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RAINWATER HARVESTING TECHNOLOGY AND WATER USE PRACTICES: A STUDY FROM PURULIA DISTRICT OF WEST BENGAL, INDIA

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ABSTRACT

Identified in the category of semi arid regions of West Bengal, the district of Purulia suffers from acute water crisis irrespective of seasons. Rainwater Harvesting Structures are being constructed under the Integrated Watershed Development Programme (IWMP) to address the problem of water scarcity. The paper attempts to focus on the prevailing water use practices in the regions and tries to examine the general perceptions and attitude of the people about environment and eventually assess the determinants of willingness to pay (WTP) towards sustainable water supply through Rainwater Harvesting technology in the region. The paper is based on primary survey carried out in 6 blocks (Baghmundi, Balarampur, Arsha, Barabazar, Joypur & Jhalda 1) of the district. A sample of 540 households was surveyed using multistage sampling method. Descriptive statistics and a logistic regression model were applied to explain household preferences for improved domestic water supply and derive estimates of WTP for such a service. The estimates show that the factors that influence willingness to pay for improved sustainable water supply include main source of domestic water used by the household, distance and average time taken to fetch water from the rainwater harvesting water source, education level of the household's head and the general perception or attitude towards environment conservation practices. The results confirm that household average income has a positive and statistically significant impact on WTP. The estimates of WTP obtained in this study indicate the possibility of introducing awareness cum demand driven program to expand the coverage of rainwater harvesting water schemes.

JEL Classification: *Q52, Q56, QC350, C870*

KEYWORDS: *Rainwater Harvesting, Willingness to Pay, Contingent Valuation Method, Water*

1. INTRODUCTION

Purulia, identified in the category of semi-arid regions of West Bengal with a population of more than twenty nine lakhs, has been experiencing the problem of water scarcity irrespective of seasons. The problem becomes more pronounced during the dry season, when ground water level goes down. Rapid population growth, urbanization and growing economic activities have led to the incessant decrease in the level of ground water in recent times. Depletion of ground water level at a fast rate has contributed to an overall increase in demand for water. The region is mostly inhabited by scheduled castes (SCs) and scheduled tribes (STs) rely on rain fed agriculture. During the summer season most of the sources of water like lakes, ponds, rivers, etc dries up and water scarcity becomes prominent. To get rid of this problem people migrates to other places and as a result of which sometimes their children are counted in the list of drop outs from their schools and individual work is also hampered. People consuming water from nearby unsafe sources suffers from health hazards. They often purify water by boiling at high temperatures. Generally forest wood is used as fuel for boiling. Increasingly cutting down of forest has threatened the animal habitat, resulting in often elephant attacks in the surrounding villages and destroying agricultural fields.

Emphasis is being given to watershed management to cater the problems in the interior dry lands through the harvesting of rainwater. Rainwater harvesting is a process by which the runoff water during the monsoon is collected and stored, purified and then supplied during scarcity of water. At the individual level, every year people dig ponds during the dry season before the arrival of monsoons. So that during monsoon the rainwater can be stored. At the regional level, Rain Water Harvesting Structures (RWHS) are being constructed here under the Integrated Watershed Management Programme (IWMP) of the central Govt. The primary objective of rain water management projects operating in this district is to increase agricultural production and consequently improve the economic and social well being of the population. Evidence reveals that most of the people in the district are reluctant to depend on rainwater harvesting water for domestic use either due to distance of the project from their locality or unable to pay high water tariff. The main challenge is to develop an appropriate and affordable innovation that can help to bridge the gap between demand and supply of water, thereby making the project economically viable, environmentally sustainable and socially acceptable.

A growing concern for environmental sustainability directs more attention to sustainable water use practices through rainwater harvesting technology. The economic, environmental and social impacts of rainwater harvesting system are enumerated in Table 1. Economic dimension is measured by availability and accessibility of safe drinking water easily, environmental dimensions in terms of preserving water for future uses thus recharging and preventing depletion of water and finally the social dimension in promoting social inclusiveness and generating other co-benefits.

