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RESEARCH PAPER

Examining the Operational Efficiency of Reverse Osmosis (RO) Plants in Tharparkar: A Comprehensive Assessment

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ABSTRACT

This paper thoroughly examines water shortage problems and its coping mechanisms adopted in Tharparkar. The area is regarded as the most water deficit region where groundwater is the only major water source for drinking and domestic consumption. However, the quality of groundwater is not safe for drinking due to high concentrations of TDS and other chemicals contamination. This study used both qualitative and quantitative methodology for assessing the status of RO plants in Tharparkar. Field research is done through spot enquiry, lab testing of water samples and undertaking FGDs in selected communities and villages. The results reveal that 53% ROs are not functional, amongst them 35% are temporary and 65% are permanently closed. The O&M Cost and Technically expertise in handling these ROs are major issues. The study recommends adopting comprehensive strategies to revamp these ROs and shifting towards alternative water harvesting options to cope with water shortage in Tharparkar.

KEYWORDS: Cope Water Shortage, RO Plants, Thar Desert, Water Treatment

Introduction

Water shortage is a major problem in Tharparkar. There is no surface water in the region other than water provided through pipe water. The area has groundwater as its only major water source. However, it has a high concentration of salts and minerals, which are not good for human and livestock health (Hirani and Ali, 2023). The quality of groundwater is not good. The total soluble salts of the groundwater in Thar desert range between 800 parts per million (ppm) to 11000 ppm. Such a high concentration of TDS is hazardous for human health. The water level varies between eight and 61 meters below the ground surface. The pH is reported to range between 7.1 and 8.6. The ground water of Thar has also a high concentration of fluoride (Kumar et al., 2022).

The lab testing of ground water of Tharparkar reveals that the values of EC, TDS, pH, chloride, salinity, alkalinity, arsenic and fluoride don't meet the minimum standard and guidelines of both NEQS and WHO for potable water. The overall quality of groundwater is very poor to unsuitable for drinking. Thus, the consumption of contaminated water is major cause for various waterborne diseases and other health related issues in Tharparkar (Kumar et al., 2020).

Thus, the regular use of groundwater has led to the emergence of various health abnormalities among the local inhabitants, which includes kidney stones and joint pains, etc. The social life of villagers is also restricted due to lack of adequate water. This particularly affects women, who are responsible for carrying water. Young children often have to forgo education as they are responsible for fetching water. Children remain a necessary part of the water collection process, which sometimes stretches late into the night (Hirani, 2021).

Additionally, drought is a recurring phenomenon in Thar. According to previous 20 years' historical trend of droughts in the desert district, the region has been continually declared as calamity-hit area owing to drought in 1968, 1978, 1985, 1986, 1987, 1995, 1996, 1999, 2001, 2004, 2005, 2007, 2013, 2014, and 2015. Drought further aggravates the severe water scarcity and creates another major challenge for the people of Tharparkar because 80% of the people in Tharparkar are dependent on rain-fed agriculture for their livelihoods, as well as on livestock (Siddiqui & Safi, 2017). Water shortage causes other problems like poor sanitation and deteriorated WASH conditions (Hirani & Mahesar, 2022).

Rainwater is an additional water source in Tharparkar to cope with water shortage. However, erratic droughts have aggravated both water shortages and food insecurity issues in the area. This situation burdens additional workload on women in Tharparkar since they are culturally responsible to fetch water from distant dug well to meet their family water needs (Memon et al., 2018).

To address this water scarcity the government and other stakeholders are trying their level best to bring sustainable solution to water needs of Tharparkar. There are however serious governance issues including bureaucratic crisis in the area. It lacks both practical and doable efforts to resolve water shortage issue in Tharparkar (Shahzad, 2017). To cope with the water quality problem various water treatment plants are designed and operated to treat potable and consumable water (Devrajani et al., 2021). Reports reveal that a total of 778 RO plants are installed and amongst them 156 are nonfunctional. The other plants have also various operational and feasibility challenges (Soomro et al., 2022).

Therefore, to address the water shortage issues in Tharparkar various approaches including ROs on solar, solar pumps, ground water extraction through dug well and hand pumps, rainwater harvesting, pipe water supply etc. are undertaken. A local NGO partner along with district administration has succeeded in developing the water security plan of district Tharparkar. The plan deals with four major components i.e. water governance, water quality, water quantity and eco system of Tharparkar. While exploring its major component i.e. water governance which also suggests to revamping the recent water related developments in Tharparkar, specifically the strategy to overcome the issues and challenge regarding RO plants.

