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STAKEHOLDER PERSPECTIVES ON CLIMATE CHANGE IN THE THRISSUR KOLE WETLANDS, INDIA

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Abstract

The current study has been carried out in Kerala's Kole wetland region to assess the perspectives of local stakeholders in the Kole wetland region on climate change, and their willingness to protect it from further damage. Primary data was collected from 100 sample households in five panchayats in the region. The respondents were enquired about their perspectives on climate change in the region, and their willingness to pay to protect the ecosystem under the contingent valuation method. Stakeholders were found to be quite aware of climate change, and also willing to contribute to a protection of the wetlands, although not all were willing to make an extra payment for climate change mitigation. It was observed in that a person's education and wealth were the most crucial factors when determining their willingness to pay for ecosystem conservation and climate change mitigation.

Keywords: Wetlands, Ramsar convention, climate change, contingent valuation method, willingness to pay

Introduction

Wetlands are highly sensitive and fragile ecosystems that act as biodiversity hotpots across the world (Mitsch and Gosselink, 2000). They are defined by Brouwer *et al*. (1999) as 'complex hydro-ecological systems, whose structure provides us with goods or products involving some direct utilisation of one or more wetland characteristics, while wetland ecosystem processes provide us with hydrological and ecological services, supporting or protecting human activities or human properties without being used directly'. Over the last one hundred years, wetlands on a global scale have been subject to massive destruction as a result of anthropogenic activities rendering them to be non-renewable natural resources that must be conserved at all costs (Adger and Luttrell, 2000; Matthews and Fung, 1987; Krutilla, 1967; Swallow, 1994). The first coordinated effort on a global scale to protect wetland ecosystems took place at Ramsar in Iran in 1971, under the aegis of The Convention on Wetlands of International Importance especially as Waterfowl Habitat.

Studies including Das (2009) have observed that environmental destruction can have great repercussions for human communities, as in the case of Odisha, where loss of the local mangrove ecosystem resulted in widespread damage to human settlements due to hurricanes. The anthropogenic activities threatening wetlands are also routinely ignored in Regional Developmental Plans of Governments, as observed by John *et al*. (2017).

The Kole wetland of Thrissur and Malappuram are part of India's largest wetland region and are spread over an area of 13,632 ha., from the Chalakudy river in the south to the Bhārathapuzha river in the north (Srinivasan, 2010). The wetlands derive their name from the Malayalam word 'Kol' which means bumper yield. The alluvial deposits brought down by the *Kecheri* and *Karuvannur* Rivers has rendered the wetlands a highly productive agricultural region, with agriculture being practiced for more than 200 years, as cited by Logan (1887) and John (2003). The Kole wetlands have been noted to act as an effective flood control mechanism in the Thrissur district by Johnkutty (1993), and in conjunction with the accompanying river basins, also plays a decisive role in groundwater recharge as a massive aquifer, while also being crucial as a discharge channel for pollutants from adjoining urban areas (Sreenivasan, 2010). The wetlands are also home to a wide variety of flora and fauna, including endangered bird, fish and mangrove species. Brander (2006) has detailed a number of direct use, indirect use, and non-use functions of wetlands in terms of wetland good and services. Among these, flood control, groundwater recharge, biological diversity, agriculture, recreational activities, and fishing are very significant in the Kole wetland region.

Climate change has, over the last few years, started to negatively affect the Kole wetlands, in the form of floods and droughts. Pal and Al-Tabbaa (2009) have indicated that shifting rainfall pattern in Kerala is an indicator of climate change, with a sharp decline in spring rainfall and rapid rise in autumn rainfall expected in the state. Reports of the Intergovernmental Panel on Climate Change (IPCC) by Solomon *et al*. (2007), as well as studies by the likes of Kumar et.al. (2006), and Dash and Hunt (2007) have projected a sharp rise in the surface temperature and overall rainfall in Kerala. Vishnu et.al., have shown with the help of satellite image data, that the 2018 floods in Kerala led to a 90 per cent increase in water cover in the Kole wetlands as a result of the flooding, with water rising to an average height of 5 meters. Mishra *et al*., have identified that extreme rainfall because of climate change was one of the primary causes of the Kerala floods in 2018.

