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DIRECT AND INDIRECT BENEFITS OF PADDY WETLANDS: THE HIDDEN COST INVOLVED

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Abstract: Although paddy fields, account for less than half of the cultivated farmland in Kerala, the positive externalities generated by paddy fields are far greater. Apart from the private benefit gained by farmers harvesting rice, paddy fields are beneficial to society at large. Research on paddy fields confirms that they help regulate floodwater, Purify and replenish groundwater. Other benefits of paddy fields include air cooling effect, nutrient retention, sediment traps and soil erosion control, beautifying the environment, regulating surrounding temperature and generating oxygen. Yet paddy fields are being converted to other land uses every year. Vast acres of wetland paddy fields have been reclaimed for household and commercial purposes. Rather than just loss of wetland acreage, the immense benefits that these wetlands provide free of cost to society are also being lost in the process. This imposes a new cost on society which it is ill equipped to bear both physically and economically. The current study attempts an identification of the economic and environmental benefits provided by wetland paddy fields and an economic estimation of these benefits. Market based techniques and contingent valuation methodology were employed for the purpose. The study estimated the value of total direct and indirect benefits provided by the paddy wetlands to the people of two panchayats to be Rs.2.02 crores. Of this 0.0198 crores was the direct benefits and Rs.2.01 crores was the indirect benefits provided by the paddy wetland. The study also estimated a mean Willingness to Pay (WTP) of Rs. 467.50 and a total WTP of Rs. 2.02 crores for the two panchayats. The study highlights two main points. The indirect benefits provided by paddy wetlands far outweigh the direct benefits that they provide. The immense value of these indirect benefits, derived free of cost, justify allowing paddy wetlands to lie fallow and uncultivated, even if economically unprofitable. Secondly, a mean WTP of Rs.467.50 in a state where average daily wages centre around Rs.500 is very low. Although people value the benefits provided by paddy wetlands, they are unwilling to pay greater amounts for the protection and continued provision of these benefits. Commercial benefits from sale/conversion of paddy wetlands to other land forms are very attractive to paddy land owners, who resent State intervention and restrictions that are barriers. Such value perceptions can only contribute to accelerated speed in the pace at which wetlands are converted to other land forms and uses. Yet, scientific evidence shows that if market mechanisms were to be implemented to replace the provision of functions provided by paddy wetlands, the cost involved in the provision of each individual service would run into billions. Revenue rich Governments let alone cash strapped governments will be unable to bear such immense cost.

Key words: Economic Value, Paddy wetlands, Direct and indirect benefits, Contingent Valuation, WTP.

INTRODUCTION

Wetland ecosystems are known for their biological diversity and considered to be one of the most productive but complex ecosystems of the world. Paddy wetlands, which comprise the terrestrial part of wetland ecosystems, are flooded parcels of arable land, suitable for growing semi aquatic rice. Economically, they are important because they provide sustainable livelihood options to society and ecologically, they are important because they are multifunctional and their linkages to adjacent ecosystems make them highly productive and biologically valuable to humanity. Positive externalities generated by paddy fields are immense. Apart from the private benefits to farmers harvesting rice and selling fodder, paddy fields help regulate floodwater, purify and replenish groundwater, are capable of nutrient retention, sediment traps and soil erosion control. They beautify the environment, regulate surrounding temperature (air cooling effect) and generate oxygen.

Despite their importance, human activities have contributed to unprecedented rates of wetland loss, which has threatened the stability and continuity of wetland ecosystems as well as their

provision of goods and services to mankind (Nunes *et al*., 2001). Disregarding the important role played by paddy and paddy fields in the Kerala economy, large scale reclamation of paddy fields for other land uses have occurred during the past two decades for a variety of reasons. Vast acres of wetland paddy fields have been reclaimed for household and commercial purposes. Equally large areas have been reclaimed for the cultivation of commercial crops. Area under paddy cultivation in the State has been steadily declining. Total paddy area during 1961-62 which was 7.53 lakh hectares has decreased to 2.8 ha in 2011-12. Although cultivated paddy wetlands accounted for less than eight percent of the total cropped area (Agricultural Statistics, 2011-12), vast tracts of paddy wetlands also lie fallow and uncultivated in various parts of the State.

