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Traditional Water Harvesting for Domestic Use:
Potential and Relevance of Village Tanks in Gujarat's Desert Region

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Abstract

Recognising the dearth of detailed analyses of the economic and environmental performance of traditional water harvesting systems (TWHS) meant *exclusively* for domestic use, this paper enquires into the relevance and explores possible modernisation/revival of *talavs* (tanks) in two villages of Gujarat's Kutch district in the Thar deserts - India's driest region. It analyses the pattern of water use, dependence on alternative sources and households' willingness to pay for reviving/modernising *talavs*. Cost estimates between reviving *talavs* and piped system have been compared. The findings suggest that *talavs* remain important sources of domestic water and if modernised/revived and, importantly, the ownership is vested in the local community, these can be of substantive use, especially, during summer. Hydrogeology specific technological strategies to harness rainwater and modernise *talavs* need to be studied as enhanced supply *per se* can reduce costs significantly. In such ventures whether and how state can intervene or shall seek private participation, both for financing and providing technical and management support, requires exploration. In case of *talavs*, the paper argues for community management as a useful strategy to protect and improvise the systems.

JEL Classification : ***Q25, Q26, R58***

Keywords : ***Water harvesting; Tanks; Rejuvenation; Willingness to pay; Rural water supply***

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1 Introduction

Ensuring sustained supply of safe, clean and potable water[1] to the growing population especially in the rural areas in India has assumed serious proportions, what with the excessive withdrawal of dwindling groundwater resources and oft-failing state-run modern piped water schemes. The situation, evidently, is grave in the arid and semi-arid regions of the country. In the absence of a comprehensive water policy, which could effectively regulate wastage, polluting and over-drafting (as may be attributed to certain categories of better-off urban dwellers, large farmers growing water-intensive crops and certain industries), rural households' scramble for water in dry belts is likely to continue. The *ad hoc* arrangement of reaching water to villages through tankers, by rail or road, eludes a meaningful and pragmatic solution to the crisis of scarcity of the resource. Unless efforts at augmenting the local water sources are made, sustainable supply to rural households will remain a tough issue to handle (Das, 2001). Moreover, an increase in the availability of water at the local level would have an important implication for the rural households, namely, pricing of water. In an almost-imminent scenario of user-charges to be levied on potable water, whether the provider is the state or a private operator, supply enhancement may, directly or indirectly, reduce the cost of water.

It is in this broad context that the relevance of fostering traditional water harvesting systems (TWHS) could be appreciated. These remarkably heterogeneous systems of water conservation, storage and recharge exemplify embodiment of centuries-old indigenous knowledge of hydrology, construction engineering and locally prevalent socio-cultural practices[2]. The notable aspect of

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1 Potable water refers to use for drinking, cooking and other domestic purposes; evidently, the quality of water matters the most for the first two uses.

2 For excellent documentation, see, Mishra (1993 and 1995); Barah (1996); Agarwal and Narain (1997); Bishnoi (2000); Agarwal *et al.* (2001); and Sridhar (2001).

such systems has been that these are almost exclusively fed by monsoon run-off, rivers and streams; thus, sparing groundwater aquifers for the posterity. While such systems are very unlikely to be the *complete* solution to the problem of water scarcity, revived and modernised with technological intervention, these ubiquitous systems could potentially contribute towards the remission of the stress. It is important to note here that the literature on TWHS in India is largely anecdotal or descriptive in nature[3]. Even though scientists have undertaken hydrological studies of TWHS in the arid regions mostly[4], one does not come across detailed analyses of the economic and environmental performance of such systems meant exclusively for domestic uses. An emphasis on the technical evaluation of the performance of the existing functional structures and *scientific* revival of TWHS is essential so as to enhance the possibility of such sources to cater to an ever-growing population. With this backdrop, this paper makes an attempt at analysing the potential of fostering TWHS in two sample villages of Gujarat's Kutch district in the Thar deserts - India's driest region[5].