The Kole wetlands have also been subject to widespread conversion into residential and commercial land since 1981, and this has played a role in limiting the ecosystem's ability to control the floods. Various studies such as Sreenivasan (2010), Vimod and Kishore (2015) and Raj and Azeez (2009) have pointed out that land under paddy cultivation, which is normally left uncultivated for six months a year, has seen a steady decline in the Thrissur Kole. Satellite data has been used to assess the pattern in land use change in the Kole region, and the results show that wetland

converted into built-up human spaces have increased rapidly. The changes in land use pattern in the region, as revealed by Srinivasan (2010) using satellite images from the National Remote Sensing Agency (NRSA) and Survey of India (SOI) toposheets, is given below in figure 1. Kulp and Strauss (2019) have used the CoastalDEM projection to estimate sea level rise and coastal flooding on a global scale by the year 2050, and their projections for Thrissur district show the Kole wetlands being subject to large-scale inundation.

Given the kind of ecological risk looming over the Thrissur Kole Wetlands, the present study seeks to explore two main objectives – i) understand the perspectives of the wetland community towards various problems in the region and climate change, ii) estimate the economic value of the ecosystem based on the community's willingness to pay for the climate change mitigation in the wetlands.

Materials and Methods

The data for the study was collected from 100 agricultural households in five panchayats Adat, Kolazhy, Manalur, Venkitangu and Mullassery of Thrissur district that lie in the Kole wetland region. Detailed interviews were also held with various stakeholder groups like agriculturalists, conservation activists, and government officials to understand their take on climate change in the region. To assess the ecosystem's economic value, the contingent valuation method (CVM) was used. CVM is a widely used tool across the world to estimate the value of natural ecosystems and to implement policy measures to conserve them from adverse human actions(Sutherland and Walsh, 1985; Bishop *et al*., 1987; Danielson and Leitch, 1986; Desvousges *et al*., 1987; Loomis *et al*., 1991; Kosz, 1996; Kaoru, 1993; Shultz and Lindsay, 1990; Binilkumar and Ramanathan, 2009; Abraham, 2004).

The CVM estimates the value of an ecosystem using either of two tools – the willingness to pay (WTP) or willingness to accept (WTA). In the present study, the WTP was chosen in accordance with Venkitachalam (2004) and the willingness to pay of each household was estimated based on a payment card method as in Lo and Jim (2015), Blaine *et al*. (2005), Johnson and Whitehead (2000) and Mitchell and Carson (1984), wherein the respondent was handed a payment card indicating six ranges for the WTP. The respondent had to mark their WTP range, as well as explicitly state the amount they are willing to pay for the conservation of the ecosystem, and for combating climate change. The respondents were also given the option to indicate zero as their WTP value. The payment vehicle proposed to the respondents was a green tax which is imposed on an annual basis for this purpose. Two separate hypothetical situations were presented before the respondents – the first aimed at maintaining the current state of the Kole wetlands where pollution is kept at a minimum, agriculture is made sustainable, and flora and fauna protected; and the second in which the state takes proactive measures to mitigate the effects of climate change such as floods and droughts. State actions would include relocation of households from flood-prone regions to higher ground, drought mitigation through water management, and monitoring of regulators to reduce saline incursion. Such efforts have generally been observed to be fruitful (Verma *et al*., 2001).

Linear regression was used to estimate the determinants of households' willingness to pay for conservation of the wetlands, in accordance with the established literature (Berrens *et al*., 2004; Tuan *et al*., 2014; Banna *et al*., 2016; and Nepal, Berrens and Bohara, 2009).