Rather than just loss of wetland acreage, the immense benefits that wetlands provide free of cost to society are also being lost in the process. Alternate market mechanisms to provide the same services to society imposes a new cost on society which it is ill equipped to bear both ecologically and economically. This study attempts to look into these issues in the belief that any attempt to value benefits provided by paddy wetlands will help generate awareness among the public regarding their value and the importance of conserving such wetlands.

MATERIALS AND METHODS

The study was based on data collected from Ala and Mulukuzha Grama Panchayats in Alappuzha district (Fig. 1). It focuses on two main objectives. The first objective was to estimate values for the direct benefits provided by paddy wetlands in

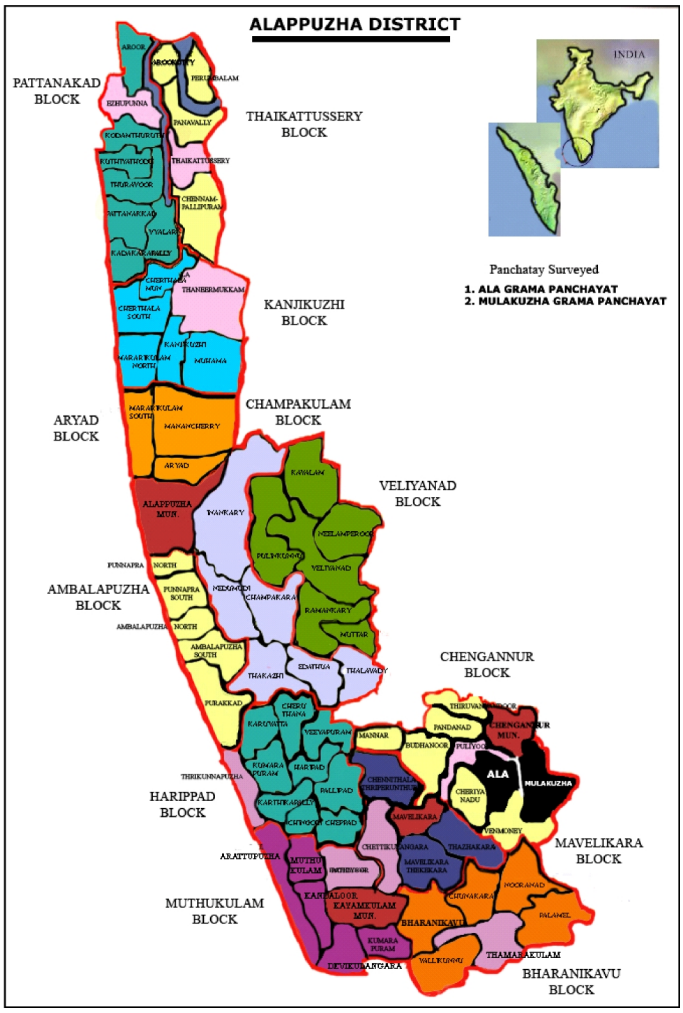

Fig. 1. The Study Area (Ala and Mulakuzha Panchayats of Alappuzha District)

the study area. The market based technique of residual rent approach was used in which the cost of extracting or harvesting the resource was subtracted from the market value of the resource. When the extraction/harvest costs include labour costs, it is the opportunity cost of labour and not the market wage rate that was considered. A questionnaire was prepared and data was collected from all the fourteen paddy cultivating households in the panchayats. The winter paddy cultivation undertakes by farmers in the study area is locally known as puncha krishi. It begins in November and is harvested after four months. A second crop can be cultivated during monsoon if environmental conditions are favourable but not by the farmers of the study area. Secondary data published by the Department of Economics & Statistics, Government of Kerala, was also used.

The second objective of the study was to estimate the indirect benefits provided by paddy wetlands. The stated preference method of Contingent Valuation (CVM) was used for this purpose. This method involves constructing a hypothetical market in a survey to elicit values representing the amount people would be willing to pay to avoid a specified environmental damage, to achieve a stated improvement in environmental quality or to receive a specified supply of a public good. The contingent valuation questionnaire was randomly executed on 1053 heads of households/housewives whose age ranged between 25 and 65. 720 questionnaires were employed in Ala Grama Panchayat and 333 in Mulakuzha Grama Panchayat. 53 questionnaires had to be rejected due to insufficient information/bias. The survey was conducted during the period from February to May, 2013.

