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EMERGING TRENDS IN MANAGING DRINKING WATER – CASE STUDIES OF COASTAL VILLAGES IN KARNATAKA

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EMERGING TRENDS IN MANAGING DRINKING WATER – CASE STUDIES OF COASTAL VILLAGES IN KARNATAKA[1]

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Abstract

This paper is aimed at understanding the drinking water status and management approaches adopted in four coastal villages of Karnataka. Saltwater intrusion, seasonal scarcity and groundwater depletion are the common problems encountered here. Collective action, successful institutional set up and water harvesting methods have shown positive impact. Attempts to resolve the drinking water crisis has been local. However, it is significant to understand that the problems need to be addressed from a larger perspective to curtail long-term effects.

Introduction

The coastal areas have a very fragile resource base that affects the economy, agriculture and other activities. The basic problem concerning water is intrusion of sea water into fresh water aquifers and making it saline, which results in reduced availability of good quality drinking water. Sustainable water management in coastal areas is becoming a necessity with the looming crisis over water resources that is threatening security and livelihoods. The combined effects of population pressures and increased economic and technological development have led to higher pollution, over-exploitation and degradation.

Similarly, in India too, the coastal areas are facing enormous pressure which has been growing over the years. India's shoreline extends

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over 5,680 Km from Gujarat in the west, down along the Konkan and Malabar coasts, around Kanyakumari and then up along the Coromandal coast to West Bengal's Sundarbans. Access to drinking water is one of the crucial problems faced by the people in these areas. With most of the water turning saline, the limited potable water available cannot meet the demands and leads to frequent conflicts. The problem of inland salinity has been observed in the arid and semiarid regions of Rajasthan, Haryana, Punjab, and Gujarat and to a limited extent in the states of Uttar Pradesh, Delhi, Karnataka, Maharashtra, Madhya Pradesh and Tamilnadu. The problem of coastal salinity due to excessive exploitation of groundwater was observed in Mangrol - Chorwad areas and coastal Saurashtra of Gujarat, Minjur in Tamilnadu, and coastal areas of Pondicherry, Orissa, Andhra Pradesh and Kerala. Immediate action is necessary to prevent further degradation of many coastal habitats.

Against this, the paper aims to understand the status of drinking water in coastal villages and the approaches adopted in managing the crisis. Focus group discussions and household surveys were carried out using questionnaires covering socio-economic, physical and financial aspects. The 'Report card methodology', helped in getting a systematic public feedback to assess performance and perceptions. Secondary data was collected from the Rural Water Supply and Panchayat Raj Department, Public Health Engineering Department and Karnataka Water Supply and Sanitation Agency and NGOs. Discussions with officials at various levels (state, district, taluk panchayat and gram panchayat and village water supply and sanitation committees) provided insights.

The paper is divided into four sections. Section I focuses on details of coastal areas in Karnataka while Section II addresses emerging trends and coping mechanisms in drinking water management in four villages of coastal districts in Dakshina Kannada and Udupi, Section III

deals with the key issues across the case study villages and Section IV describes lessons learnt and future options. The positive initiatives could be replicated, while the villages which have not been able to make the required impact could learn lessons and not repeat mistakes. Although the attempts to resolve the crisis of drinking water has been local, it is important to understand that the problems need to be addressed from a larger perspective to curtail long-term effects.

Section I

Karnataka's Coastal areas

Karnataka's coast stretches for 300 Km along the three districts of Dakshina Kannada, Udupi and Uttara Kannada (Refer Fig 1.0) measuring 160 Km, 98 Km and 42 Km respectively. It lies between the Arabian Sea and the Western Ghats, which is one of the 25 recognised 'biodiversity hot spots' in the world, and comprises estuaries, beaches, monsoon wetlands, agricultural and forestlands, and mountains. It is rich in natural resources and provides enormous direct and indirect benefits in terms of fish and plant products of domestic and commercial value, freshwater, recreation and tourism.

The coast has 27,000 Km² of continental shelf. The state's share of "Exclusive Economic Zone" comprises 87,000 Km² of coastal waters and open sea with more than 300 varieties of marine fishes. Its resource potential is estimated at annual fish harvest of 4.25 M tons. There are 29 fish-landing centres including five minor fishing harbours. The annual marine fish yield along coastal Karnataka is 1.5 M tons. In Karnataka, the coastal area's average population density is 253 persons/Km² (Dakshina Kannada was highest with 337 persons, Udupi 290 and Uttara Kannada 132) (Census 2001). It has 22 urban agglomerations and 1,044 villages (The Hindu, Mangalore, March 11 2004).