Results

Climate change has recently been a major problem in the Kole wetlands, with successive droughts and floods, as well as saline incursion due to sea level rise emerging as major problems in recent years. In light of these issues, the respondents were asked whether they were aware of the problems posed by climate change. In the sample, 85 per cent of the respondents said that they were aware of climate change happening around them. Only 10 per cent of respondents replied that they didn't know much about climate change, while 5 per cent remarked that they did not know about the phenomenon. This shows that the individuals who live in the Kole wetland region are generally aware of the situation that they face if the effects of climate change worsen in the future.

To understand the peoples' apprehensions about climate change, they were asked five questions, and asked to mark their responses on a five-point scale. The questions asked are as follows:

1. Do you feel that climate change is a process that can leave the wetland region prone to severe flooding as a result of sea level rise?
2. Do you feel that human actions like conversion of wetlands for commercial purposes have worsened the situation during floods?
3. Do you feel that climate change will lead to a loss of biodiversity in the region?
4. Do you think that climate change mitigation should be a responsibility of the state?
5. Do you think local stakeholders should be a part of the steps to mitigate climate change?

The respondents, though aware of climate change, were not equally knowledgeable about various effects of the phenomenon. Although close to 90 per cent of them believed climate change would lead to an irreversible loss of biodiversity in the region, only 30 per cent were aware of coastal flooding caused by rising sea levels. Respondents who agreed that rising sea levels would swallow the Kole were mostly from the western panchayats of Mullassery and Venkitangu, which have been experiencing saline incursion and subsequent crop loss over the last three years. Regarding the large-scale conversion of wetlands, two-thirds of respondents expressed an opinion that human intervention in the wetlands had adversely affected the ecosystem and played a role in enhancing the effects of natural disasters like the 2018 floods.

When asked whether it was the state that had to take an initiative to mitigate climate change and safeguard the lives and livelihoods of the people, only about 8 per cent believed that it was outside of the Government's purview. However, when asked is they also felt like playing a role in the conservation and mitigation process, the proportion of respondents fell from 92 per cent to 75 per cent. One fourth of the respondents were hesitant to be a part of the change, although it must be noted that 22 per cent of them were

neutral to the prospect, and only 3 per cent outright denied that they had to play a role in climate change adaptation and mitigation.

Determining the Willingness to Pay

The households were initially asked whether they were willing to pay for the conservation of the wetland ecosystem, and the response was unanimous, with all one hundred agreeing that they would do so. Various factors were identified that could influence a person's decision to part with a certain sum of money to ensure a better environment. These are age, period of residency in the Kole region, years of education attainment, monthly income, and size of total land holdings. A respondent's willingness to pay is defined as a function of these five variables:

WTP = f (Age, Res., Edu., Land., Y)

An OLS regression was run, with the model expressed as follows:

$$WTP = \alpha + \beta_1 Age + \beta_2 Res. + \beta_3 Edu. + \beta_4 Land. + \beta_5 Y + \varepsilon$$

The results of the OLS regression, shown in table 2, indicate that the model is a good fit for the sample, due to a high R^2 value of 0.715. It is visible that all variables except for the respondent's age are significant at a 95 per cent confidence level. Educational attainment, land holding size and monthly income are significant at the 99 per cent confidence level as well. The regression results indicate that a person's willingness to pay can increase when their wealth or education are higher. Both land holding size and household income can be counted as measures of the household's wealth.

The respondents were also asked if they were willing to revise their WTP to a higher level if steps were taken to mitigate the effects of climate change. Seventy three per cent of households indicated that they would be willing to do so, while among the others, more than half responded that it either wasn't feasible to pay a higher amount annually or that they felt it was unnecessary to do so. Close to one-third of these households also said that they would revise their WTP only after seeing if their initial payment was worth it. A few of the respondent also responded that the state could find other ways to combat climate change, rather than burden the taxpayers, while a miniscule number felt that the question was irrelevant.

