Agricultural Economics Research Review 2019, 32 (2), 199-208
DOI: 10.5958/0974-0279.2019.00032.6

Conserving the Kuttanad wetlands: stakeholder preferences of management alternatives

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Abstract Multiple user groups benefit from wetland ecosystem services; therefore, conflicts of interest between stakeholders are common. Anthropogenic intervention has compromised wetlands and their conservation, and an institutional framework is urgently needed for using wetlands sustainably. This case study of the Kuttanad wetlands, framed to analyse stakeholders' preferences of management alternatives for conservation, finds that all stakeholders prefer public management over the other institutional arrangements, and all prefer an improvement over the status quo. The stakeholders are willing to pay for conservation.

Keywords Wetland conservation, institutional arrangements, choice experiment, conditional logit, willingness to pay

JEL classification Q57, Q34, C25

Policymakers consider wetlands to be 'wastelands', but this attitude needs to change. Wetlands are productive—yet ecologically sensitive—multi-use/ multiple-user ecosystems. Wetlands provide ecosystem services worldwide (Costanza and Folke 1997; MEA 2005; TEEB 2012), and global wetland valuation studies explain their importance from a social perspective (Costanza et al. 2014; de Groot et al. 2012). Many vulnerable groups and rural subsistence populations depend on wetlands for their livelihood and survival. Continual anthropogenic over-exploitation degrades wetlands, however; and the need to balance livelihood preservation and wetland conservation leads to conflicts of interest between stakeholder groups and to intense wetland use. Such intense use of wetlands compromises conservation.

The success of conservation is determined by the institutions and property rights associated with resource ownership and management decisions (Adger and Luttrell 2000). What kinds of institutional arrangement would facilitate the judicious use of wetlands and restore the sustainability of ecosystems? What institutional arrangements would balance the divergent interests of stakeholders and ensure their coordination? These decisions constitute the main challenge to the sustainable utilization and conservation of wetlands. For institutional governance to be effective, it is important to understand stakeholders, their preferences, and their level of involvement in management. Wetland management, especially of access to resources and use, requires a comprehensive policy, legal, and regulatory framework (Moses 2008; Adger and Luttrell 2000), because poorly defined property rights and market failure worsen wetland degradation. In India, wetlands deliver goods and services to multiple stakeholders (Kadekodi and Ravindranath 1997; Thomson 2003; Kundu and Chakraborty 2017). The Wetlands (Conservation and Management) Rules (MoEFCC 2017), the national-level legal mechanism instituted by the environment ministry, decentralizes the management of wetlands for identifying and managing

ecologically fragile areas. Some states have enacted their own wetland laws. The Kerala Conservation of Paddy Land and Wetland Act, 2008, for example, prohibits the transfer of land and the reclamation of paddy or wetlands.

The Kuttanad Wetland System (KWS)—a part of the Vembanad-Kol site, which is the largest tropical wetland in South India, and a Ramsar site[1]—is a multi-use, multi-beneficiary system that provides its stakeholders ecological and societal value. But anthropogenic pressures and over-exploitation, and the absence of an institutional framework of wetland protection and conservation, have severely deteriorated the KWS and its resources. Farmer–fishermen conflicts and equity issues are key reasons (MSSRF 2007). Some policies with implications for the KWS are the Coastal Zone Management Notification of 2007, and the report of the M S Swaminathan Research Foundation (MSSRF) on measures to mitigate agrarian distress in Alappuzha and the Kuttanad Wetland Ecosystem (ATREE 2008). The report of the Planning Commission (2008) underlines the need for instituting an appropriate institutional mechanism and enforcing its rules strictly, however; and, considering that conflicts of interest between the primary stakeholders lead to social welfare losses, it is necessary to develop socially desirable management options. This case study of the KWS was framed to analyse stakeholders' preferences over management alternatives for wetland conservation.