The empirical core of this study derives from detailed primary surveys conducted at the household level and village level focus group discussions (FGDs). Apart from the standard socio-economic surveys focusing on water use, management of sources and so on, using a modified contingent valuation method (CVM)[6] information on the willingness to pay (WTP) for both the obtaining water through modern pipelines and reviving/modernizing the *talavs* was collected. Relevant hydrogeological and engineering enquiries towards estimating costs of reviving/ modernizing the systems were conducted by concerned technical experts.

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3 For a discussion of issues, see, Das (2005: 1-3).

4 See, Athavale (2003), for detailed references of such studies.

5 This paper draws upon a larger study conducted in three west Indian states of Madhya Pradesh, Rajasthan and Gujarat; see, Das (2003).

6 Notwithstanding limitations of the controversial but widely-used CVM, it was important to devise a set of steps, which could be effectively used in the survey process as no substantive study dealing with WTP for TWHS in the Indian context was available. For details of methodology, see, Das (2003: 25-27).

2 Selection of the Systems and Sites

In the selection of the TWHS for the present study, it was ensured that these were (a) community-owned resources; (b) primarily (if not exclusively) used or were being used in the past for drinking and domestic purposes; and (c) still in a functional state, irrespective of whether currently these are being used as sources of drinking or domestic water. Following literature survey and extensive discussions with different stakeholders, including villagers and concerned government and NGO officials, *talavs* in the Kutch region were chosen for the study[7].

In the first sample village, Tera in Abdasa taluka, *talavs* have been in use for various domestic including drinking purposes, Tera has three inter-connected huge *talavs* reported to be at least 300-year old (Figure 1). The first is meant for washing and bathing, the second is for drinking purposes and the third for use by the cattle. In addition to these traditional systems of water supply the state-run modern piped supply (Rassalia Water Supply Scheme) also exists in the village. This is part of a regional water supply scheme that supplies water from tubewells in Netra to 11 villages including Tera, which falls at the tail end. As here, as elsewhere, piped water supply is not reliable, this has increased villagers' dependence on *talavs* for domestic uses.

Moreover, saline water is found in the wells of Tera and neighbouring villages; this is likely to be due to the existence of salinity-rich pliocene rocks found in these areas. Cretaceous sandstones, which are suitable for tubewell drilling, are found as distantly as far as about 20 km away from Tera. Cretaceous sandstone aquifer here is over-stressed because of its limited extension and recharge, indicated by a fall of 1 to 4 metres in water levels of tubewells every year.

7 The main forms of TWHS found in the Kutch district include wells, step-wells (*vavs*), canal and tanks (*talavs*). However, the most common system is the *talav*. The district geographically falls in the Thar region and its particular topography and physiographic features make an excellent site for the water harvesting system of *talavs*.