An OLS regression was run for these 73 households to see if there was any change in the relationship between revised WTP and the same variables as in the model for initial WTP. The results of this OLS regression is given in table 3.With an R^2 value equivalent to 0.643, the model for the revised WTP measure is a good fit. The OLS regression for revised WTP shows that two variables – age and period of residence – have no significance in the model. Although monthly income continues to be significant at 99 per cent confidence level and thus the most important variables influencing a household's decision to revise their willingness to pay, educational attainment and land holding are significant only at the 95 per cent confidence level. Thus, although a respondent's decision to increase his/her WTP to contribute to climate change mitigation, their financial status holds more clout than education attainment or total land holding.

Discussion

The economic value of an ecosystem is calculated for an ecosystem by estimating individual WTP, which is then extrapolated onto the total population in the region under study. The average initial willingness to pay for each of the 100 households in the sample for maintaining the wetlands in their present state with minimal pollution is ₹476, with a median value of ₹300 and a standard deviation of ₹414. Using the median WTP of ₹300 as returns a figure of ₹22,77,63,000 as the total WTP of the wetland and the surrounding region. Alternatively, extrapolating the mean WTP value of ₹476 gives the total annual WTP of Thrissur district as ₹36,13,83,960[3].

When estimating the value of the wetlands according to the revised WTP expressed by the households for climate change mitigation on top of improving the condition of the wetlands, the value becomes much higher. The mean revised WTP is ₹876, with a median value of ₹750. The average change in WTP for the households is ₹400, which is 84 per cent of the initial value. This implies that those households that are willing to pay an additional figure for climate change mitigation are willing to pay sums that are close to double of their originally stated WTP value. Estimating the value of the wetlands with the revised median WTP returns a value of ₹56,94,07,500, and the doing so on the basis of mean WTP gives a value of ₹66,50,67,960. Given these values are annual contributions from the stakeholders, value ascertained to the ecosystem over a long run period of five to ten years is very substantial, indicating that the local stakeholders view the wetlands as being an integral part of their daily lives and hence worth conserving and improving upon.

Conclusions

The stakeholders in the Kole wetland region of Thrissur district are highly aware of climate change affecting their daily lives. Events such as the floods of 2018 have left a deep scar in the minds of the people, making them more aware of protecting their environment and mitigating the negative effects of climate change. Stemming from a fear of the region's ecological balance being upset, the households were also willing to contribute a sum for the conservation of the wetland ecosystem, although not everyone was in favour of contributing a higher amount for climate change mitigation and adaptation. It was seen that a person's education attainment and total wealth in terms of land holding and income were very significant when it came to their reported willingness to pay for conservation of ecosystem services. Income was identified as the more important variable in the case of both the initial and revised willingness to pay of a respondent.

Recommendations

Large-scale public interest in wetland conservation can act as a stimulus for a state-sponsored initiative to improve the ecosystem. A state tax aimed at generating funds for environment conservation or to raise awareness among the citizens and discourage destructive practices can the government's exchequer, while making the stakeholders partners in climate change mitigation and adaptation. Any revenue generated as a result of such participatory activity can also lead to the emergence of sustainable agricultural practices in the Kole wetlands, and conservational practices

by either the state or other players such as action-oriented NGOs.

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Notes

1. For sampling, the farmer collectives in the Kole wetlands were approached for their list of agricultural households. Collectives in five panchayats shared their complete and accurate list of farmers, and from these, twenty households each were selected for the study.
2. The six ranges were ₹0-200, 200-400, 400-600, 600-800, 800-1000 and >1,000.
3. If the standard deviation is substantial, the median can be considered a better measure of WTP for extrapolating onto the general population (Brander *et al*., 2006). However, certain studies such as Jordan and Elnagheeb (1993) advocate the usage of arithmetic mean to calculate total economic value of an ecosystem due to a potential skewness of the distribution.