Data and methodology

Study area and the survey

The choice experiment concerns the Kuttanad wetlands in Kerala (Figure 1). Enormous anthropogenic interventions over time, along with neglect and overuse, have led to their deterioration. A representative area of the wetland ecosystem was selected from different agroecological and socio-economic environments in

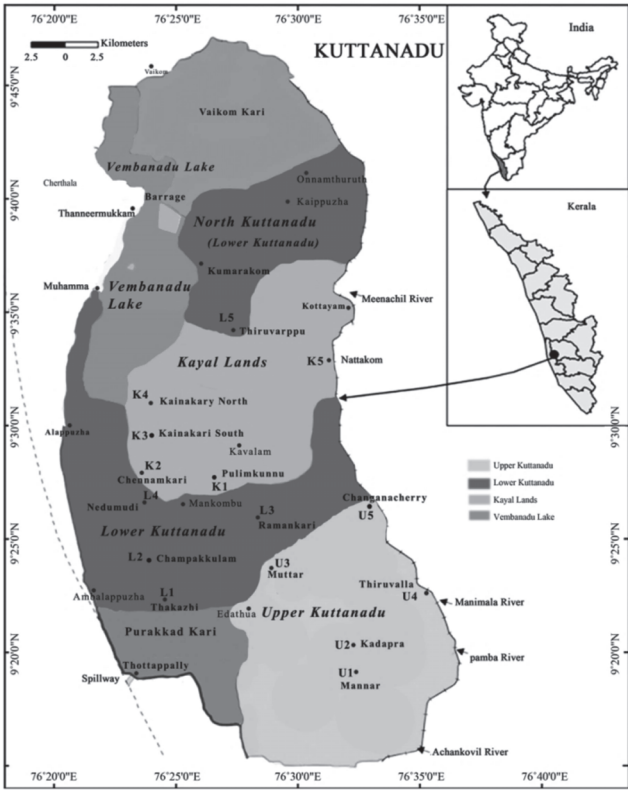

Figure 1 Study area of Kuttanad wetland ecosystem
Source Vijayan and Ray (2015)

Kuttanad. Focus group discussions[2] were held with stakeholders, ecologists, and environmental scientists to delineate the ecosystem services provided by coastal wetlands. Through these processes, the stakeholders directly dependent on the ecosystem were identified and categorized into farmers, fishermen, and residents living in the vicinity of the wetlands. Based on these discussions and in-depth literature surveys, different levels of attributes were identified and developed.

A multi-stage random sample of rice farmers, fishermen, and neighbourhood residents were selected from six villages: Alleppey, Muhamma, Thannermukkom, Champakkulam, Ramankary, and Neelamperoor. The sample size was determined using Cochran's formula.[3]

[1] The Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention), 1971, is an international treaty for the conservation and sustainable use of wetlands. It is also known as the Convention on Wetlands. A wetland that the convention designates as important is a Ramsar site.

[2] The focus group discussions included personal interview based on the preliminary questionnaire which was followed by an open discussion for revisions. A pilot survey with a revised questionnaire was undertaken in Moncompu (Kerala) area before the main survey.

[3] For large populations, Cochran (1977) developed a formula to yield a representative sample for proportions: $n_0 = \frac{Z^2 pq}{e^2}$ where e is the desired level of precision (i.e., the margin of error), p is the (estimated) proportion of the population which has the attribute in question, q is 1 - p and Z=1.96 (from statistical table which contain the area under the normal curve).

Table 1 Wetland management attributes

	Attribute	Description	Levels
1	Water quality	Potability of water	1. Low: Depletion from current level 2. High: Improvement from current level
2	Fish wealth	Fish wealth in the wetlands	1. Decrease: Depletion of fish wealth from current level 2. Increase: Increase in fish wealth
3	Ecological services*	Various ecological services provided by the ecosystem	1. Low ecological services 2. High ecological services
4	One-time payment	Amount that the respondent is ready to pay for wetland conservation	1. INR 50 per respondent 2. INR 100 per respondent

Note *Ecological services indicate the various invisible services provided by the ecosystem other than direct services such as sediment retention, nursery for fishes, and biodiversity management.

Assuming a lower variability of 0.2 among the paddy farmers and the fishermen (based on the pilot survey estimates), at a confidence interval of 8% at 95% confidence level, the sample size of paddy farmers and fishermen was 96 (16 from each of the six villages). Since the heterogeneous group of neighbourhood residents was observed to have different socio-economic and occupational status, a higher variability of 0.4 was assumed. The total sample size was estimated to be 144 (24 per village) at 95% precision. The method of personal interview adopted was a structured pre-tested interview schedule along with direct observation. A detailed household survey was conducted between July 2016 and February 2017. The schedule composed of two parts: socio-economic status, occupation and other basic information about the respondents (Part A) and choice of institutional arrangements for wetland conservation and management (Part B).