Table1: Impact of RWH in different Dimensions

Dimensions	Perspective-Impact
Economic Efficiency	Benefits to users, easy access to safe water, increase income, improve household Assets and savings. Increased agricultural production and thus supports economic Growth. Supply of harvested water from the govt. reduces the pressure on pumps and Hence reduces electric bills.
Environmental Sustainability	Recharge ground water and helps to reduce the depletion of ground water level, Reduction in natural hazards, soil erosion, floods. etc and thus supports environment. Enhances security of environmental resources and sustainability. It plays a significant role in promoting the ecological and environmental conservation, thereby reducing the damage to our creeks.
Social Impact	Increases capacity in decision making, confidence building, integration of social activities, increases economic linkages in terms of employment, education, and basic facilities etc and finally enhanced access to safe water supports social sustainability.

Therefore to envisage better livelihood conditions for local residents both public and private investments for improved water-related services, through rainwater harvesting systems, are essential. To implement these investments, decision-makers need information about the possibility of adopting an impartial, cost-recovery strategy resulting from the application of water tariffs to domestic users. Globally the sale price of purified water has been estimated to be one-third of the cost of producing it (World Bank, 1993).This utility is often highly subsidized keeping in consideration the community's health benefit. Paradoxically, the beneficiaries who are connected to this highly subsidized system are often non-poor while the poor rely more on unsafe sources. What variables inhibit or facilitate the adoption of rainwater harvesting? How do these variables relate to general environmental concerns, conservation-related attitudes and behaviors, and consumers' environmental responsibility? What are general water-related attitudes and beliefs of consumers regarding water, water tariffs and their willingness to pay such tariff? The answers are important for decision makers in water management, public policy, and educational institutes to develop effective strategies for enhancing consumers' water conservation practices.

The focus of the study is confined to the watershed project area and its residents. The paper tries to investigate the impact of improved water supply on the livelihoods of the watershed area with focus on the willingness to pay by the domestic users of improved water supply services. Against this broad aim of the study the primary objectives are:

- To focus on the water use practices prevailing in the region.
- To assess the general perceptions of the residents of the watershed regarding environment and sustainable water supply through rainwater harvesting projects.
- To identify the factors that governs the willingness to pay for sustainable water supply services.

The paper is organized as follows: Section 2 deals with the materials and the methods, Section 3 presents the empirical model. Section 4 presents the results and their discussion while Section 5 concludes with policy implications.

RELEVANT LITERATURE

A substantial literature exists on valuation of water and other environmental services. The literature varies widely over different valuation techniques, the types of services valued and scale and location. The most popularly used technique is CVM because of its appropriateness. Whittington D. et al. (1990) estimated WTP for water service in Southern Haiti (a developing country) by applying contingent valuation method. The results of the study advices that it is quite often possible to apply a CVM survey in a vulnerable regions and achieve satisfactory and true answers. Henceforth CVM methodological survey is a feasible method for estimating individuals WTP for an improved water public project and its services in Southern Haiti. Johnson N.L. (2004) examined the economic value of improving water supplies of local watershed services in hillsides of Nicaragua by applying contingent valuation service. Results revealed that a participatory and multi sector approach is the best that can simplify management of watersheds. Baiyegunhi (2015) in a study from South Africa on determinants of willingness to pay for adaptation of rainwater harvesting technology found that age, gender, income and social capital, general perception about the technology and contact with extention agent to be statistically significant in explaining the adaptation behaviour. Mwakaje et al (2013) employed contingent valuation method to estimate willingness to pay for watershed services and conservation in Tanzania. The study found parameters like education, farm size and household income to be significant. However, an inverse relationship was found between WTP and farm distance, probably due to the perceived risk of decreasing water availability as distance increases. Amoah et al (2013) also used the contingent valuation method to estimate the demand for clean rainwater used for domestic purpose. The results advocated that education on the modern method of harvesting rainwater should precede the implementation of such strategy in Ghana. Hashimoto (2008), in his research to understand the farmers' willingness to implement water conservation practices showed cost compensation would be necessary to promote implementation of such practice. The study showed that farm size consistently had a positive effect on conservation practice implementation. The estimated WTP or the price that the households were willing to pay for water services was significantly higher than what they had paid for untreated water sold on streets and thus was enough for the community to finance a potable water supply project .

In another similar study, Olajuyigbe and Fasakin (2010) examined some factors that explained citizens' willingness to pay for improved sustainable water supply in Southern Nigeria using the logistic linear regression model. The empirical results reveal that the most important determinants of water services in this area are the distance from main source to the house, adequate supply from main source, quantity of water used per person per day, quantity of water purchased per day from vendor, average amount spent on water during dry season, main source of domestic water used by households, access to improved source of water, attack by water-borne diseases and performance of water supply from the State Water Corporation.