According to official figures, the government of Sindh has installed a total of 750+ ROs by 2016-18. These RO plants have the production capacity of potable water ranged between 60000 and 80000 gallons/day operated on solar energy. However, many other issues like their capacity, ownership, functionality and maintenance are yet other aspects to deal with. It is pertinent to note that the installation of ROs has remained very controversial in Tharparkar due to various raised concerns of its operation and maintenance and further functionality. These concerns were reflected through different opinion-based campaigns, social, print cum electronic media and intellectual discussions.

This study is conducted to gauge the status of the RO plants in Tharparkar and to identify the issues and challenges repelling the functionality of ROs. Furthermore, this study has also assessed the quality and quantity of water retrieved from these functional ROs. Based on the status and challenges the pragmatic recommendations are suggested for policy making and future course of actions to address the water shortage problem in Tharparkar.

Methodology

The assessment primarily used quantitative methods to seek answers to key questions. Brief qualitative interviews with the stakeholders were additionally undertaken to triangulate findings. The main assessment instrument was a structured Focal Group Discussion (FGD) questionnaire which was filled and assessed randomly 148 villages in all talukas of the district in which the RO plants were installed. The questionnaire included the basic demographic information, physical verification, community feedback and moreover the quality and quantity of the water abstracted through the RO plants. A total of 148 FGDs were conducted with 882 community members including 548 male and 334 women among the surveyed villages. FGDs is a useful tool to collect and identify shared knowledge from a group of people which otherwise is not possible to collect from each separate individual (Eeuwijk and Angehrn, 2017). FGDs are very useful tool of data collection from participants. They not only keep participants engaged in responding to research questions but also enjoyed by the participants while partaking in survey activity (Scheelbeek et al., 2020).

A relatively smaller round of qualitative fieldwork was also carried out by interviewing the Key stakeholders of the district including PHED, NGOs, International NGOs and likeminded. The interviews were unstructured and open-ended, and focused on assessing the impact of RO plants, its feasibility, issues and challenges and moreover to garner pragmatic suggestions and feedback for the effective functioning of RO plants.

The random sampling method is useful to select unbiassed sample from large number of populations to given equal opportunity to every participating sample in the research (Kazimierczuk et al., 2009). Therefore, for this study purpose random sampling methodology was employed. The sample size, which was 148 ROs represent the 30% of the total 491 installed ROs. Whereas, in this sampling priority was given to the ROs installed in year 2014, 2015 and 2016 comparing to smaller number of ROs installed during 2012-2013.

Table 1
Taluka Wise RO Plants Assessed

Sr: No.	Name of Taluka	Number of RO Plants Assessed
1	Chhachhro	28
2	Diplo	7
3	Islamkot	32
4	Mithi	79
5	Nagarparkar	2
	Total	**148**

Results and Discussions

Functional Status

The results showed that out of a total of 148 surveyed ROs in the district, 78 (53%) are found non-functional. Of these non-functional RO plants, 35% are temporarily closed due to the failure of membrane and other technical faults, while the remaining (65%) appear to be permanently closed. Hence, overall, 70 RO plants (47% of total 148) are found functional

Surveyed Population

A total of 148 villages from all tehsils of Tharparkar were surveyed, where these RO plants are installed. Referring to the population ratio, the functional ROs are benefiting a total of 97,656 peoples, which signifies **45%** of the total population among the surveyed villages. Whereas the rest of 55% communities still relies on untreated ground water extracted through dug wells, hand pumps and solar pumps. The data also reveals that, on average, one RO plant serves 211 households (1,395 individuals). Which is beyond its capacity to provide sufficient water.