The respondents were given a brief description of the importance of Kuttanad on a global scale and the issues faced by wetlands, and then the purpose of conservation and restoration of the Kuttanad wetlands. Next, the attributes used in the choice experiment were elaborated. In the present study, the dependent variable (categorical: unordered) was the wetland management scenario, and four management options were considered: community management, public management, private management, and public–private partnership management. The respondents who did not opt for any of these were assumed to prefer the status quo with the intention that one of the options must always be in the respondent's currently feasible choice (Hanley, Mourato, and Wright 2001).

Using four attributes (Table 1), an orthogonal design comprising the main effects was developed using the SPSS application; this design, comprising three choice sets for each respondent, was administered to the respondents in the sample. Each choice set contained five management scenarios (four proposed scenarios and the status quo). The options in each choice set are described using four attributes that take on various levels (Table 1). The respondents were asked to choose one option, and the selected option was assumed to provide the respondent the greatest utility (choice reveals preference). The data on choice are binary in nature—when a respondent chooses an option, the choice takes the value of one, otherwise zero. Therefore, corresponding to each choice set there will be a single entry of 1 and four 0 entries. The model was estimated using conditional logit regression. Three different regressions were estimated for the three major wetland stakeholder groups: rice farmers, fishermen, and neighbourhood residents. The choice probability of management and factors affecting the choice were analysed using the conditional logit method in STATA software.

Choice modelling: theoretical framework

The theoretical basis of choice experiments originates in Lancaster's model of consumer choice (Lancaster 1966) and in random utility theory (McFadden 1974). The utility of goods comprises an observable component function of attributes and a random error component (McFadden 1974). The first step in a choice experiment is to identify choice alternatives, attributes, and their levels. Later, the design is developed based on the attributes and its levels in line with the theory

of experimental design (Birol, Karousakis, and Koundouri 2006). The respondents were asked to choose a management option with the help of a set of attributes and its levels (Hanley, Mourato, and Wright 2001); choice experiments help to determine the attributes' relative importance to people and hence can be used for developing socially desirable management options. Choice modelling is more suitable for understanding the acceptability or adoptability of new intervention policies. The model is based on the assumption that stakeholder utility is a function of a set of available choice alternatives being studied.

Econometric specification

The choice experiment model assumes that the stakeholder's utility depends on the set of available management alternatives of the Kuttanad wetlands. The stakeholders' utility function takes the form:

$$U_{ij} = V(Z_j) + e(Z_j) \quad \ldots(1)$$

It states that for any stakeholder *I*, a given level of utility will be associated with the alternative of wetland improvement chosen *j*. The utility depends on the wetland attributes (*Z*). The stakeholder utility from a choice includes a deterministic component (*V*) and an error component (I). The random utility framework states that the utility of the choice follows a predetermined distribution; based on the framework, the choice between the alternatives will be a function of the probability that the utility associated with an option is higher than that of others (Birol, Karousakis, and Koundouri 2006). Let X_i stand for the characteristics of individual *I* and Z_i, for the characteristics of the *j*th alternative for individual *I*, with the corresponding parameter vectors denoted by â and á, respectively. Let *j* be the number of unordered alternatives (for the moment, assume constant for all individuals) and P_i, the probability that individual *I* chooses alternative *j*.

$$P_{ij} = \frac{\exp(Z_{ij}\alpha)}{\sum_{k=1}^{j}\left[\exp\left(Z_{ik}\alpha\right)\right]} \quad \ldots(2)$$

The explanatory variables in this model are characteristics of the alternatives or choices; therefore, the conditional logit model—in which the revealed choice is considered as a function of the attributes, rather than the respondent characteristics—is used (McFadden 1974; Hanley, Mourato, and Wright 2001).

Estimation of willingness to pay

The choice experiment method assumes a linear relationship between the preference and the attributes. The experiment is in line with the economic principles of utility maximization (Bateman et al. 2002). The willingness to pay (WTP) is estimated as a proxy for welfare measure using the formula:

$$\text{WTP} = \frac{\ln\sum_{k=0}^{n}\exp(V_k^1) - \ln\sum_{k=0}^{n}\exp(V_k^0)}{\beta_{\text{monotary attribute}}} \quad \ldots(3)$$

where WTP = proxy for welfare measure, $\beta_{\text{monetary attribute}}$ = marginal utility of money income from the monetary attribute in the choice experiment, V_k^1, V_k^0 represents indirect utility functions before and after wetland management changes.