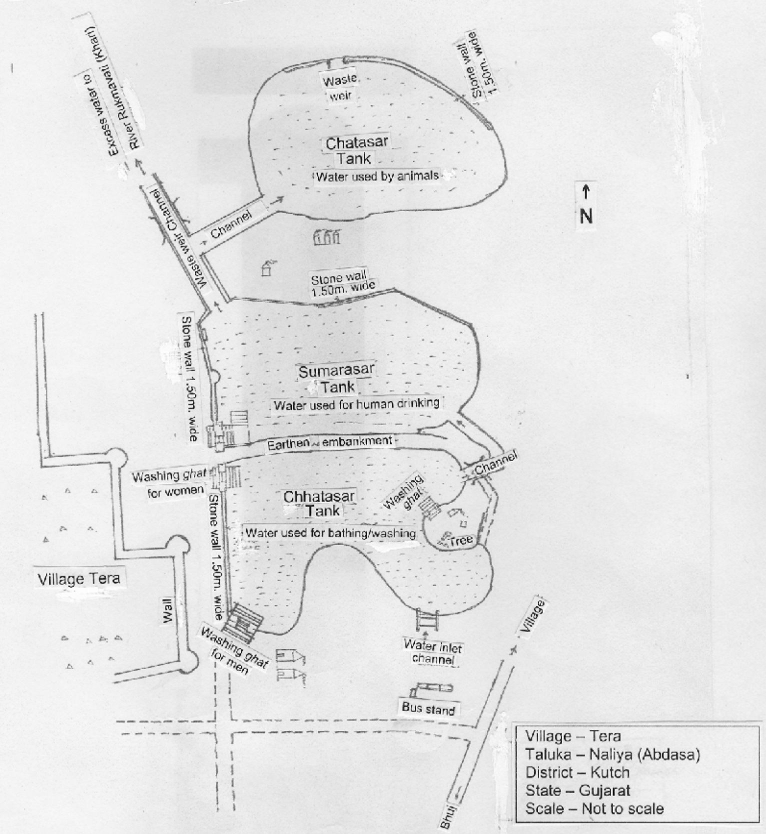

Figure 1: Sketch of Talavs in Village Tera, Kutch, Gujarat

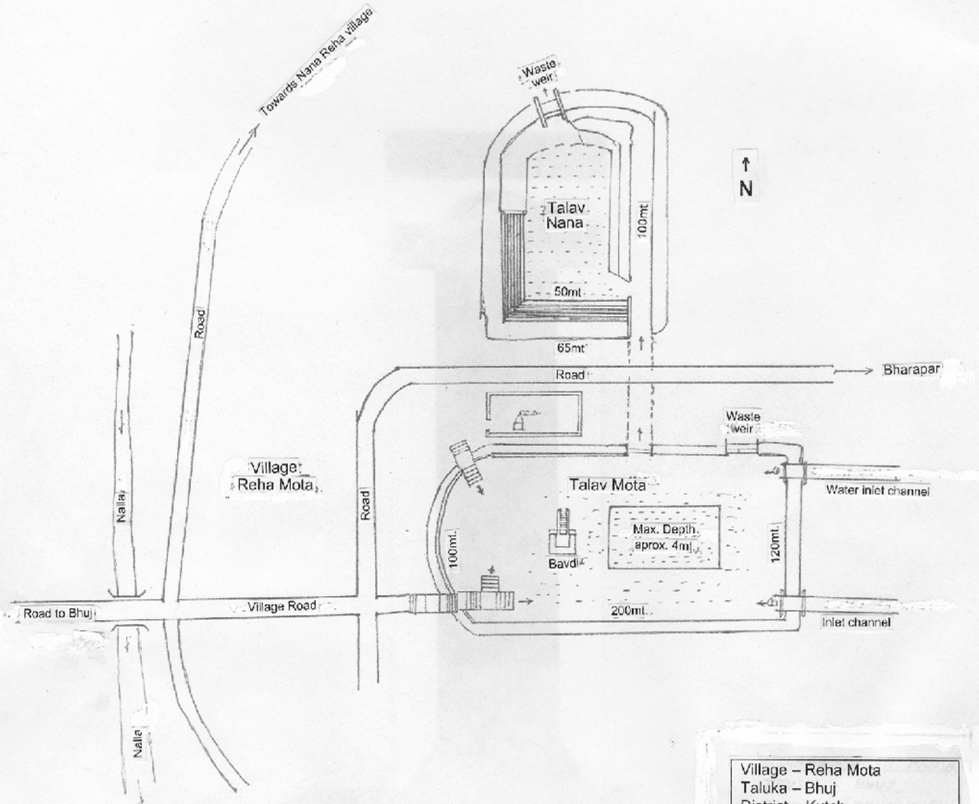

Figure 2: Sketch of Talavs in Village Reha Mota, Kutch, Gujarat

The second village, Reha Mota in Bhuj taluka, has one about 100-year old large *talav*, which served the water needs of the village round the year. Water overflowing from this *talav* goes to a second adjacent *talav* that is meant for domestic uses other than drinking and cooking. (Figure 2). The *talav* can store 40000m^3 of rainwater. The area around Reha Mota consists of cretaceous sandstones, which are potential aquifers for groundwater development. However, a major concern here is that of recharging of the existing aquifer since the water levels of the aquifer have been reported to be declining rapidly. The farmers drill deep tubewells to draw water for irrigation purposes. Although stand-posts, bore wells and taps exist in the village, due to irregular electricity supply, these modern systems do not work always[8]. Neglect of the *talavs* was noticeable even when these continued to be the regular sources of water for most villagers.