Table 2
Number of Functional ROs with coverage

Taluka	Functional ROs NO.	Male	Female	Children	Total Population	Total Households
Chhachro	12	4219	5136	9005	18360	3060
Diplo	2	552	672	1176	2400	400
Islamkot	13	4069	4954	8677	17700	2950
Mithi	42	13441	16332	28583	58356	9726
Nagarparkar	1	193	235	412	840	140
Grand Total	**70**	**22474**	**27329**	**47853**	**97656**	**16276**

Hygiene Conditions

The data collected from the surveyed villages revealed that, a total of 96% ROs found with the poor hygienic conditions i.e. the residual water was observed in the open space causing several waterborne diseases such as malaria, Cholera, Typhoid etc. Moreover, the water storage tanks were also found in unprivileged hygienic status. Meanwhile it was also observed that communities are not fully aware regarding water health and hygiene, as most of the containers used for transporting water from source to household are also found unhygienic. Even the RO treated water is not being stored in a bacteria free masonry tank. Moreover, the residual water is also contaminating the ground water. Additionally, due to the high TDS ranged from 10000 to 30000 it also affecting the surrounding land to abandoned.

Technical Analysis

Capacity of RO plants

Data reveals that, among the surveyed villages, a total of 7% RO plants are found of the capacity of 60000-80000 gallons/day, whilst rest of 93% RO plants are found of the capacity to provide 15000-gallon water per day. It was surprising to know that the capacity of ROs were calculated as per 24 hours duration, however the current installed ROs do operate for a maximum of six hours per day. Hence, all the pre estimated calculations must be reduced by 04 times to know the actual output. Besides, the majority of the ROs operating over solar power can also operate for about six hours per day during availability of sufficient sun light. It clearly shows that currently the capacity of these ROs to provide the water may vary around 3000 to 4000 gallons per day which is only appropriate to cater the water needs of maximum 50-60 households. It includes water for both drinking and cooking (average 15ltr/day/person as per WHO standards). On the other hand, the households and population among the surveyed villages were observed from 15 households to maximum 1150 households. It clearly shows that these plants strongly lack the appropriate water calculations before installation.

Membrane

According to data, a total of 27 ROs are found to be temporary nonfunctional due to the failure of membrane. It may be noted that the membranes inevitably require periodic cleaning from 2 to 3 times a year depending on the feed water quality otherwise it will cause fouling. Fouling occurs when contaminants accumulate on the membrane surface effectively plugging the membrane. Fouling typically occurs in the front end of the RO system and results in a higher pressure drop across the RO system and a lower permeating flow. The community feedback further stressed the lack of periodic O&M of these membranes caused the failure.

Residual Water Management

The sum-up results revealed that 100% RO plants lack the appropriate mechanism to control the residual water. Currently the residual water is left over in open space which further triggers the several problems for the local inhabitants. Typically, the TDS level of the residual water may vary from 10000 to 30000, which will not only erode the rain fertile pastureland, but it is also highly hazardous for both human and livestock. Meanwhile it is also contaminating the ground water and the land. Parallel to that, the residual water is a source to incite mosquitoes and flies in the area which may result in aggravating health related problems including outbreak of cholera and dengue etc.

RO Design

The assessment also highlighted that the design of the ROs have been changed in the past couple of years, which is completely disowned by the communities among the surveyed villages. The revised design of these ROs consists of the machine fitted in the container and a pipe sketched from the container connected with the taps at outer sides without any fixed location. While the residual water is flowing at the back side of the container through the pipeline directly to the ground, which also contaminates groundwater. Most communities preferred the previous design to include a room made of bricks coupled with a water storage tank.

Operation & Maintenance of RO

Lack of proper management, operation and maintenance of the ROs is the major problem partaking to non-functionality of these schemes in the district. According to the data, 93% of the community members are completely unaware regarding the O&M of these RO plants. However, only 7% of the communities reported that the company (PAK OASIS) is mainly responsible for the O&M of the plants. Besides community feedback also revealed that the operator is mainly responsible to report the company in case of any fault occurs in the machine. Meanwhile, the data shows that the period of nonfunctional RO's ranged from minimum 1 month to maximum 2 years. Additionally, there was not any training in O&M provided to the operators at village level. Whilst PHED is not effectively involved in the RO plants design and installation which shows the lack of ownership of RO plants at district level or from the public-sector.

The communities can't take over the responsibility of O&M of these plants as they have limited capacity to operate a complex system. Furthermore, they do not have adequate financial resources to pay the cost to change the membranes and filters and replacement of the solar panels after a certain period when these ROs will be handed over to communities. This reflected the poor mechanism of O&M and delay in response from the company coupled with the unavailability of technical person at village level and lack of ownership by local inhabitants are the prime reasons which are causing the failure of machines.