The area is predominantly agrarian involving about 60 per cent of the workforce. More than 70 per cent of cropland is under cereals with rice as the principal crop. Fishing is the other major source of livelihood with about 1 lakh people directly engaged in it and another 2 lakh in associated activities. In addition, industrial activity also has been increasing, providing direct employment to nearly 2 lakh people. Similar to problems across the globe, the situation is no different in Karnataka – industrialization, improper land use, unsustainable economic activities and overexploitation of natural resources have adversely affected the coastal environment. The effluents and emissions discharged by large industries and power plants, unregulated tourism, and intensive aquaculture has adversely impacted the coastal environment. Decline in mangroves and coastal wetlands have eroded its pollutant-filtering capacity. It is receiving increased attention in view of the exploitation of natural resources, fisheries, sand mining and developmental activities.

Source: Maps of India

The importance of the coasts was legally established when the Coastal Regulation Zone Notification (CRZ) was drawn up in 1991 under the Environment Protection Act, 1986. The CRZ notification lays down norms for safeguarding the sensitive coastal ecology. The Coastal Aquaculture Authority Bill, 2004 aimed to establish a Coastal Aquaculture Authority for regulating activities connected with aquaculture in the coastal areas (http://mpa.nic.in/preb05.htm).

The Coastal Regulation Zone Notification in mid-2002 allows for the establishment of SEZs. The Exim Policy of 2000 (Gujarat, Karnataka and Orissa) was amended although it faced opposition from environmentalist and social activist groups. They argue that the state level policy to initiate efficient use of local resources could affect the coastal ecosystems intensely. Allowing SEZs to function will lead to acquisition and conversion of land use and loss of livelihood for the affected population. In Karnataka, SEZs were planned at Tadri in Uttara Kannada, Padubidri in Udupi, and Baikampady in Dakshina Kannada. Padubidri was where Cogentrix was to set up its power plant. The Barge Mounted Power Plant (BMPP) and the expansion of Tadri port have been, and continue to be, severely criticised by the local people for its negative social, economic and environmental impact. The other important issue is that of impact assessment procedures. Only some of the projects proposed in the SEZs may come within the purview of Schedule I of the Environment Impact Assessment (EIA) Notification, 1994. It is recommended that it would make more sense to carry out the cumulative environmental and social impact assessment of an SEZ rather than assessing aspects of individual projects (Kalpavriksh Environmental Action Group, Pune.)

Section II

Initiatives and Approaches - Four Case Study Villages

The drinking water situation and the initiatives taken to manage it and its impacts. in the four case study villages are discussed in this section. Two villages (Yanegudde, Kote) are in Udupi district while the other two (Bajpe and Hosangadi) are in Dakshina Kannada district. Some of the basic features of the four villages are presented in Table 1.

Table 1: Basic Details

Details	Yanegudde (Forest Gate)[5]	Bajpe	Kote (Indira nagar)[6]	Hosangadi
Geographical area in Ha	403	723	187	1064
Distance from City in Km	14	15	10	20
Total population	353	8033	676	3132
Number of households	70	1182	115	625
Major crops grown	Paddy, Cereals, Pulses, Coconut	Paddy, Pulses, Coconut, Spices Mango, Floriculture	Coconut, Arecanut, Spices, Paddy	Cashew, Arecaunut, Rubber, Coconut and Vanilla

Source: a. RDPR, 2003
b. Based on Survey, 2003

The Yanegudde Experience - Yanegudde is a coastal village of Katapadi Grama Panchayat of Udupi district. 'Yenagudde Forest gate' is one of the clusters within the village with 70 households. The River Papanashini flows adjacent to the village. But despite being so enticingly close to the river it has very little naturally occurring freshwater.

[5] Yanegudde Forest Gate is a cluster of households, which forms a part of the Yanegudde village.

[6] Indiranagar is a cluster of households, which forms a part of the Kote Village.

Salt water has long been entering the region's groundwater resources. Water scarcity is severe during summer with salinity levels rising. People had to walk 1.5 kms – 2 kms to fetch water. However, the positive intervention of piped water supply in 2000 made all the difference in terms of availability and accessibility to clean and sufficient water. The PWS was totally the effort of the people and inspired leadership for sustainable and effective implementation.

Trigger

Initiative of the local minister- Currently, the village has sufficient access to drinking water which resulted out of a combined effort by the then State Cabinet Minister of Fisheries, Mr. Vasanth Salian, The Malnad Development Authority and the philanthropic attitude of Mr. Devdas Alwa. The "Sampath Multi-purpose Co-operative Society' was formed involving one member from every household. The objective of the society was to spread its activities to various sectors (like marketing fish, agricultural produce etc) apart from providing effective water supply. Thus, a planned and joint effort resulted in the installation of a pipeline from an open well. It was considered important to involve all the households in managing the system. So informing and involving people at every stage was focused upon meticulously, resulting in creating awareness about the functioning of the society and its roles. Members of the society agreed to contribute a minimum of Rs.2500 irrespective of the economic background. However, some households contributed more.

Management - The governing body of the society aids in the functioning of the society and meets every month. All the members attend the annual meeting where the accounts are explained to the people and future plans are discussed and suggestions are made. Members vouch for the transparency and accountability of funds, collection and expenditure. The formats used are simple. The gram panchayat, taluk

panchayat and zilla panchayat (district council) have no role to play in the water supply in this village as it is was executed and maintained by the society on its own.