In this study, assuming a linear relationship between the preference and the attributes, WTP is represented as the ratio of coefficients.

$$\text{WTP} = -1\left\{\frac{\beta_{\text{wetland attribute}}}{\beta_{\text{monetary attribute}}}\right\} \quad \ldots(4)$$

Results and discussion

A sample of 336 stakeholders was selected from the population (Table 2). Based on multi-stage random sampling, a random sample of 96 rice farmers and fishermen along with 144 neighbourhood residents was selected from the study area. The standard deviations in socio-economic features were lower among the stakeholders. A slightly higher deviation from the mean is observed in the resident stakeholders, justifying the assumption of relatively higher variability while determining the sample size. With STATA 14, we estimated the standard conditional logit model with the status quo as the base outcome. From the orthogonally designed random choices provided to each stakeholder (Appendix 1), we obtained the stakeholders' relative preferences of the institutional arrangements of wetland management (Table 3). In public management, the state takes ownership of resources, manages these, and provides user rights to communities that depend on the system for livelihood, and all the stakeholders—46% of the rice farmers, 47 % of the fishermen, and 49% of the neighbourhood residents—prefer public management over the other institutional arrangements. All three groups consider that public management is the best way to conserve and manage the Kuttanad

Table 2 Descriptive statistics observations from stakeholder interview

Variable	Rice farmers				Fishermen				Neighbourhood residents			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Age (years)	63	11.9	25	78	49	9.4	24	70	53	9.8	24.5	79
Education (years of schooling)	9	4.03	0	16	7	2.5	0	15	9	2.37	4	16
Family size (number)	4	1.27	2	8	4	1.4	2	8	4	1.41	2	8
Annual income (INR, million)	0.14	0.076	0.055	0.5	0.112	0.087	0.016	0.55	0.208	0.11	0.051	0.625

Note The summary statistics display slightly higher variations than the assumed lower variability among paddy farmers and fishermen (because the assumptions were made based on the pilot survey estimates). Even though the assumption is weak, the representativeness of the existing samples is warranted.

Table 3 Relative preferences of the institutional arrangements for management of Kuttanad wetlands

	Management alternatives	Rice farmers	Fishermen	Residents	Overall stakeholder preference
1	Community management	89 (30.83)	85 (29.44)	118 (27.22)	294 (29.17)
2	Public management	132 (45.83)	136 (47.22)	212 (49.17)	470 (46.67)
3	Private management	9 (3.06)	13 (4.44)	8 (1.94)	32 (3.15)
4	Public–private partnership	16 (5.56)	9 (3.06)	41 (9.44)	68 (6.76)
5	Status quo	42 (14.72)	46 (15.83)	53 (12.22)	144 (14.26)
	Total observations*	288 (100)	288 (100)	432 (100)	1,008 (100)

Note *Each respondent was given three choice sets to state their preference. Hence, the total number of observations (for stakeholder category of n samples) each is $n \times 3$. Figures in parentheses represent percentage.

Source Field survey

wetlands, probably because these wetlands occupy a vast area and the stakeholder groups have several conflicts of interest.

The subsequent preferred arrangement was community management; it was preferred by 30.83% of the rice farmers, 29.44% of the fishermen, and 27.22% of the resident stakeholders. Community management involves the active participation of local communities in decision-making related to conservation and management of wetlands. The Ashoka Trust for Research in Ecology and the Environment (ATREE) (2008) trusted the need to actively involve dependent communities in wetland management, but the absence of management effort has caused the KWS to deteriorate. To strengthen public involvement, it is recommended that community rights over the protection and harvesting of resources be institutionalized. About 14% of the stakeholders preferred the status quo; on average, only 6.76% of the stakeholders preferred public–private partnership and 3.15% preferred private management—the stakeholders were sceptical that these institutional arrangements could conserve wetlands.

Assuming a linear relationship between the utility from the preferences and attributes in the choice sets, the probability of stakeholder preference was expressed in terms of a conditional logit in STATA 14 (Table 4). All the wetland management attributes are significant factors in the wetland management choice scenario and, ceteris paribus, any change in the attribute level is shown to vary the probability of selection of the management attribute. Each stakeholder's choice of management options is significantly influenced by water quality, fish wealth, ecological services, and the one-time payment (Table 4). The results are in line with previous studies on the attributes affecting the choice preference in wetland management. Birol, Karousakis, and Koundouri (2006) use the choice experiment in the case of the Cheimaditida wetlands of Greece and find that diverse species wealth and clean water surface

Table 4 Conditional logit estimation of discrete choice experiment for wetland management