Calderon at el (2007) pointed out the low level of awareness of the respondents about watersheds and found that they are willing to pay (WTP) for improved watershed management provided their contribution is used solely for the management of the watersheds supplying water to their place Metro Manila.

A study by Li et al. (2000) on the socioeconomic aspects of rainwater harvesting agriculture pointed out that the spread of rainwater harvesting agriculture should consider the constraints specific to technological, ecological, social, economic, and political factors.

Sattar et al (2008) estimated WTP for safe drinking water, Hyderabad, Pakistan by acquiring primary data and applying a multinomial logit regression with estimated probabilities for analyzing the economic consciousness of safe drinking water. The results revealed that WTP of an educated person is higher than that of uneducated persons and females are willing to pay more than that of males.

Olagunju et al. (2015), examined the rural household's WTP for portable water in Oyo State, Nigeria by applying a multistage sampling method and logit regression model. Results of the study revealed that the monthly income and the literacy rate of the respondent's bears a direct relationship with WTP for better water service. Hence if environmental cum formal education is being promoted in the community then it will automatically push up the households WTP for improved water and side by side will boast up potable water use practices.

Haq et al. (2008) examined the households WTP for improved water service level and its quality in Abbottabad District of Pakistan by employing contingent valuation method and related preference method. The results revealed that seventy percent of the respondents of Abbottabad district were willing to pay for safe drinking water supply.

2. MATERIALS AND METHODS

2.1. The Study Area

The study was carried out in six blocks of Purulia district namely Arsha, Baghmundi, Jhalda 1, Joypur Barabazar and Balarampur located around the Ayodhya hills. It has a sub tropical climate with high evaporation and low precipitation. Days are very hot during summer season from April to June when temperature ranges between (42-48) degree Celsius while winters are extremely cold with temperature coming down to 2.8 degree Celsius. The total geographical area of the district is 6259 sq. kms, out of which the Urban and Rural areas are 79.37 sq. kms (1.27percent) and 6179.63 sq. kms (98.73 percent) respectively. The district receives 1100-1400 mm of rainfall per year which is much lower than the state average (Table 2). The average number of rainy days is 12 per year. Groundwater is unavailable for agriculture as the water table is very low. The undulating topography and rugged hilly terrains with presence of crystalline rocks lowers the retention capacity of the soil.

Table 2: Average Rainfall during the Last 10 Years of West Bengal & Purulia District

Name of the State/District	Average Number of Rainy Days/Year	Total No of Rainy Days in	last10 years	Average Rainfall (mm)
West Bengal	35		340	1439 mm/year
Purulia District	12		180	(1100-1400) mm/yr

General elevation of the land surface ranges from 150 m to 300 m, the master slope being towards the east and south-east. Total forest coverage in this district including social forestry and degraded forest as per Satellite Imagery data (IRS-IB LISS II Dec. 1994) is 1857.26 sq. km., which is 29.69 percent of the total land of the district. The area is mainly inhabited by the local tribes who heavily draw on the forest resources for the daily maintenance. Fuel wood is almost the only cooking fuel for the rural households. Agriculture is the most important activity practiced in the area. Two major rivers Subarnarekha and Kangsaboti drain the district for the whole year but also dry up fully during the summer season. The district is counted as the most backward district of West Bengal as illiteracy, vulnerability, unemployment heavily exist here which in turn has given a colossal increase in population in the last two decades.

2.2. Contingent Valuation Instrument and Data Collection Procedure

The Contingent valuation method is a popular method used extensively in decision making specially related to environmental issues. In this method people are allowed to express the value they place on all the non-marketed goods and services through the creation of hypothetical markets where respondents are asked a question ―how much would they be willing to pay for continuing accessing water from the watershed project? The method attempts to elicit information about respondent's preferences for a good or services. WTP accords with standard economic theory. The social value of a policy or program can be assessed by summation of individual responses.