RESULTS AND DISCUSSION

As part of the attempt to elicit values for the direct benefits provided by paddy wetlands in the study area, the study estimated average revenue per acre as Rs. 22,371/-. This included value of output received from sale of paddy and straw. The average cost per acre was estimated as Rs. 8,300/-. Production of paddy is very much dependent on the forces of nature. However, paddy production in all the fields surveyed was found to be profitable. The net revenue realized per acre from paddy cultivation was Rs. 14,071/. Table 1 below gives the details.

Respondents pointed out that cost of production was lower due to subsidies received from the Government for seedlings, fertilizer, electricity and water pump rentals. If the cost of subsidies were also included in cost calculations, it is probable that per acre profits would be lower or even at a loss. Agricultural Statistics (2011-12) published by the Department of Economics and Statistics, Government of Kerala, estimates cost and revenue from paddy cultivation during 2010-11. According to this study, the total cost of paddy production (winter crop) per acre was Rs.50,531/-. This included imputed cost of household labour and other opportunity costs. The value of output received was estimated as Rs. 22,819/- per acre. This would mean an average loss of Rs. 27,712/- per acre. In the adjacent panchayat of Thazhakara, Sukumaran (2013) reported a net value of Rs. 12,222/- per acre from paddy cultivation during lean season and Rs. 35,000/- per acre during a bumper harvest season. Satheesan (2013) reported a net value of Rs. 39,253/- per acre from paddy cultivation in Onnattukara during 2013.

Table 1. Values Realized from Paddy Cultivation

Output of Paddy per Acre	Value of Output Received	Value of Output per Acre	Total Cost	Cost Per Acre	Net Value Generated	Net Value per Acre
(Kg.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)	(Rs.)
1257	313200	22371	116200	8300	197000	14071

In addition to the direct benefits provided by wetlands, indirect benefits provided by wetlands are also enjoyed by the respondents and the local community as a whole.

Regression was fitted to the CVM data using a Multinomial Logit Model with marginal effects. The statistical package *limdep* was used to run the regression and estimate values. Goodness of fit of the model was explained using *pseudo* R^2. This was obtained using the formula (1- (log unrestricted/log restricted) and was estimated as 0.11. Significance of *pseudo* R^2 is given by significance of Chi square statistic (112.423) (Table 2).

Table 2. Regression Results of Estimated WTP

Multinomial Logit Model	
Maximum Likelihood Estimates	
Dependent variable	WTPDUMMY
Weighting variable	ONE
Number of observations	1000
Log likelihood function	- 453.4743
Restricted log likelihood	- 509.6858
Chi-squared	112.4229
Degrees of freedom	11
Significance level	.0000000

A probability density function was worked out[1]. A lognormal distribution with a spike falling at zero was fitted to the probability distribution. The spike model was estimated using the Maximum likelihood estimation method, the height of the spike representing the probability of having zero willingness to pay (WTP). It was calculated as 0.38 which is very negligible. From Table 3, it can be seen that education was not significant (as the probability column shows). Gender was also insignificant. Age had very little impact on WTP and was negatively related to probability of WTP. As age increases by 1 unit, the probability of WTP decreases by 0.27 percent. Coefficients of all income dummies were significant at 1 percent level. If the occupation of the respondent was directly dependent on wetlands, then there was a 7 percent higher probability of WTP than people with occupation that are independent of wetlands. All the coefficients explained above are based on the marginal effects coefficients obtained in the last column. (*Footnotes*).

The study estimated a mean Willingness to Pay (WTP) of Rs.467.50 and a median WTP of Rs.400. As a final exercise, the sample values were expanded to the population of the two panchayats in order to obtain an estimate for how much the residents of the two panchayats valued the indirect benefits provided by the paddy wetlands. The amount estimated was Rs.2.01 crores. Table 2 gives the details.