Table 1: Chemical Analysis of Water Samples of Two *Talavs*

Sample No.	1	2
Source of Water	Tera *Talav* (for drinking)	Reha Mota *Talav*
Odour	Unobjectionable	Unobjectionable
Turbidity NTU	4	240
PH	8.46	8.18
Total hardness as $CaCO_3$ mg/l	NA	272
TDS mg/l	150	520
Calcium (Ca) mg/l	14	46
Magnesium (Mg) mg/l	8	37
Chlorides (Cl)	24	116
Sulphate (SO_4)	7	58
Nitrate	Nil	0.34
Fluoride	0.16	0.25
Alkalinity	84	152
Remarks	*Potable*	*Potable*

8 Tube wells, fitted with motors, are mostly with the richer people.

Table 2: Bacteriological Analysis of Water Samples of Two *Talavs*

Sample Source	MPN of Coliform per 100 ml of sample	MPN of faecal coliforms per 100 ml of sample
Tera *talav*	> = 1600	220
Remarks	*Unfit for potable use*	
Reha Mota *talav*	> = 1600	> = 1600
Remarks	*Unfit for potable use*	

Water from the *talavs* of both the villages was analysed for chemical and bacteriological properties. Table 1 presents the results of chemical test. The *talav* water being the rainwater was less saline and had low amounts of TDS as compared to water from local open wells or tubewells. However, the bacteriological tests revealed that in both cases, the *talav* water was highly contaminated with the presence of coliform bacteria (Table 2). The water needed to be treated with chlorine or bleaching powder to improve its quality.

3 Socio-Economic Characteristics of Sample Villages

Both the surveyed villages are relatively better endowed with basic amenities including access to health, schooling, communication and transport facilities. As may be seen from Table 3, as between the censual years 1991 and 2001, the main occupations of the households in both the villages relate to cultivation, farm labour, household enterprises and dairying. However, it appears that there has been a notable shift towards occupations in the services sector, including construction, trade, commerce, transport, storage and communication. In terms of social groups, whereas in Tera in about 52 per cent of the households belong to OBC, ST and SC categories, in Reha Mota the same account for 65 per cent of the total sample households (Table 4). Given the agro-climatic conditions, topography and remoteness of the villages, one observes limited economic development and income earning opportunities in these areas. This is reflected in the fact that over about 90 per cent of the sample households in both the villages had an average monthly income below Rs 4000 (Table 5). This is mainly due to the fact that the average yield is generally low; agriculture here is essentially rainfed and the soil salinity is high.

Table 3: Distribution of Workers in the Villages

Type of workers	Tera				Reha Mota			
	Male		Female		Male		Female	
	1991	2001	1991	2001	1991	2001	1991	2001
Main workers	628	658	322	145	312	287	89	30
Cultivators	195	100	122	25	63	44	16	5
Agricultural labourers	183	215	129	50	78	16	27	3
Livestock & allied activities	20	-	-	-	16	-	-	-
Mining & quarrying	-	-	-	-	1	-	-	-
Household industry	50	71	47	41	61	1	31	2
Construction*	11	-	1	-	28	-	1	-
Trade and commerce*	69	-	1	-	19	-	-	-
Transport storage and communication*	14	-	-	-	16	-	1	-
Other services	86	272	22	29	30	226	13	20
Marginal workers	1	50	175	404	49	103	76	118
Non workers	493	601	775	769	315	385	556	566

Note: * For the year 2001, *Census* figures individually for these three categories of workers are yet to be finalised and, currently, merged with 'Other services'.

Source: *District Census Handbook, Kutch, 1991* and *Primary Census Abstract, Gujarat, Census of India 2001* (on CD).

Table 4: Caste and Family Size of Sample Households in the Sample Villages

Particulars	Tera	Reha Mota
Number of households	50	60
Population	243	329
Family size	4.9	5.5
Caste:		
SC	5 (10.0)	7 (11.7)
ST	7 (14.0)	7 (11.7)
OBC	14 (28.0)	25 (41.7)
General	24 (48.0)	21 (35.0)

Note: Figures in brackets indicate proportions to the total number of sample households in the village.