The study used multistage stratified random sampling to select a sample of 540 households. A total of 18 watersheds (3 from each block – 1 large, 1 medium and 1 small) are selected. From each watershed 3 villages were selected based on the distance (one village nearer, one medium, and one far) from the project. Then from each village 10 households were randomly selected. The sample size (18 x 3 x 10 =540) is a representative covering both participating and not participating households in watershed activities. Focus group discussion was also done to collect the background information on water use practices of the households. Both the primary and secondary data were collected. The secondary data was collected from the administrative level and the primary data was collected through personal interviews from the sample households with the help of a structured questionnaire. Information's were obtained on socio economic characteristics and willingness to pay. The data collected were analyzed using descriptive statistics and logit model based contingent valuation method using the Eviews software.

The factors that are considered as influencing willingness to pay for improved water services in Purulia are age, amount spent on purchasing RWH water, average income of the household, distance from the RWH source of water, education of the head of the household, family size of the household, land holding size of the household, User of RWH source as the main water source for the household and average time taken to fetch water from the RWH source. The description of these variables specified in the empirical logistic model is presented in Table 3.

Table 3: Description of the Variables

Variable	Definition of Variables	Expected Sign
Dependent Variable	Willingness to pay(Dummy: 1 if yes and 0 if no)	
Independent Variables	Household head's age	-
	Average amount spent to buy RWH water	+
	Size of the household	+
	Distance of household from RWH source	-
	Education of the household's head	+
	Size of Land holding	+
	Use RWH water as the main source (1 if yes and 0 if no)	+
	Average time spent to fetch water from RWH source	-

3. EMPIRICAL MODEL

The standard logistic regression model was used to determine the factors that have significant influence on the willingness to pay (WTP) for improved water services through rainwater harvesting technology in the study area. The model was chosen because outcome variable is dichotomous, having a value of 0 or 1, where 0 = not willing to pay and 1 = willing to pay for the new technology. Households have responses in either of the two categories. Let X_i be the set of parameters including socio economic characteristics of the households which governs the willingness to pay decision. For an individual household, I_i be the indirect utility derived from the improved water supply services which is a linear function of k explanatory variables (X), and is expressed as:

$$I_i = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + \mu_i \tag{3}$$

where β_0 is the intercept term and β_1, β_2, β_3……..β_{ki} are the coefficients of the explanatory variable X_1, X_2, X_3 … X_{ki} . The probability that the ith household is willing to pay is given by:

$$P_i = \frac{e^{I_i}}{1+e^{I_i}} \tag{4}$$

Where P_i denotes the probability that the ith household is willing to pay, then $(1-P_i)$ is the probability that the household is not willing to pay. The odds (WTP = 1 versus WTP= 0) can be defined as the ratio of the probability that a household is willing to pay for improved water services (P_i) to the probability of not willing to pay ($1–P_i$) i.e. $\frac{P_i}{1-P_i}$.
Taking the natural log, the prediction equation for the ith household can be represented as:

$$ln\left(\frac{P_i}{1-P_i}\right) = \ln(\text{odds}) = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + \mu_i = I_i \tag{5}$$

In the binary logistic regression if the odds ratio Exp (β) is less than one, the independent and dependent variables have negative relationships and if it is greater than one their relationship is positive. Following the empirical model, WTP can be expressed in a linear regression form as follows:

WTP = β_0 + $\beta_1$age + β_2 amount spent on purchasing RWH water + β_3 average income of the household + β_4 distance from the RWH source of water + β_5 education of the head of the household, +β_6 family size + β_7 land holding size + β_8 User of RWH source as the main water source + β_9 average time taken to fetch water from the RWH source + μ.

4. RESULTS AND DISCUSSIONS

4.1. Socio Economic Profiles of the Sample

The socio economic characteristics of the respondents are summarized in table 4.

Age: Almost 86.67 percent of our sample belongs to the labour force component of the population which indicates those young and earning age groups are more likely to be concern about the environment, health and hence willing to pay for improved water services.

Education: The education of the respondents was expressed in the terms of years of schooling. Education increases one's ability to understand information and apply it. Education has a positive effect on respondent's willingness to pay for environmental services. It is evident that 48.51 percentage of population had primary education.

Family Size: Family size was expressed in three group size i.e. (1-5), (6-10) and (11-15). Results reveal that 73.33 percentages of households have family size lying in the second group i.e. (6-10)

Annual Income: Annual family income is the most important indicator for the socio-economic condition of a household. A household's willingness to pay for environmental services depends directly on income of the people. Results show that maximum percentage of the sample population belongs to the category having annual income in the range of Rs (50000-150000).