Village level Operators of RO plants

According to the data collected from these 148 villages, the education level of operators for the RO plants shows that 36% of the operators possess primary education, 16% among these are middle passed, while 17% have education up to Matric. Only 3% of operators are graduates and the other 3% are uneducated. This reflects that there is not any constant education level required for the operators to run these RO plants. The results also highlight that there is not any orientation or training imparted to these operators regarding the O&M of the RO plants. They are only known to switch on and off these Plants with limited knowledge of TDS/PH meter etc.

Water Quality

Ninety-Seven 97 water samples were collected from the functional RO plants. The source of these RO plants is underground water. All water samples are analyzed at the water testing Lab of a local NGO at Mithi.

Physicochemical Characteristics:

The analytical water testing results show that out of 97 water samples, 47% samples were found unsafe due to presence of total dissolved solids (TDS) beyond the maximum permissible limit (1000 mg/l), the highest concentration for TDS was measured 4100mg/l. Meanwhile the samples also include presence of fluoride and nitrate content beyond the maximum permissible limit recommended for safe drinking water as per WHO standards. However total of 53% samples were found safe for human consumption.

TDS Level

The sum-up results emphasized that of these 97 samples, a total of 43% contains the TDS level up to 500, while 19% samples were found with the TDS level from 501-1000, however 26% samples have the TDS level ranged from 1001-2000, meanwhile rest of 12% samples were observed the TDS level above 2000.

Fluoride and Nitrate

The data revealed that a total of 10% samples contain fluoride above 1.5mg/liters which is higher than the WHO recommended level for safe drinking water i.e. 1.5mg/liters. Meanwhile 16% of the total samples were also found with the nitrate value above than safe drinking water value i.e. 0.2mg/liters

Microbiological Contamination

The water testing data stressed the presence of E. coli among 29% samples which specifies the bacteriological contamination of RO treated water and further distracts the concept of "zero bacteria" behind these RO plants.

Social and Environmental Impacts:

Social Impact

The assessment also reveals the overall community feedback for the RO plant, it emphasized that a total of 67% community members among the surveyed villages reported that it is beneficial while rest of 33% community disowns the ROs. Meanwhile in order to triangulate the results the data further classified into three segments which are as follows:

The data shows that a total of 33% FGD participants reported the test of water is not satisfactory, while 33% reported the quality of water is not satisfactory. However, an additional 30% have reported that they are not satisfied with the quantity of water because it does not fulfill the overall water needs of the village.

Water Handling and location of RO plants

The qualitative data stressed that there is not any distribution mechanism that exists at village level through which all community members can easily and equally get water from RO plants. This also causes community disputes. The community feedback also revealed that locations for all these RO plants are finalized with the consent of politicians through the political activist of the village. Hence these ROs were installed at the locations (para-sub hamlets) near to activist's household. In Tharparkar majority of the villages are scattered and their sub hamlets are also found far from each other which creates hurdles for the rest of hamlets to fetch water from the plants specifically for women due to cultural hindrances in most villages.

Environmental Impacts

Following environmental impacts are observed during the assessment:

1) The poor mechanism of the residual water is potentially threatening to the ground water contamination and may also cause harm to local trees and shrubs. Moreover, livestock is found more vulnerable to water borne diseases subject to consumption of the residual water.

2) Poor hygienic conditions found around the RO plants, causing the increase in bacteriological contamination of the water.

3) It is expected that 750 RO installed in different villages of Tharparkar district would have serious impacts on lowering of water table and depletion of groundwater

Water Security Planning Tharparkar

A local NGO in Tharparkar with financial assistance of WaterAid felt this indispensable need to develop water security planning (WSP) of Tharparkar. This plan was developed followed by three years long experimental research and involving all stakeholders (Civil society and Government) at all stages. The plan emphases to adopt programmatic approaches while consolidating all efforts to ensure Tharparkar "water secure zone". The WSP consists of detailed research work on the RO plants installed in Tharparkar.