Source: Field Survey

Table 5: Income Classes of Sample Households

Village	Income Groups (Monthly Income in Rupees)			
	< 1000	1000-4000	4001-8000	All
Tera	13 (26.0)	32 (64.0)	5 (10.0)	50 (100.0)
Reha Mota	9 (15.0)	47 (78.3)	4 (6.7)	60 (100.0)

Note: Same as in Table 4.

Source: Field Survey

Even when occupational classification suggests greater dependence on agriculture, Table 6 clearly brings out that the proportion of landless households is much higher in the sample. In fact, in Reha Mota not only that about 87 per cent households had no ownership of land, but the average landholding size was a meagre 0.20 hectare.

Table 6: Landholding Status of the Sample Households

(No. of households)

Size of Landholding	Tera	Reha Mota
Average landholding (in hectares)	1.05	0.20
<1 ha (Marginal)	7 (14.0)	5 (8.3)
1-2 ha (Small)	11 (22.0)	2 (3.3)
2-10 ha (Medium)	8 (16.0)	1 (1.7)
Landless	24 (48.0)	52 (86.7)

Source: Field Survey

4 Demand for and Sources of Water

Like in most villages in Kutch, both Tera and Reha Mota suffer from high deficiency in water for domestic use (Table 7). Significantly, the availability of potable water (that is, for drinking and cooking) has been extremely low at about 16 lpcd, way below the prescribed norm of 40 lpcd. Further, given the requirement of water for livestock consumption, the deficiency is observed to be almost total. This is cause for concern as livestock related activities contribute to the local livelihood processes in a major way.

Table 7: Village Level Demand Pattern for Domestic Water Use

(litres per day)

Purpose	Tera		Reha Mota	
	Total Qty Used	Per Capita Qty Used	Total Qty Used	Per Capita Qty Used
Drinking (Human)	2775 (89.20)	11.42	3975 (57.99)	12.08
Cooking	1105 (95.48)	4.55	1175 (69.36)	3.57
Bathing (Males)	1460 (96.42)	17.38	2010 (53.98)	18.79
Bathing (Females)	1380 (98.55)	18.65	1990 (60.05)	18.09
Bathing (Children)	1295 (97.68)	15.24	1660 (73.80)	14.82
Washing Clothes	1980 (95.45)	8.15	2495 (72.55)	7.58
Washing Utensils	1305 (96.55)	5.27	1410 (65.60)	4.29
Latrine (Males)	180 (100.00)	0.74	190 (36.84)	0.58
Drinking (Livestock)	10 (100.00)	0.06		
All Purposes	11450 (97.12)	28.00	14905 (63.27)	34.91
Standard Quantity (Human)	13120		16640	
Standard Quantity (Livestock)	4980		2990	
Deficiency (Human)	1680 (12.81)		1735 (10.43)	
Deficiency (Livestock)	4970 (99.80)		2990 (100.00)	
Total Deficiency	6650 (36.74)		4725 (24.07)	

Notes: Standard quantity for human consumption is based on the criterion of 40 lpcd (litres per capita per day)

Standard quantity for livestock (cattle at 30 lpcd and sheep & goat at 10 lpcd)

Total deficiency includes deficiency for human and livestock consumption plus the actual quantity of water used for animal washing.

Figures in parentheses are the percentage of deficiency towards standard quantity required.

Source: Field Survey

Enquiries regarding the preferred sources of water by households unequivocally revealed that in both the villages, the dependence was almost entirely on traditional sources (*talavs* and wells). As shown in Table 8 in Tera it is 100 per cent as the piped water supply was reported to be extremely unreliable and in Reha Mota over two-thirds of the water need is met by the traditional sources. It is to be noted that the traditional source of significance was clearly the *talavs*, which catered to over 97 per cent and 63 per cent of domestic water consumption, respectively, in Tera and Reha Mota. Unlike Tera, in Reha Mota piped water supply is fairly reliable largely because of ample groundwater resources.

