Research article

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

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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

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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 Mondulkiri 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-

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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 4^5 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):

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

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

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