The diagnostic surveys and analysis helped to illustrate followings issues

- The RO plants have not been designed considering the local conditions in terms of quantity and quality of groundwater, demand of water by the local communities and the desired level of solar power to abstract groundwater and the quantity of treated water. There are greater variations in these parameters at the RO plants visited by the Consultant. Some of the plants are over-designed and others are under-designed. It seems that RO plants were purchased and then installed without any design.
- The operation of RO plant is not on regular basis as some of the plants are not being operated due to certain reasons like problems with the membrane, reduced supply of power due to cloudy sky, and thus tube well water is being provided to the community without treatment.
- The root cause is that there is a need to develop an understanding with the community that the RO treated water is basically of the drinking water quality and it should be provided for drinking purposes only. Currently, the treated water is being stored in a masonry water storage tank, which is not in hygienic condition. The RO treated water must be provided in a bacteria free container.
- During the visit, the Consultant also observed that pumped brackish groundwater is also being stored in the water tank designed for the RO treated water because the RO plant is not being operated. In principle, RO plants should be operated only for the provision of RO treated water for drinking purposes in safe water containers.

- Carbon filters are essential to provide safe water to communities - zero-bacteria water
- The daily record book in terms of operation of the RO plant is not available at any of the RO plant visited by the Consultant or not shown to the Consultant.
- There is no record book maintained for the change of filters at the RO plant, therefore monitoring of the O&M of the plant is not possible.
- The staff currently involved in the operation of the RO plant do not have the capacity in terms of quantity and quality of treated water and demand of the community.
- The RO Plant installed in the village Fangrio provides 20,000 liters of water per day for 500 households, meaning that water available per household is around 40 liters per day. This quantum of water can be taken as drinking water for a household of 10-12 persons. Therefore, the current strategy of providing water for domestic uses must be changed to the provision of safe drinking water only. Even if the plant is of higher capacity to provide water for domestic uses the cost of RO treated water can be justified only for drinking purposes. Most of these plants can provide water adequate for drinking purposes to the rural communities and rest can be sold in nearby towns for drinking purposes at higher prices. Alkhidmat Foundation has already adopted this strategy for the plant installed in Mithi city.
- The deep tube wells equipped with submersible pumps can provide brackish water for domestic uses other than drinking needs but currently there is no distribution system developed for provision of water at the household level. The RO treated water must be provided at the RO plant in safe containers so that water consumers can have access to safe drinking water.
- The RO plants are costly both in capital cost and O&M. These are also difficult to maintain. The current condition of RO plants indicates that these will not be having longer life. There are serious concerns in relation to higher energy costs, higher cost of replacement of filters and membranes, etc.
- Some of the plants in the past have also been installed on electric or diesel or hybrid power systems and community or PHED will never be able to pay for the energy cost. Further, the operation of the pumping systems and RO plants will also be affected by load shedding and power failures.
- The installation of RO plants was undertaken without considering the alternative options. At least the option of storage of runoff and floodwater was not considered while developing the feasibility at a particular location. Who will be the owner, operator and manager of these plants is still undecided.

Conclusion

Tharparkar, a desert district and one of the most water scare regions of the country is facing acute water shortage. To cope this water scarcity Government and other stakeholders are trying their level best to bring sustainable solution to water needs of Tharparkar. Various approaches including ROs on solar, solar powered submersible pumps, ground water extraction through dug well and hand pumps, rainwater harvesting, pipe water supply etc. are being undertaken simultaneously.

The results showed that out of a total of 148 surveyed ROs in the district, 78 (53%) are found non-functional. Of these non-functional RO plants, 35% are temporarily closed due to the failure of membrane and other technical faults, while the remaining (65%) appear to be permanently closed. Hence, overall, 47% (70 RO plants) are found functional.

A total of 148 villages (having 216,366 individuals) from all tehsils of Tharparkar are taken under this study where these RO plants are installed. Referring to the population ratio, the functional ROs are benefiting a total of 97,656 individuals - 45% of the total surveyed population. Whilst the rest of the 55% population still relies on untreated ground water extracted through dug wells, hand pumps and solar pumps. The data also revealed that on an average one RO plant is providing potable water to around 1,395 individuals (211 households).

However, capacity of ROs was calculated based on 24 hours duration. Whereas the current installed ROs do operate for a maximum of six hours per day. Hence, all the pre estimated calculations must be reduced by 04 times to know the actual output. Besides, the majority of the ROs operating over solar power can also operate for about six hours per day during availability of sufficient sun light. Therefore, the capacity to provide the water as per design may vary from 3000 to 4000 gallon/day. Moreover, while analyzing the capacity of these RO plants by inquiring the local communities among the surveyed villages, it was found that they are capable to cater the water needs of only 50-60 households which includes water for both drinking and cooking (average 15ltr/day/person as per WHO standards).