Table 8: Demand for Water Met by Traditional and Modern Sources

(Percentages)

Village	Source			
	Traditional	Selected TWHS (*Talavs*)	Modern	All
Tera	2.88	97.12	Highly Unreliable	100.0
Reha Mota	3.66	63.27	33.08	100.0

Notes: Sources in Tera: traditional - wells, modern – none. Sources in Reha Mota: traditional – wells, modern – private taps.

Source: Field Survey

An important dimension that calls for attention in a discussion on potable water is the quality of water, especially when the dominant source is an open structure, here, a *talav*. Acknowledging poor and irregular quality analysis infrastructure at the village level an impression about respondents' perception of water quality in the village *talavs* can be obtained from Table 9. It is interesting to observe that in Tera, where dependence upon the *talav* is nearly complete, as high as over 70 per cent of respondents opined that the water was of potable quality. Not only that a highly unreliable piped water system has rendered a comparison (between modern and traditional or, for that matter, protected and open sources) irrelevant, but the emphasis was clearly on sustained good care being taken by the local community to ensure that water meant for domestic use was not being misused or polluted. In a different scenario, as in Reha Mota where piped water is available, a much lower proportion (43 per cent) of respondents felt that water from their village *talav* was potable. While such popular perception on quality and concurrent use of water for domestic purposes may be indicative of the potential of open TWHS as *talavs* for the rural population, this does not reduce the significance of scientific analysis of water from such useful sources. In fact, from a policy perspective, serious attention needs to be paid both to test water quality of such open sources on a regular basis and also pursue such scientific methods that would ensure purification of water. The state needs to play a vitalrole in rendering this service to the local community.

Table 9: Respondents' Perception of Water Quality of Village *Talavs*

(No. of Households)

Perception About Quality	Tera	Reha Mota
Potable (Good for drinking, cooking and domestic use)	31 (70.5)	22 (43.1)
Non-potable but used for other domestic purposes		11 (21.6)
Used for domestic purposes but not for cooking and drinking		11 (21.6)
Non-potable and unsuitable for any domestic purposes	13 (29.5)	18 (35.3)
Used but may cause diseases	12 (27.3)	18 (35.3)
Unsuitable for any domestic purpose	1 (2.3)	

Note: Same as in Table 4.

Source: Field Survey

5 Cost Estimation and Willingness to Pay

While reliable piped water system may be the most preferred mechanism of water supply, the relevance and potential of TWHS in rural areas especially, cannot be overstated. In fact, it is eminently possible to modernize/revive TWHS so as to enhance recharge, storage and water quality through scientific (engineering, hydrological and chemical) intervention. In the two villages, an effort was made to assess cost implications of modernization/revival of local *talavs* and popular willingness to contribute to such initiatives. The same was proposed to be compared with modern piped water provision.

Whereas, and eventually, hydrogeological and structural engineering studies were conducted by concerned experts in the field, the assessment of WTP through systematic surveys was undertaken by us. The scientific team worked out the interventions that would modernize/revive the sample *talavs* on a long term sustainable basis and also arrived at estimates both for capital costs as well as O&M; these indicated the size of financial investment that would be made in case the modernization/revival projects were taken up. Such estimates represent the total use value of potable water meant for domestic consumption only; the existence value of the water becomes irrelevant. Also, the nature of benefits of having access to good quality water is very much within the knowledge of the potential users. For instance, the users are aware that such an access can substantially save the average daily time spent by households covering long distances to fetch water and that good quality of water would positively contribute to their health and wellness. While recognizing the aspect of consumption of time to fetch water from a distant source, we have desisted from using the usual opportunity cost concept here due to its obvious limitations of applicability in our study.

It may, hence, be held that the assessment of WTP undertaken in the study falls within the broad purview of the cost-benefit analysis. Assuming that the entire cost of modernization/revival would be shared between all the households in the village, an assessment of the WTP for the improvised structures was made. The household surveys were based upon structured questionnaires prepared in the CVM framework. The introduction of the option of mode of payment was supposed to help reveal respondents' actual ability to pay for the amenities. A similar exercise in WTP was also conducted for laying a network of piped water system to provide household level tap connections.