Levels of attributes	Rice farmers	Fishermen	Residents
Water quality (relative to *status quo*)			
Water quality: 5% Decrease	–0.165	–0.296	–0.005
	(0.302)	(0.301)	(0.307)
Water quality: 5% Increase	0.624**	1.120**	0.608*
	(0.323)	(0.321)	(0.328)
Fish wealth (relative to *status quo*)			
Fish wealth: 2% Decrease	–0.675	–0.617	–0.165
	(0.456)	(0.457)	(0.433)
Fish wealth: 2% Increase	0.697*	1.207*	0.429
	(0.456)	(0.456)	(0.425)
Ecological services (relative to *status quo*)			
Ecological services: Low	–0.391*	–0.452*	–0.287
	(0.216)	(0.237)	(0.473)
Ecological services: High	0.125	1.287**	0.560*
	(0.229)	(0.431)	(0.465)
One-time payment (relative to zero payment)			
One-time payment: INR 50	0.012*	0.011**	0.009*
	(0.006)	(0.004)	(0.006)
One-time payment: INR 100	–0.0082*	–0.013**	–0.0076*
	(0.004)	(0.006)	(0.004)
Log-likelihood	375.13	379.44	370.61
Chi-square	126.56	121.95	121.62
Pseudo R^2	0.444	0.438	0.441
No. of respondents	96	96	144
No. of observations	288	288	432

Note ***, **, and * imply significance at 1%, 5%, and 10%, respectively. Figures in parentheses represent the standard error.

area are important attributes in respondent preferences. Similarly, in this study, fish species wealth, water quality attributes, and ecological service attributes were important attributes (Table 4). Carlsson Frykblom, and Liljenstolpe (2003) also find that species biodiversity, fish, and a fenced waterline influence respondents' preference.

All the levels of the four different attributes are compared with the status quo. A 5% improvement in water quality in the Kuttanad wetlands significantly and positively affects the choice of wetland management. Stakeholders prefer the management option rather than the status quo for an increase in water quality, but a decrease in water quality does not significantly affect their institutional choice. A 2% increase in fish wealth positively and significantly affects rice farmers' and fishermen's choice of institutional management. The negative coefficient in the case of declining water quality indicates the respondents' dislike.

A decline in the present level of ecological services would negatively affect the choice preferences. The one-time payment attribute negatively yet significantly influenced the choice preferences of all the stakeholders. However, at a lower level of payment, it has a positive and significant influence on the management decision. It is not in their interest to pay higher amounts, but stakeholders are actually willing to pay a small amount—rather than paying nothing, the status quo—to conserve and manage the Kuttanad wetlands. Birol, Karousakis, and Koundouri (2006) find a similar sign of the payment coefficient and reflect that the utility of a choice set with a higher payment level is negative. These observations show that the stakeholders prefer to pay for institutional arrangements to conserve wetlands and improve their condition rather

Table 5 Marginal willingness to pay (WTP) for wetland management attributes at 95% confidence interval

Attributes	Marginal WTP (in INR per respondent)(confidence interval)		
	Rice farmers	Fishermen	Residents
Water quality: 5% Decrease	NS	NS	NS
Water quality: 5% Increase	76.1**	86.2**	80.0*
	(68.1–84.1)	(78.7–93.6)	(77.6–82.4)
Fish wealth: 2% Decrease	NS	NS	NS
Fish wealth: 2% Increase	85.0*	92.9*	NS
	(77.7–92.3)	(88.8–92.3)	
Ecological services: Low	32.6*	41.1*	NS
	(20.4–44.7)	(33.8–48.3)	
Ecological services: High	NS	99**	73.7*
		(93.7–104.3)	(71.3–76.0)

Note (1) ** and * imply significance at 5% and 10%, respectively. (2) NS = not significant. The WTP has not been calculated for non-significant wetland attributes. (3) Figures in parentheses represent the confidence interval.

than pay nothing. Therefore, if policymakers impose a tax or levy, the stakeholders would bear it and financially support wetland conservation.

Estimates of willingness to pay

The interpretation of regression coefficients is limited to significance and relative preferences. That is why we estimate the willingness to pay as a proxy for the welfare changes due to change in management. The willingness to pay indicates that we can establish a monetary value to each change in attributes in the choice provided. The estimates of marginal willingness to pay (Table 5) provide policymakers a relevant input in determining wetland institutional arrangements. The marginal willingness to pay is obtained using the formula by Bateman et al. (2003) and Birol, Karousakis, and Koundouri (2006).