Table 1: Participant Responses towards Aspects of Climate Change

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Q1	8	22	40	16	14	100
Q2	1	6	26	25	42	100
Q3	0	3	8	47	42	100
Q4	0	1	7	49	43	100
Q5	2	1	22	40	35	100

Source: Primary Data

Table 2: OLS Regression Results (Initial WTP)

Variable	Unstandardized Coefficients		Standardized Coefficients	t – value	Sig.
	β	*Standard Error*	*β*		
Constant	-145.889	137.16		-1.064	0.290
Age	-2.293	1.831	-0.088	-1.252	0.214
Period of Residency	2.716	1.260	0.145	2.155	0.034
Years of educational attainment	26.023	7.467	0.244	3.485	0.001
Total Land Holding	.588	.174	0.262	3.384	0.001
Average Monthly Income	0.12	.002	0.514	6.359	0.000
R^2			*0.715*		
Adjusted R^2			*0.699*		
Sample Size			100		

Table 3: OLS Regression Results (Revised WTP)

Variable	Unstandardized Coefficients		Standardized Coefficients	t – value	Sig.
	β	Standard Error	β		
Constant	-55.989	251.379		-0.223	0.824
Age	-4.008	3.693	-0.105	-1.085	0.282
Period of Residency	4.481	2.404	0.234	1.864	0.067
Years of educational attainment	34.221	13.613	0.179	2.514	0.014
Total Land Holding	0.641	0.299	0.224	2.148	0.035
Average Monthly Income	0.016	0.004	0.497	4.649	0.000
R^2			*0.643*		
Adjusted R^2			*0.616*		
Sample Size			73		

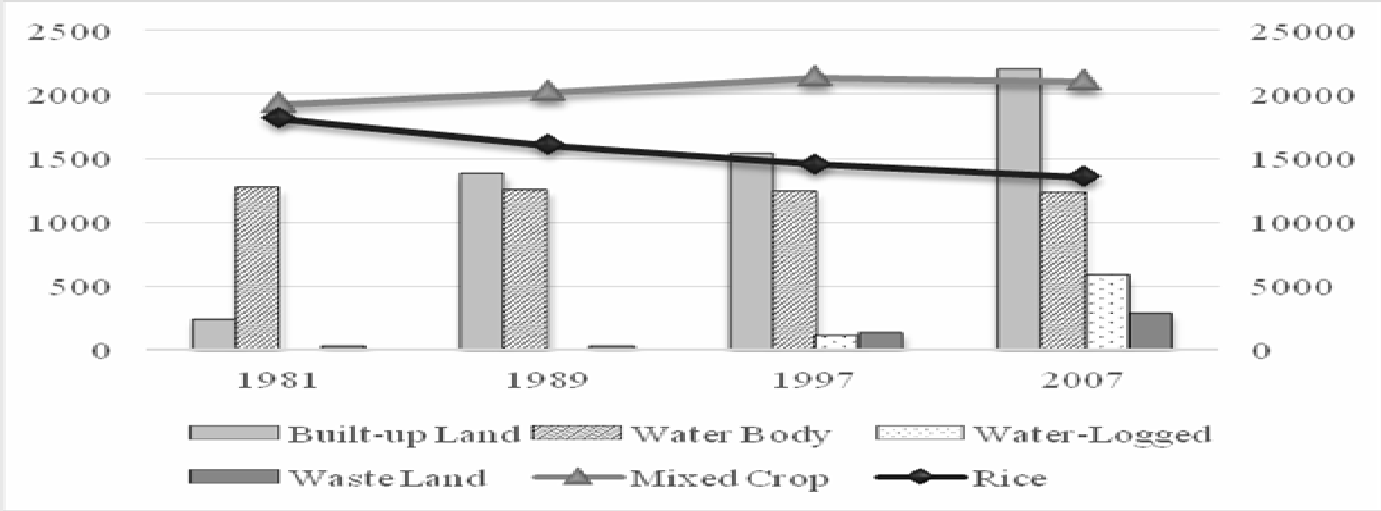

Fig. 1: Land Use Changes in the Thrissur Kole

Source: Srinivasan (2010)

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