As per the engineering and hydrgeological surveys there existed much scope for the modernisation/revival of *talavs* in both the villages; Table 10 provides the cost estimates for the interventions required. Also estimates were prepared for laying of piped water system so as to provide household tap connections (Table 11). It may be noted that the figures for piped water system for Reha Mota seem much smaller than the same for Tera. This is mainly due to the fact that the former already has a basic functional piped water supply infrastructure in place; hence, such costs as tubewell digging and laying pipeline network would not be required again. The responses to questions on WTP for both the facilities varied distinctly across the villages. In Tera, the enthusiasm for the revival of the *talav* was very high reflecting their strong dependence on *talavs* and lack of confidence in the reliability of the piped water supply, developing facilities for which, nevertheless, was relatively too expensive. Contrarily, the respondents in Reha Mota relied heavily upon the piped water system and would not prefer to consider paying for the revival of the *talavs*, which would also be a costly proposition. Even the amount of cost the respondents in both the villages were willing to pay formed only a meagre less than 4 per cent of their monthly income.

Table 10: Cost Estimates for Revival of *Talavs* in the Sample Villages

Particulars	Amount (Rs.)
Tera	
Cost of desilting the *talav*	5,80,000
Cost of desilting/ cleaning of the channel (main canal)	8,30,000
Repair/ replacement of the walls and steps	1,65,000
Slit traps with wire mesh in the upper catchment	85,000
Sub-Total	16,60,000
Add 20%	3,32,000
Total	19,92,000
Reha mota	
Cost of desilting the *talav*	1,37,000
Cost of desilting/ cleaning of the channel (main canal)	1,95,000
Repair/ replacement of the walls and steps	40,000
Slit traps with wire mesh in the upper catchment	20,000
Sub- total	3,92,000
Cost of construction of new walls and steps	6,33,000
Sub-Total	10,25,000
Add 20%	2,50,000
Total	12,30,000

Source: As prepared by hydrologists and concerned civil engineers.

Table 11: Cost Estimates for Laying Piped System in the Sample Villages

Particulars	Amount (Rs.)
Tera	
Tubewell digging	8,00,000
Laying pipelines	12,00,000
Taps and pipelines within village	9,22,500
Elevated Storage reservoir	6,40,000
Total	35,62,500
Reha Mota	
Elevated storage reservoir	60,000
Pipelines and taps within the village	60,000
Total	1,20,000

Source: Same as in Table 10.

For those who were willing to pay for the facilities proposed, the amounts agreed upon have been classified across income classes in Table 12. It is useful to note here that so far as *talav* modernisation/revival was concerned 25 per cent respondents for Tera and 41 per cent from Reha Mota would not pay at all, irrespective of levels of household income. The proportion of those who would pay for *talavs*, but less than half the proposed cost, turned out to be 50 per cent of all the respondents in Tera but just about 14 per cent in Reha Mota. As for the piped supply, a high 88 per cent of respondents were not willing to pay at all, as they already had the basic infrastructure and were convinced that the state had to undertake whatever additional provision was planned for. But in Tera while about 55 per cent of respondents (including a sizeable proportion from the lower income classes) were willing to pay up to half the proposed cost, another 18 per cent of respondents would pay their total share of the cost. The rather complex outcome does point to the complementarities between the two types of water provisioning.