Major Occupation: Occupation is the most important indicator for willingness to pay in Purulia district. Mainly seven types of economic activities are found in this here namely cultivation, factory worker, government job, private job, mason, business, bidi making labour and other types of labour. However, agriculture constitutes the main source of livelihood for majority of the population.

Land Size: Size of land holding is an important factor which could determines household's WTP for improved water services. About 41.48 percent of populations hold land size ranging between (2000-3000) square feet and are marginal landholders.

Contribution to Environment Conservation Fund: To assess the respondent's perceptions about environment and to capture their concerns towards environment conservation practices, the respondents were asked if they were willing to contribute towards a fund to conserve environment. Only 27.59 percent of sample population are willing to pay for environmental conservation fund indicating a very low percentage of people aware about environment.

Table 4: Socioeconomic Characteristics of the Respondents

Socio Economic Characteristics	Frequency	Percentage
1. AGE (years)		
Less than 35	15	2.77
(35-59)	468	86.67
Above 60	57	10.55
2. EDUCATION (Years of Schooling)		
Primary(1-4)	262	48.51
Middle(5-8)	143	26.48
Matriculation and above	135	25
3. FAMILY SIZE (in numbers)		
(1-5)	131	24.25
(6-10)	396	73.33

Table 4: Contd.,		
(11-15)	13	2.41
4. ANNUAL INCOME(in rupees)		
Less than 50000	237	43.88
(50000-150000)	275	50.92
Above 150000	28	5.18
5. MAJOR OCCUPATION		
Cultivation	319	59.07
Factory Worker	63	11.66
Govt. Job	32	5.92
Private Job	11	2.03
Mason	31	5.74
Business	17	3.14
Bidi Labor & other Labors	60	11.11
6. LAND SIZE (in sq.ft.)		
Less than 2000	135	25
(2000-3000)	224	41.48
More than 3000	181	33.51
7. CONTRIBUTION TO ECF		
Yes	149	27.59
No	391	72.41

4.2. Water Use Practices in Micro Watersheds of Purulia District

Survey confirms that there is no pipe water network of the government in these villages. People mostly depend on wells, ponds, lakes, rivers etc. for water. It is found that 26.48 percent of people use own wells as their primary source of water. Middle and higher class people have their own source of water and use different purifying system at household's level to purify water. Mostly poor people depend on unsafe source of water for their sustenance. Rainwater harvesting structures are built under Integrated Watershed Management Programme (IWMP) to make water available to the residents of the micro watersheds. Untreated water from the rainwater harvesting projects is supplied to the agricultural fields through canals while treated water is chargeable. Currently, farmers are not required to pay for irrigation water under the so called water user rights. However, domestic water use from rainwater harvesting projects is not costless. These projects are supervised and maintained by the local govt bodies. To expand the sharing responsibility by the water users and to incorporate the broader issues of water management, tariffs were introduced. The tariff rate that prevails is volumetric. However a significant proportion of the people are reluctant to depend on rainwater harvesting projects either due to distance from the projects or high tariff rates. The inhabitants of the regions are mostly poor and are not capable of paying tariffs. Lack of awareness about health hazards is also a reason behind. They treat water to be a free good and buying water is equivalent to luxury.

4.3 Details of Primary Water Use Practices

The respondent households were asked to indicate their sources of drinking water, primary person who were in charge of fetching drinking water, the time required to bring water etc. Table 4 shows the details of the water use practices, distance from RWH, actual money spent for buying water, time taken for fetching, primary persons in charge for fetching and the total consumption of RWH water by the user household.

Estimation results shows that out of 540 households surveyed only 118 households i.e. (21percent) were using RWH water which indicates that the coverage of the RWH source is quiet low. Deep enquiry reveals that for some households buying water for drinking is equivalent to luxury. The poorer households were reluctant to use RWH water as they cannot afford to pay and were automatically left out of improved water services available through rainwater harvesting projects. Proximity to the RWH project was one of the major reasons for using water from it. Fetching water from RWH source is time consuming and needs a lot of effort. Women folk (55.08percent) share the responsible of fetching water for the households.

