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WILLINGNESS TO PAY FOR TANK MAINTENANCE: A STUDY ON TANK IRRIGATION IN THE DRY ZONES OF WEST BENGAL IN INDIA

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ABSTRACT

The optimal management of available water resources has become a major issue world over. Tanks can play a vital role to conserve water. Sustainability of irrigation systems is very important from perspectives of both farmers and government. Developing countries like India are facing tremendous budgetary pressure arising from the need to defray irrigation costs. Quite often, farmers do not receive adequate service owing to an insufficient O & M budget. This undoubtedly affects crop productivity and farming income. It is therefore important to decrease the budgetary burdens of government through local control and support. Willingness to Pay (WTP) is an economic concept, which aims to determine the amount of money a consumer is willing to pay for the maintenance of tanks. The present paper attempts to find the determinants of WTP for tank maintenance and estimates the total willingness to pay based on the primary survey of 533 households in the three districts of West Bengal namely Bankura, Purulia and Paschim Medinipur in the dry zones of West Bengal.

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KEYWORDS

Irrigation, Tank, Willingness to pay, Dry zones.

1. INTRODUCTION

The optimal management of available water resources has become a major issue world over. Global warming has made the monsoon more variable and unpredictable. The predicted increased variability of precipitation with longer drought periods would lead to an increase in irrigation requirement even if the total rainfall remains the same. Water storage to conserve flood water due to climate change will be an important agenda in the future (Palanasami 2000, Palanasami et al 2010). Tanks can play a vital role to conserve water (Sreedhar 2007, Shah 2009, Sengupta 1985, Sakthivadivel 2004, Shah 2003, Vaidyanathan 2006, Jana 2010, Jana 2012, Balasubramanian 2003, Anbumozhi 2007, Bardhan 2000 and Chakravorty 2006). Tank irrigation, in certain parts of India particularly in the dry zones, provides a good alternative for irrigation development. Tank means a reservoir or place which is used for the storage of water. Tanks can have a wider geological distribution than large-scale projects. Income distribution and employment generation effects are not limited to one area in case of tanks. Tank investments tend to be less capital intensive, have fewer negative environmental impacts and offer a good scope for adaptation to climate change through rain water harvesting. In spite of the advantages of irrigation development, development of tank irrigation deteriorated in almost every state in India including West Bengal. The share of tank irrigated area in India has declined from 13.2% in 1970-71 to 3.5% in 2003-04 (Central Water Commission). There are various causes behind this phenomenon. One of the main causes of degradation of traditional methods is lack of public fund of tank renovation (Agarwal 2009, Dhawan 1986, Shah 2009, Narayanmoorthy and Deshpande 2005).

Sustainability of irrigation systems is very important from both farmers' and government perspectives. Conversely, developing countries like India are facing tremendous budgetary pressure arising from the need to defray irrigation costs. Quite often, farmers do not receive adequate service owing to an insufficient O & M budget. This undoubtedly affects crop productivity and farming income. It is therefore important to decrease the budgetary burdens of government through local control and support. Willingness to Pay (WTP) is an economic concept, which is used here to determine the amount of money a consumer is willing to pay for the maintenance of tanks. The consumers' WTP is becoming increasingly popular and is one of the standard approaches that is used by market researchers and economists to place a value on goods or services for which no market-based pricing mechanism exists (Chandrasekaran et al 2012). The approach, involves taking a survey through a structured questionnaire of consumers' WTP specified prices for hypothetical services, also referred as Contingent Valuation Method (CVM). The WTP is defined as the amount that must be taken away from person's income while keeping his utility constant. The CVM still have serious methodological and theoretical shortcomings when used to assess WTP for non-market based goods and services, such as format bias, embedding effect, ordering problem, starting bid effects, strategic bias, information bias, non-response bias, payment vehicle, free rider problem, warm glow effect (Chandrasekaran 2009, Koss et al 2001, Mitchell et al 1989, Raje et al 2002, Chandrasekaran 2009, Venkatachalam 2004, Griffin 1995). In this study, the CVM method is used to determine the economic value of tank maintenance for the dry zones in West Bengal.