The data collected from the surveyed villages revealed that a total of 96% ROs found with poor hygienic conditions i.e. the residual water was observed in the open space causing the several waterborne diseases such as malaria, Cholera, Typhoid etc. The water storage tanks are also not in satisfactory hygienic status. Ironically, communities were also not found much mobilized / sensitized regarding water health and hygiene, since most of the containers, used for water transporting, were also unhygienic.

The data reveals that among the surveyed villages 100% RO plants lack the appropriate mechanism to control the residual water. Currently, residual water is left over in open space, which may trigger several problems for the local inhabitants. Since the high TDS of the residual water (10000 to 30000) will not only erode the rain fertile pastureland but it is also hazardous for both human and livestock. It is a source of incite mosquito and flies in the area which may result to aggravating health related problems including outbreak of cholera and dengue etc.

PHED was not effectively involved in the designing and installation of these RO plants; hence there seems no ownership of these RO plants in the district from the public-sector. The communities can't take over the responsibility of O&M of these plants as they have limited capacity to operate a complex system. Furthermore, they do not have adequate financial resources to pay the cost of change of membranes and filters and replacement of the solar panels after a certain period. This reflects the poor mechanism of the O&M and delay in response from the current contractor coupled with the unavailability of technical person at village level and lack of ownership by local inhabitants are the prime reasons which causing the failure of these machines.

The analytical water testing results show that out of 97 water samples, 47% were found unsafe due to presence of Total Dissolved Solids (TDS) content beyond the maximum permissible limit (1000 mg/l), the highest concentration for TDS was measured 4100mg/l. The 47% unsafe samples with high TDS also include objectionable taste and due to presence of fluoride content beyond the maximum permissible limit recommended for safe drinking water. The lab reports suggested 53% of water samples as safe to drink.

Water testing further intimated that 29% of samples are unsafe for human consumption due to bacteriological contamination i.e. presence of E. Coli. Hence, the goal of "zero bacteria environment" behind these RO plants is in vain. Pathetically, 33% FGD participants also reported the test of water is not satisfactory, whilst a similar number of respondents said that the quality of water is not satisfactory. Additionally, 30% intimated that they are not satisfied with the quantity of water because it does not fulfill the overall water needs of their villages.

The study suggests there is in dire need to address O&M of these ROs through third party involvement and through capacity building of local communities. Secondly, these ROs must be designed keeping in view basic needs. Thirdly the water quality test must be carried out to ensure the provision of safe drinking water to the rural masses.

Recommendations:

Based on the detail assessment of the RO plants and stakeholders' feedback narrated below are the pragmatic recommendations.

Awareness about the technology and Safe Drinking water:

- The assessment shows that awareness about technology and safe drinking water is very limited in the communities. Without this awareness, the provision and use of safe drinking water will remain a dream.
- Awareness about the appropriate use of technology, hazards of unsafe drinking water and the importance of safe drinking water for healthy living should be created in the communities through regular sessions and training.
- The village level water management committee should be formed in order to undertake the regular monitoring of the RO plants.
- The community should be well oriented to collect and store the RO treated water, using safe and hygienic containers. It includes the mass awareness through hygiene sessions on water purification methods and timely cleaning and maintenance of the Water storage tanks at the source and household level.

Operation and Maintenance:

- Lack of proper management, operation and maintenance of the ROs is the single most important problem partaking to the non-functionality of schemes in the district.
- A detailed training on Operation and Maintenance of RO plants should be imparted to the village activists along with the operators to orient them regarding the basics of O&M for timely repair of temporary closed ROs.
- There should be a district level committee for the RO plants, who mainly look after the issues and challenges and timely respond to the situation.
- Currently, the RO treated water is being provided free of cost to the rural communities. When water is provided free of cost, the water consumers will hardly understand the value of RO treated water. Therefore, the RO treated water should be charged reasonably to generate revenue for its O&M cost and to develop sensitization regarding its worth among local people.

Technical Aspects

- To install RO plant, there should be an analysis of water budget at the local level, current and projected water demands and socio-economic situation in the district.
- There should be a mechanism to control the residual water of RO plant, either to construct the water pond or the mechanism to increase the evaporation.
- The test bore should be done while installing the RO plants.

- It is recommended that the Water Quality test should also be done, probably on a quarterly basis, and respective communities must be oriented regarding the quality of water.

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