Increase Endangered Species for Conservation	-0.7923 (-1.7723, 0.1877)

Source: Survey Data (95% confidence interval)

CONCLUSION

This study presents results from empirical application of choice experiment to valuation of sustainable rattan management. The choice experiment aimed at identifying the preferences and behaviors of local community and all stakeholders toward all activities for sustainable rattan management both inside and outside protected areas. Each attribute that was found to be statistically significant should be helpful to policy makers to see the appreciation of forest dependent people for managing their resources. Additionally, the results showed that nearly 94% of respondents were willing to pay for harvesting their resources and sustainable rattan management in their communities with the majority of 3 USD per collection time. Thus, the government and

other stakeholders can use this approach for better management of rattan and species conservation for the benefit of poverty alleviation in rural economy.

In managerial terms, several implications for the planning and managing effectively from the results obtained in this study. First, it was observed that enrichment planting is the first preference so that they are keen on restoring and rehabilitation of their resources especially rattan. Second, it was also observed that their marginal willingness to pay value is 18.30 USD, 0.33 USD, 0.0587 USD and 0.7923 USD per month, respectively. It means that the local community and stakeholders are appreciating the benefits from sustainable rattan management. Third, among policy circle and the wide public, for long-term sustainability there is a need to look outside the public sector for additional funding for biodiversity conservation and environmental protection. Fourth, it is evident that the primary target should be the improvement of sustainable rattan management for the benefit of both conservation species and improve their living standard. Fifth, although sustainable management provides insufficient funds for the conservation and management activities suggested, the investigation of the local community shows the appreciation of the non-market value of all attributes for sustainable rattan management. Finally, local communities are strongly support in the participating of rattan management and these results should be contribute to the decision makers to define appropriated policy before implementing any projects.

Several research topics could follow up from this study in order to provide clearly insights into the application of CE especially investigating the effects of payment to revolving fund and the benefit from REDD+.

ACKNOWLEDGEMENTS

I would like to gratefully acknowledge to Professor Dr. Mitsuhiro Terauchi at Tokyo University of Agriculture, and Professor Dr. Mitsuyasu Yabe at Kyushu University, Mr. Thibault Ledecq, WWF Cambodia Programme Manager, and Dr. Charles M. Peters and Dr. Andrew Henderson from the New York Botanical Garden for their valuable comments, suggestions, discussion, and providing some materials for research. I am grateful to the dedicated members of rattan team, WWF staff, park rangers, park director, forest administration, authorities and local community for their support during data collecting. I would like to also gratefully acknowledge Tokyo University of Agriculture and SEARCA for sponsoring and helping various procedures required during my staying in Japan.

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