2. STUDY AREA AND RESEARCH FRAMEWORK

We have selected three districts namely Bankura, Purulia and Paschim Medinipur for our study as high proportions of these regions fall in the dry zones. Fluctuating rainfall with intermittent drought spell between two successive rainfalls makes the crop, generally the Khariff crop, very vulnerable in these regions. Though the average annual rainfall in the districts is about 1500 mm, the districts suffer from vagaries of rainfall which seriously affect the crop yield. As the geology of the regions is not favourable to ground water irrigation, the option of tank irrigation should be explored further. It may be pointed out that the area irrigated by Tank in Bankura, Purulia and Paschim Medinipur were 20.8, 22.4 and 26.4 thousand hectare respectively in the year 2001-02. The primary objective of the paper is to judge the importance to the farmer-households through willingness to pay of the households for renovation/reconstruction of the tanks. For the willingness to pay analysis we have used Tobit Model. The data used for this paper has been collected both primary and secondary sources, though the work is mainly based on primary data. The primary data used in this study has been collected using the structured questionnaire meant for primary survey and the survey had been conducted during the period of 2008-09. The precondition for dry zones in the three districts of Purulia, Bankura and Paschim Medinipur did not allow us to adopt random sampling. We used purposive sampling procedure for the selection of blocks and villages. The blocks have been selected with the discussion of the officials of the departments of irrigation, Principal Agricultural Officer and other officials in the districts. The villages have been selected in consultation with GP offices. But for the selection of households we have used random sampling procedure. Table- 1 presents the number of districts, blocks, villages and households selected in West Bengal for our survey.

TABLE 1: NUMBER OF DISTRICTS, BLOCKS, VILLAGES, TANKS AND HOUSEHOLDS SELECTED IN WEST BENGAL

Districts	No. of blocks selected	No. of GPs /Municipality selected	No. of villages selected	No. of tanks selected	No. of Households selected
Bankura	2	5	26	52	155
Purulia	3	8	27	60	198
Paschim Medinipur	6	14	49	69	180
Total Sample	11	27	102	181	533

Source: Based on Primary Survey

3. SOCIO-ECONOMIC CHARACTERISTICS OF THE HOUSEHOLDS

As we have already stated we have collected data on different socio-economic characteristics from 533 households in our study area. Some socio-economic characteristics of the households are mentioned below:

- (1) The percentage of female is 46%.
- (2) The percentage of households belonging to different land classes are as follows: marginal - 54.8%, small - 27.2% and medium – 18%.
- (3) The average family size is 6.
- (4) The caste-wise percentage of households is as follows: General – 38%, OBC – 32%, SC – 11%, ST – 19%.
- (5) The average level of education of the head of the household is calculated as five.
- (6) Out of 533 households surveyed 345 households have Kachha houses.
- (7) Percentage of NREGS job card holder is 76% and average working days from NREGS per family is calculated as 27.
- (8) The average of percentage of irrigated land out of total agricultural land for the sample households is calculated as 55.8%.

4. WILLINGNESS TO PAY (WTP) AND ITS DETERMINANTS

We had asked each household about their willingness to pay (WTP) if the new tank/new bund is constructed or tank/bund is renovated and the water supply is ensured for them. The question was open-ended one. We have different responses about their willingness to pay. Some of the respondents are willing to pay zero amount or they avoided to answer the question. From the willingness to pay behavior of households, we have tried to measure the Total Willingness to Pay (WTP) of the tank maintenance for three districts under consideration.

Firstly, we have used the TOBIT regression model to identify the determinants of willingness to pay for improving the Bund condition. Then we have estimated the total willingness to pay. The persons who are not willing to pay or have not expressed anything about their willingness are assumed to have 0 WTP. The negative value of WTP is not observable. The dependent variable is censored at the value 0. Thus in this analysis, the Tobit model can be written as

$$WTP = WTP^*, \text{ if } WTP^* > 0 \\ = 0, \text{ otherwise}$$

It should be mentioned that method of estimation procedure depends upon the structure of the bidding game. If the bidding game is closed ended type, the relevant estimation procedure would be logit/probit. For open-ended question like ours, censored regression like Tobit is more appropriate. We have taken the following model to find the determinants of WTP.

The model is $WTP^* = b_1 + b_2 \text{ HEADED} + b_3 \text{ FAMEXP} + b_4 \text{ TANKQUAL} + b_5 \text{ WATERDD}$

HEADED: Education of the head of the household

FAMEXP: Family Expenditure (Rs./month)

TANKQUAL: Score value of the quality of tank as judged by the households out of 100 based on different quality parameters

WATERDD: Water requirement (Acre-mm) calculated from the area cultivated by households for different crops and water requirement for those crops.

We have tested the WTP model with the whole sample of 533 households in three districts. The estimated results are shown in the table 2.