Table 12: Willingness to Pay for *Talavs* and Piped Supply Across Income Classes

Income (Rs. Per Month) Range	System	Proportion of Amount of WTP						
		0	< 25%	26-50%	51-75%	76-99%	100%	All
Tera								
< 1000	T	2 (4.5)	7 (15.9)	1 (2.3)			2 (4.5)	12 (27.2)
	P	2 (4.5)	8 (18.2)	1 (2.3)			1 (2.3)	12 (27.2)
1000-4000	T	9 (20.5)	10 (22.7)	4 (9.1)	1 (2.3)		4 (9.1)	28 (63.6)
	P	8 (18.2)	11 (25.0)	4 (9.1)			5 (11.4)	28 (63.6)
4001-8000	T						4 (9.1)	4 (9.1)
	P				1 (2.3)	1 (2.3)	2 (4.5)	4 (9.1)
All classes	T	11 (25.0)	17 (38.6)	5 (11.4)	1 (2.3)		10 (22.7)	44 (100.0)
	P	10 (22.7)	19 (43.2)	5 (11.4)	1 (2.3)	1 (2.3)	8 (18.2)	44 (100.0)
Reha Mota								
< 1000	T	1 (2.0)		2 (3.9)			4 (7.8)	7 (13.7)
	P	5 (9.8)					2 (3.9)	7 (13.7)
1000-4000	T	20 (39.2)	1 (2.0)	2 (3.9)	2 (3.9)		17 (33.3)	42 (82.4)
	P	38 (74.5)		2 (3.9)			2 (3.9)	42 (82.4)
4001-8000	T		1 (2.0)	1 (2.0)				2 (4.0)
	P	2 (3.9)						2 (3.9)
All classes	T	21 (41.2)	2 (3.9)	5 (9.8)	2 (3.9)		21 (41.2)	51 (100.0)
	P	45 (88.2)		2 (3.9)			4 (7.8)	51 (100.0)

Notes: T represents *Talav* and P represents Piped Supply
Figures in parentheses are percentages to the total number of sample households in the respective villages.

In fact, a close examination of the nature and extent of households' WTP provides interesting insights into such a pattern of response. Very unlike the capital cost, most villagers in both the surveyed villages were willing to pay for the O&M for *talavs*; in many cases the estimated contribution for O&M for the proposed piped system was much higher than that for *talavs* (Table 13). People's willingness to contribute labour free indicates the preference for the modernization/revival of the *talavs*. An important aspect of this exercise in assessing WTP is that even the most sophisticated methods of valuation may be inadequate to elicit information on the WTP behaviour if the respondents refuse to participate in the 'bidding' process due mainly to abject poverty and rejecting the very proposal that potable water could be priced for the rural poor.

Table 13: Household Level Willingness to Pay for Revival of *Talavs* and Laying of the Piped System

(No. of households)

Village	TWHS			Piped System		All Sample Households
	Capital Cost	O & M	Labour	Capital Cost	Labour	
Tera	34 (77.3)	41 (93.2)	34 (77.3)	8 (18.2)	32 (72.7)	50
Reha Mota	6 (11.8)	46 (90.2)	38 (74.5)	4 (7.8)	7 (13.7)	60

Note: Same as in Table 4.

6 Concluding Observations

In TWHS, the trickier issue has been management with community participation. The control over the system by the local dominant group is difficult to wish away. As revealed through village level FGDs and household surveys, management and maintenance of TWHS posed the real challenge in terms of ensuring sustainability of the source. In Tera, the local community had, traditionally, assumed the responsibility of jointly maintaining the *talav* system; this is where the use of water from *talavs* has been extensive and also the quality of water has been well cared for. In Reha Mota, however, a preference has been expressed for complete or partial involvement of state government in managing and maintaining the sources; the general lack of confidence in the efficacy of the sarpanch in managing these sources is striking. The possibility of public and private participation in financing the revival of the TWHS in this village could be explored.

It was apparent that TWHS were not or will not be able to cater to the total requirement of drinking water in the villages, mainly due to the rise in population in the past decades. Nevertheless, if revived / modernized / repaired and, importantly, the ownership is vested in the local community, these sources can be of substantive use, especially, during summer. Piped water system, though preferable, has implications of increasing cost in future either due to increase in population or depletion of groundwater or both. Additionally, the ubiquitous problem of unreliability of piped water supply has serious implications for considering alternative sources.

Hydrogeology specific technological strategies to harness rainwater and modernise TWHS need to be explored as enhanced supply *per se* can reduce costs significantly. In such ventures whether and how state can intervene or shall seek private participation, both for financing and providing technical and management support is an issue to be explored. The need for a pragmatic policy mechanism addressing these issues concerning TWHS needs no underscoring.

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