Table 4: Details of Primary Water Practices

Characteristics Related to Water Use Practices	Nos.	Percentage
1. Source of Primary Water		
Own well	143	26.48
Self Collection from nearby sources	279	51.66
Municipal taps	0	0
RWH source	118	21.85
2. Distance of the Household from RWH Source		
(50-200) mts.	234	43.33
(201-400) mts.	131	24.25
(401-600) mts.	55	10.18
(601-800) mts.	120	22.22
3. Time Spent for Fetching RWH Water by 118 Households (Weekly)		
Less than 3 hrs	42	35.59
(3-5) hrs	32	27.11
(5-7) hrs	19	16.10
More than 7 hrs	25	21.18
4. Primary Persons in Charge of Fetching RWH Water (in 118 Households)		
Men	21	17.79
Women	65	55.08
Children	28	23.72
Vendor	4	3.38
5. Actual Money Spent by households for Buying RWH Water (Annually in Rs)		
(1000-2000)/-	26	22.03
(2001-3000)/-	58	49.15
(3001-4000)/-	20	16.94
(4001-5000)/-	14	11.86
6. Total Consumption of RWH Water by 118 Households (Litres/Week)		
Less than 150 lts	23	19.49
(150-300) lts	43	36.44
More than 300 lts	52	44.06
7. Total Consumption of Non RWH Water by rest 422 Households(Litres/Week)		
Less than150 lts	129	30.56
(150-300) lts	162	38.38

Source: Primary survey

4.4. Analysis of Results of the Empirical Logistic Model

Results of the model show that the variables like education, RWH as the main source of water, distance of the household from the RWH source of water, time taken to fetch water to be highly significant factors in determining the willingness to pay. However family size and landholding size are found to be insignificant.

Table 6: Results of Logit Regression

Variable	Coefficient	Std. Error
Constant	- 5.526***	1.387
Age	0.029	0.019
Amount spent for RWH water	0.001	0.001
Average income of household	0.000***	0.000
Distance from the RWH source	- 0.018***	0.004
Education of the Head	0.158***	0.058
Family size	- 0.100(NS)	0.078
Land holding size	0.000(NS)	0.000
RWH user (Dummy:Yes=1,No =0)	2.644*	1.581
Time taken to fetch RWH water	0.965***	0.177
McFadden R square:0.590612, Mean dependent var: 0.338290,LR Statistic:406.6520, Prob(LR statistic): 0.000, Log likelihood: -140.9373 S.E. of Regression: 0.279172. *Significance at 10 percent,** Significance at 5 percent, *** Significance at 1percent, NS -Not Significant		

While other studies (Li et al, 2007) have found age to have negative influence on willingness to pay for improved water supply in our study we found age having positive impact on WTP decisions. This may be due to the fact that age of the household's head captures the experience of living in arid region and in agriculture adopting improved farming technologies requiring more water. Therefore older people are more likely to pay for improved water supply, which is not consistent with our hypothesis.

Education has exhibited a positive relationship with WTP for improved rainwater that is consistent with our expected result. This suggests that educated people have a higher probability of paying for improved rainwater relative to the uneducated. It is generally assumed that educated people are more aware and informed about contamination of water and its health implications, therefore express higher willingness to pay. The probability of paying is positive and significant at 1percent level of significance. Education increases the capability for resourcefulness and invention.

As hypothesised, average income of the household is positively correlated with WTP and significant at the 5 percent level. It is also found that the households which spent on purchasing water from RWH source is also found to be positively influencing the willingness to pay and significant at 10percent level. This justifies our hypothesis. However, contrary to the hypothesis set, the value of family size is insignificant.

Interestingly, the time taken to fetch water from the RWH source has significant positive impact on willingness to pay. This do not confirm with the expected sign. The possible explanation may be the segment of sample population who are willing to pay belong to middle income and higher income groups. As such to reduce the time and effort associated with travelling to the water source they usually hire persons who fetch water for them.

As hypothesised, the distance from the rainwater harvesting water source is found to have negative influence on one's willingness to pay and are highly statistically significant at 1percent level. This is consistent with the results of Farolfi et al(2007).Water from rainwater harvesting projects used as main source of water is also found to have significant positive impact at 5percent level of significance. The results of our study show that the farming variable size of land holding is insignificant in influencing households' willingness to pay. These results are completely diverting from our expectation. The possible reason may be that irrigation water is available free of cost under user rights.