TABLE 2: TOBIT ESTIMATION RESULT OF WTP

	Coefficient	Std. Error	z-Statistic	Prob.
C	82.49120	145.3455	0.567552	0.5703
HEADED	9.543463	4.420112	2.159100	0.0308
FAMEXP	0.030330	0.013190	2.299378	0.0215
TANKQUAL	-4.867150	2.852038	-1.706551	0.0879
WATERDD	0.038641	0.007326	5.274484	0.0000

Source: Own Estimation

The above results indicate that the decision of the individuals to contribute or not to contribute for tank maintenance depends significantly upon education of the head of the family (HEADED), family expenditure (FAMEXP), and Water demand for crops cultivated (WATERDD) and negatively with Quality of the tank (TANKQUAL).

5. ESTIMATION TOTAL WILLINGNESS TO PAY FOR TANK MAINTENANCE

Demand for a resource depends upon total economic value (TEV). TEV consists of both use value and non-use value. As water for the tank is used for irrigation, bathing and fishery purposes, it has certainly use value. Contingent valuation method (CVM) has been used here for the valuation of use value though CVM is generally used for valuation of non use value. We have already stated our sample consists of 533 households. We have collected information about their annual willingness to pay for tank maintenance. Total willingness to pay has been calculated by median WTP multiplied by the relevant population. Total willingness to pay reflects the demand for Bund/tank. In the Table 3 we have reported the number of holdings for different size classes for the three districts we have surveyed. There are 13.48 lakh holdings in total in the three districts in 2010 as per the reports of District Statistical Handbooks of Government of West Bengal.

TABLE 3: DISTRICT WISE NOS. OF HOLDINGS FOR DIFFERENT LAND CLASSES, 2010

	Marginal	Small	Semi-medium	Medium	Large	Total
Bankura	2,39,365	84,960	36,870	5,827	20	3,67,042
Paschim Med	5,77,469	82,262	19,001	1,478	23	6,80,233
Purulia	2,13,085	63,750	22,455	2,197	27	3,01,514
Total	10,29,919	2,30,972	78,326	9,502	70	13,48,789

Source: District Statistical Handbook, Government of West Bengal

Out of 13.48 lakh land holdings in the three districts, we have tried to estimate the number of households those who are willing to pay on the basis of our sample observation. Out of 533 households surveyed we have observed that 121 households are not willing to pay for the renovation/reconstruction of Bund. The distribution of 121 households by size classes are presented in the third row of the table 4. In the next row we have estimated the number of households in the district not willing to pay given the proportion of households not willing to pay in the sample. Then we have estimated the number of households willing to pay in the three districts.

TABLE 4: ESTIMATION OF NOS. OF HOLDINGS WILLING TO PAY IN THE THREE DISTRICTS

	Marginal	Small	Semi-medium	Medium	large	Total
0 WTP (Nos. in sample)	46	28	30	11	6	121
0 WTP (proportion in sample)	0.380	0.231	0.248	0.091	0.050	1.000
0 WTP (Population)	3,91,539	53,448	19,420	864	3	4,65,274
Estimated no of holdings Willing to pay	6,38,380	1,77,524	58,906	8,638	67	8,83,515

Source: Own Estimation Primary Survey

We have collected the data of willingness to pay for all the 533 households in the district. Out of these 121 households have 0 willingness to pay (WTP). So the rest of 412 households have some amount of willingness to pay. From these 412 households we have calculated the median willingness to pay for different categories of farmers, which has been reported in the third row of the following table. In the last row, we have reported the population wtp for the three districts. The total willingness to pay is calculated as 6.07 crores.

TABLE 5: ESTIMATION OF TOTAL WILLINGNESS TO PAY IN THE LAND CLASSES

	Marginal	Small	Semi-medum	medium	Large	Total
No of holdings Willing to pay	6,38,380	1,77,524	58,906	8,638	67	
Median WTP (Rs.)	50	100	150	250	1,000	
Total WTP (Rs.)	319,18,977	177,52,393	88,35,950	21,59,545	66,528	607,33,395

Source: Own Estimation Based on Primary Survey

6. CONCLUSION

Sustainability of irrigation is an important agenda both from the point of view of farmers and the Government, particularly in the context of climate change. Our study is based on the primary data collected from some dry zones in West Bengal. Poor maintenance of tanks in the study area is affecting the crop productivity and farming income of the farming households. Local support is essential to ease the budgetary pressure on government for operation and maintenance. We have tried to estimate the economic value of tank maintenance through contingent valuation method and have found out some of its important determinants. The study reveals that if proper institutional mechanism could be developed then farmers are willing to pay for the maintenance of the tanks. The fees will bring an ownership feeling to the farmers so that the co-operation among the farmers for conservation gets enhanced.

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