All the stakeholders are willing to pay for an improvement in water quality. For a 2% increase in fish wealth of the wetlands, each respondent fisherman is willing to make a one-time payment of INR 86.2 (2018 prices). However, a decline in the water quality or fish wealth of the wetlands does not significantly affect stakeholder welfare. Low ecological services positively impact the rice farmers' welfare, but high ecological services do not influence it significantly. The fishermen category represents a higher bio-centric nature; their willingness to pay for improved ecological services is INR 99 per respondent but INR 41.1 per respondent for lower ecological services. An improvement in surrounding ecological services positively affects the preference of local stakeholders (Kosenius and Markku 2015; Carlsson, Frykblom, and Liljenstolpe 2003). Every study is area-specific and dissimilar in attribute measurements; therefore, a direct comparison of attribute-wise estimates of willingness to pay is not appropriate. The willingness to pay of neighbourhood residents shows that an improvement in water quality and high ecosystem services positively influences the neighbourhood residents' welfare and utility maximization. Because of the regional nature of the KWS and the lower socio-economic status of the associated stakeholders, the willingness to pay is lower than in developed countries,[4] although it is similar to the INR 91.2 per household per annum that local citizens are willing to pay to improve the quality of the water in Ganga River in West Bengal (Birol and Das 2012).

Conclusions and policy implications

The stakeholders of the Kuttanad wetlands agree that enormous over-exploitation of wetland resources and human intervention has deteriorated the ecosystem and that this ecological imbalance has negatively impacted the farming and fishing scenario. To ensure the sustainability of the wetlands, Kuttanad needs to be

[4] The willingness to pay for improving the water quality in River Thames is GBP 8.64 per annum (Bateman et al. 2003) and for river ecology services in the UK is GBP 12.19 per annum (Hanley et al. 2001). GBP 1 = INR 90 (approximately).

managed in a holistic way. With this perspective in mind, this study focused on understanding stakeholders' preferences of ways to conserve and manage the Kuttanad wetlands. All the stakeholders (rice farmers, fishermen, and neighbourhood residents) preferred public management over the other institutional arrangements; they were influenced by water quality, fish wealth, ecosystem services, and one-time payment. Except the declining levels of the attributes, the higher levels of attributes were observed to have significantly influenced the choice of management options. All the levels of the four different attributes were compared to the status quo. The stakeholders chose an improved management option for an improvement in water quality, fish wealth, and ecosystem services. This would imply to policymakers that stakeholders would bear any tax levied to conserve and manage wetlands in the area and financially support wetland conservation. The willingness to pay for each attribute was estimated as a proxy to the welfare; it was maximum for high ecological services followed by fish wealth and water quality improvement. The willingness to pay for wetland conservation estimated by this study may help formulate a payment system for conserving and managing wetlands.

Acknowledgement

The authors wish to acknowledge the fellowship support—provided by the Department of Science and Technology: Innovation in Science Pursuit for Inspired Research (DST-INSPIRE) of the Government of India—for the PhD programme to the first author, from which this paper originates. We also thank the anonymous reviewer of the Journal for his/her constructive comments.

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Received 27 June 2019 Accepted 24 December 2019

Appendix 1 Choice set for wetland management alternatives

	Choice Designs					
Sl. No	Mgmt Options	Water Quality	Fish Wealth	Ecoservices	OTP*	I choose
C1.a						
1	Community	5% decrease	2% decrease	low	2% of m.income	
2	Public	5% increase	2% decrease	low	2% of m.income	
3	Private	5% increase	2% decrease	high	5% of m.income	
4	PPP	5% decrease	2% increase	high	5% of m.income	
5	Status Quo	Remains same	Remains same	Remains same	Nil	
C1.b.						
1	Community	5% increase	2% increase	low	5% of m.income	
2	Public	5 % decrease	2% increase	high	2% of m.income	
3	Private	5% increase	2% decrease	high	5% of m.income	
4	PPP	5% decrease	2% decrease	high	2% of m.income	
5	Status Quo	Remains same	Remains same	Remains same	Nil	
C1.c.						
1	Community	5% decrease	1% decrease	low	2% of m.income	
2	Public	5% increase	1% decrease	high	5% of m.income	
3	Private	5% increase	1% decrease	low	5% of m.income	
4	PPP	5% decrease	1% increase	high	2% of m.income	
5	Status Quo	Remains same	Remains same	Remains same	Nil	

*OTP is one time payment
Similarly 6 more choice sets were designed.