5.5. Analysis of Plausible Reasons for Willing or Not Willing to Pay

Education and average annual income of a household significantly influence the willingness to pay for improved water supply. A detailed investigation indicates that of the 21.85 percent of people who are willing to pay most of them were attached to the RWH system only because they think it to be safe and reliable to drink, conveying their health concern which may arise from other sources. However, 31 percent expressed their willingness to pay for the technology and system to be sustainable and continue to provide clean and safe water even for generations to come. They assumed that if maintenance is not done, water crisis may further aggravate in the region. However, only 9 percent were found to be solely concern about environmental degradation. They specifically mentioned that they not only support the present water supply programmes of the government but are also willing to promote and contribute for other environment restoration cum conservation activities and initiatives taken by the government.

Analysis of those not willing to pay clearly indicates that people in the region are poor and helpless. They resented any sort of contribution. They argued that providing safe and clean water to its people comes under the purview of social responsibility of the government. 49.62 percent of the people not willing to pay were not capable of affording such burden, 21.85percent felt it the responsibility of the govt. while 7.03 percent had no faith in the source.

5. CONCLUSIONS

The aim of the study was to assess of the perceptions of the residents of micro watershed, water tariffs and the role of watersheds in ensuring a sustainable water supply and to judge the willingness to pay of the domestic water users for availing the benefit and to identify the factors determining the willingness to pay. Survey results confirm that only a small proportion of people (21.85percent) use water from RWH source. They basically lack awareness about ill health effects and in most cases are economically poor. Buying water is like a luxury to them as water is freely available at ponds, lakes, rivers etc. There is a need for policy makers to attract people towards RWH by reducing water tariff rates. The revenue collection system of the watersheds should be more re-organised and providence of clean, reliable and sufficient water in all times should be emphasised.

The results of the logistic regression model indicates that education, income, RWH water as the main source of domestic use, distance from RWH source and the time invested to fetch water from it along with general perception/attitude towards RWH are statistically significant in explaining WTP for improved water services in the study area. Proximity to the water storage tank of the rain water harvesting project from the dwelling is definitely a significant determining factor in explaining WTP. During the survey it was found that many households had their view that it is the responsibility of the government to provide clean and sufficient water to the people as they are already paying tax. The people of the area are mostly economically and socially backward as such the general awareness about environment is low. There is a strong positive relation between willingness to pay and income. Lower income implies lower willingness to pay. Hence there is a need to generate new avenues of employment in the area and encourage the lower income groups to expand their sources of income. There is a strong positive relation between education and awareness of conservation practices. So there is a need to educate people and carry out a awareness campaign about the positive impacts of watershed services on health and environment as a whole

REFERENCES

1. *Johnson N.L., Baltodano M.E. (2004): 'The economics of community watershed management: some evidence from Nicaragua', Ecological Economics, Vol. 49, page no 57-71.*

2. *Baiyegunhi S., L. James (2015): 'Determinants of rainwater harvesting technology (RWHT) adoption for home gardening in Msinga Kwazulu-Natal, South Africa', Water SA, Vol. 41, No.1.*

3. *Srinivasan V., S. M. Gorelick and L. Golder (2010): 'Sustainable water supply in South India: Desalination, efficiency improvement or rainwater harvesting'. Water Resource Research, Vol. 46.*

4. *Wong J. J. (2011): 'Optimizing Rainwater Harvesting Installation in Kashongi, Uganda: Sustainable Rural Water Supply, Collective Action and Institution'.*

5. *Whittington D., J. Briscoe, X. Mu and W. Barron (January 1990): 'Estimating the Willingness to Pay for Water Services in Developing Countries. A Case Study of the Use of Contingent Valuation Surveys in Southern Haiti'. Economic Development and Cultural Change, Vol. 38, No. 2, Page No. 293-311.*

6. *Tussupova K., R. Berndtsson, T. Bramryd and R. Beisenova (2015): 'Investigating Willingness to Pay to Improve Water Supply Service: Application of Contingent Valuation Method'. Open Assess Water, Vol. 7, ISSN No. 2073 - 4441, Page No. 3024 – 3039.*

7. *Sattar A., E. Ahmad and K. P. Pant (Winter 2007): 'Willingness to Pay for Quality of Drinking Water (with Comments)'. The Pakistan Development Review, Vol. 46 No. 4.*

8. *Omonoma B. and O. Adeniran(2012): 'Consumers Willingness to Pay for Improved Water Services in Ilorin Metropolis of Kwara State Nigeria'. Journal of Economics and Sustainable Development. ISSN No. 2222 –1700 (Paper), ISSN No. 2222 -2855 (Online) Vol. 3, No. 9.*