Table 2. Regression Results of Estimated WTP on Selected Environmental and Socio Economic Variables

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z Significance	Mean of X	Marginal Effect
EDUDUM1	0.139621	0.25655623	0.544	0.5863	.3000977	- 0.018602
EDUDUM2	0.212156	0.23883074	0.888	0.3744	.5474095	0.0274788
INCOME1	1.242759	0.35401273	3.510	0.0004	.1153470	0.1609643
INCOME2	1.175632	0.29874700	3.935	0.0001	.3255132	0.1522699
INCOME3	1.138167	0.29576514	3.781	0.0002	.3607038	0.1448269
INCOME4	1.111132	0.27424754	3.912	0.0002	0.301013	0.1377761
INCOME5	4.126324	0.76378746	5.402	0.0000	.1339198	0. 5344486
GENDER	- 0.19160	0.19961879	- 0 .96	0.3371	.7438905	- 0.024817
AGE	- 0.02217	0.00700515	- 3.17	0.0015	39.35679	- 0.002872
OCCUDUM	0.565269	0.25741512	2.196	0.0281	.1378299	0.0732147

[1] The probability density function worked out for the WTP variable was:

$$f(y) = \frac{1}{\sqrt{2\Pi}(1.8610)} e^{\frac{(y-3.4563)^2}{2(1.8610)^2}}$$

Table 2. Willingness to Pay Estimates

Annual Income (Rs.)	Percentage of Respondents (%)	Mean WTP (Rs.)	Total WTP (Rs.)
< 5,000	28.4	411.6	8006463
5,000 - 10,000	29.5	331.4	2406638
10,000 – 50,000	18	463.3	6593233
50,000 – 1,00,000	7.9	687.3	2152067
> 1,00,000	16.2	711.4	909906
Total	**100**	**467.6**	**20068307**

Source: Primary Data, Feb-May, 2013

The study estimated the total value of direct and indirect benefits provided by the paddy wetlands to the people of the two panchayats to be Rs. 2.027 crores. Of this 0.0197 crores was the direct benefits and Rs. 2.01 crores was the indirect benefits provided by the paddy wetland.

Matsuno *et al.* (2006) estimated the value of services that regulate ecosystem functions to be US$ 72.8 billion in Japan. Wu (2003) evaluated the air-cooling effect of paddy wetlands and showed that the net electric power saving by paddy fields was 4,497 unit power/ha/day. Ikuo *et al.* (2003) observed in their study the capacity of paddy field to remove up to 3.5 kg of nitrogen per hectare. Tanaka *et al.* (2010) estimated that reduction of paddy cropping area led to a 25% reduction in annual groundwater recharge in the Shira River Basin. Yoshikawa *et al.* (2010) estimated prevention of soil erosion from paddy fields in Okayama Prefecture to be 0.83 t/ha/y. If market mechanisms were to be implemented in place of each function provided by the paddy wetlands, the cost that would be incurred would far exceed Rs. 2.01 crores.

CONCLUSIONS

The study highlights two main points. Paddy wetland ecosystems provide benefits of immense value to mankind and the indirect benefits (Rs. 2.01 crores) far outweigh the direct benefits (Rs. 0.0197 crores) that they provide. Even if paddy cultivation was not profitable, the indirect benefits that paddy wetlands provide free of cost to society, justify allowing them to lie fallow and uncultivated, even if economically unprofitable.

Secondly, an annual mean Willingness to Pay (WTP) of Rs.467.50, in a region where average daily wages centre around Rs.500, is very low. Although people acknowledge the benefits provided by paddy wetlands, they are unwilling to pay greater amounts for the protection and continued provision of these benefits. Commercial benefits from sale/conversion of paddy wetlands to other land forms are very attractive to paddy land owners, who resent State intervention and restrictions that are barriers. Such value perceptions can only contribute to accelerated speed in the pace at which wetlands are converted to other land forms and uses. Yet, scientific evidence shows that if market mechanisms were to be implemented to replace the provision of functions provided by paddy wetlands, the cost involved in the provision of each individual service would run into crores.

This study concludes that it is in the best interest of society to undertake measures that will encourage and make paddy cultivation profitable. This way, society continues to enjoy both direct and indirect benefits from paddy wetlands. But if this were not possible, it still makes economic sense to allow paddy fields to lie fallow and uncultivated so that society may continue enjoying the indirect benefits they provide. The present trend among owners, to dispose off their land or turn it to other forms of land use, stems from the lure of profits and not, from ignorance of the benefits of paddy wetlands. If society could evolve new institutional mechanisms that make it economically worthwhile for paddy land owners to retain their land even if in a fallow and uncultivated state, this will help curtail the large

scale destruction/conversion of paddy wetlands that is witnessed today. Kerala may be able to import rice from outside but once lost, the indirect benefits that paddy wetlands provide free of cost to society cannot be easily revived, or if so, only at extremely high cost. Revenue rich Governments let alone cash strapped governments would be unable to bear such immense cost.

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