9. *Mmopelwa G., D.L. Kagathi, W.R.L. Masamba and A. Thakuja (2005): 'Households' Willingness to Pay for Reliability of Water Supply and Quantity in Chobe Suburb of Maun: An Application of the Contingent Valuation Method'. Botswana Notes and Records, Vol. 37, Special Edition on Human Interactions and Natural Resource Dynamics in the Okavango Delta and Ngamiland, Page No. 97 – 107.*

10. *Oseni. M. O: 'Paying for Improved Electricity Services in Developing Countries: Any Role for Previous Mitigation Action'.*

11. *Roy J., S. Chattopadhay, S. Mukherjee, M. Kanjilal, S. S. and S. Roy (January 10-16, 2004), 'An Economic Analysis of Demand for Water Quality: A Case Study of Kolkata', Economic and Political Weekly, Vol. 39, No. 2, Page No. 186 – 192.*

12. *Olagunju K., A. Adeoti, O. Adebaya (June 2015): 'Determinants of Rural Households Willingness to Pay for Potable Water in Oyo State, Nigeria'. International Journal of Innovation and Scientific Research, ISSN. No. 2351-8014, Vol.16. No. 1. Page No. 103-113.*

13. *Haq M., U. Mustafa and I. Ahmad (winter 2007): 'Households Willingness to Pay for Safe Drinking Water: A Case Study of Abbottabad District'. The Pakistan Development Review, Vol. 46, No, 4, Page No, 1137-1153.*

14. *Amiraly A., N. Prime, J. P. Singh: Rainwater Harvesting, Alternative to Water Supply in Indian Urban Areas: The Case of Ahmadabad in Gujarat.*
15. *Briscoe J., P. F. de Castro, C. Griffen, J. N. O. Oslen (May1990): 'Toward Equitable and Sustainable Rural Water Supplies: A Contingent Valuation Study in Brazil'. The World Bank Economic Review, Vol. 4, No. 2, Page No. 115-134.*
16. *Adebara S.A. and Afoloyan A. (2015). Investigation into Water Treatment Process and Possible Bottlenecks Affecting Water Distribution Network In Osogbo Osun State, Nigeria. Researcher 2015; 7(11), Page No. 86-90, ISSN No. 1553-9865.*
17. *Shutz, S.D., B.E. Lindsay. (1990): 'The Willingness to pay for groundwater protection, Water Resources Research, Vol. 20, No. 2, Page no. 1869-75.*
18. *Mwakaje A. G., P. I. Ndetewio, M. Mujwahuji, J. Ngana 2013: 'Factors Influencing Willingness to Pay for Watershed Services in Lower Moshi, Pangani Basin', International Journal of Agriculture and Environment, 2013(02).*
19. *Koji H.,(2008): 'Study on Willingness to Participate in the Payment for Environmental Services Scheme in the Mara Basin', A thesis,2008.*
20. *Anthony A, C. Dorm-Adzobu (2013): 'Application of Contingent Valuation (CVM) in Determining Demand for Improved Rainwater in Coastal Savanna Region of Ghana, West Africa', Journal of Economics and Sustainable Development, Vol.4, No.3, 2013.*
21. *Arlene A. J. (2007); 'Willingness to Pay for watershed Protection by domestic water users in Tuguegarao City, Philippines', Prem Working Paper Prem07/06, September, 2007.*
22. *Calderon M. M., L. D. Camacho, M. G. Carandang, J. T Dizon, L. L. Rebugio, Tolentino N. L. (2007): 'Willingness to Pay for Improved Watershed Management: The Case of Households in Metro Manila, The Philippines@', A thesis, 2007.*
23. *Van L. (2010): 'Valuing Wetlands in Southern Ontario's Credit River Watershed, Phase 2, Contingent Valuation Analysis', 2010.*
24. *Schets F.M., R Italiaander, H.H.J.L. V. d. Berg and A.M. de R. Husman (2010): 'Rainwater Hartvesting: quality assessment and utilization in The Netherlands". Journal of Water and Health. Page No. 224 -235.*
25. *The World Bank Water Demand Research Team (January 1993): 'The Demand for Water in Rural Areas: Determinants and Policy Implications'. The World Bank Research Observer, Vol. 8, No.1, Page No. 47-70*