Collecting Water Charges - Water is supplied for 45 minutes every day. Houses have sumps and pump the water to overhead tanks. The waterman is in charge of supplying water and collecting water charges. Water is charged on volumetric basis. Water meters were installed, but frequent floods damaged them so each household pays a flat charge of Rs. 60 per month. Delay in payments is acceptable up to 3 months and after that a warning notice (printed format) is issued to the defaulter reminding him to pay failing which water supply is cut. Rules are clear on payment schedule and penalties. Households are not expected to waste water and are fined if found guilty.

Positive impacts - Water supplied is adequate with per capita supply of more than 70 lpcd. Timings are maintained and people are highly satisfied. Good participation and governance has aided in clarity in the functioning of the system. Majority of consumers follow rules and there has been no problem. If there are defaulters, which is uncommon, others object and complain to the authorities who warn the respective households immediately.

The Hosangadi experience - Hosangadi village is situated in Belathangadi Taluk, Dakshina Kannada district. Individual households have their own source of water supply – open wells and borewells while a cluster of households (130) have piped water supply which is metered and managed by the Village Water Supply and Sanitation Committee (VWSC). Strong institutional backing was formed through the VWSC as per the guidelines of the Sector Reforms Programme (SRP). The main aim was to bring in accountability and efficiency in the service, which has improved accessibility and has made the scheme sustainable. Majority

of the beneficiaries belong to the middle and the lower middle class. Open wells cannot be dug in this area due to lack of space. Hence household connections are useful to these people. Currently, water is supplied for 2 hours a day (morning and evening). As the land is uneven, accessibility varies depending on the location of the households. Work is in progress to improve the situation by placing control valves. People are willing to pay as per the meter charges and have understood that water is not a social good but an economic good if service has to be provided.

The situation in the past has revealed that scarcity during summer was a serious problem and women had to walk long distances, up to 2-5 kms to fetch water. Later, borewells with hand pump (BWHP) was introduced followed by Mini Water Supply (MWS) and Piped Water Supply (PWS).

Positive interventions

- Installation costs were borne by all while households that could not contributed through labour.
- Water charges were based on meter readings and slab rates were introduced to minimise water usage, and for better accountability. The minimum charge was Rs.40 upto 8,000 litres and after which it is Rs.5/1000 litres. Each household paid Rs.1000 as initial deposit. Rs.100 extra was added every year as and when new connections were taken. Penalty of Rs.10 or 10 per cent of the total amount, whichever is higher was charged.
- Meters were placed at the entry point to the house and not in private lands to avoid misuse of water.
- Good foresight in planning for the future.
- Committee is planning to charge for public taps at Rs.20 per month.

- Creation of reserve funds for unforeseen expenditure. The committee has Rs.40,000 as reserve fund.

- The committee has formulated sub-groups with 10 members identified as group leaders. Their responsibilities include:
    - Preventing wastage of water
    - To see that meters are working properly
    - Preventing misuse of meters
    - Collection of water charges
    - The group leader to be made the Committee member. This system is in the planning stage and the objective is to make the beneficiaries more responsible for easy administration. This method is not mentioned in the SRP guidelines and is an innovative idea.

The Kote Experience - Kote village belongs to Udupi district. There are 192 households and are divided into 4 clusters. This case study focused on the Indiranagar cluster where roof water harvesting has been taken up for 30 households.

Earlier, the households were dependent on one open well and 2 borewells with handpumps. With the implementation of PWS in 1993, water supply has improved but is not adequate. The water supplied from PWS is used for secondary purposes and drinking - water is collected from an open well near by. People face water scarcity during summer season and salinity is a problem as the village is situated very close to the seashore.

Piped water is supplied once in 2 days for 2 hours and the people with household connections are not satisfied with the service and are willing to pay more than the prescribed charge of Rs 75 for improved service. People queue up from morning 4 a.m. to night 12 p.m. to collect water. Each household gets a chance to fill up 2 pots. Burning

of motors cause distress because it takes 8 to 10 days to repair it. The people often quarrel over water.

One of the positive initiatives taken up was implementation of roof water harvesting in 30 households. People having these structures are pleased and convinced that it could solve their water problem during summer. It can create a sense of awareness, as people experience the positives practically. As the study was conducted immediately after the RWH structures were installed and people were waiting for the monsoons, it was not possible to document the impact.

There was discontentment in a few households, because identification of households was not based on proper representation. As people were not involved and were not aware of the technology they preferred to have two open wells that would help the whole village rather than be partial only to 30 households. In general there was poor awareness about rainwater harvesting. With no contribution from the households, people did not reveal a sense of ownership among the RWH owned households.

The Bajpe Experience - Bajpe village, located at a distance of 15 kms from Mangalore and resembles a small town with 2,500 households and a population of 12,000. Mangalore International Airport is 2 kms away from the village which is one of the main reasons for its rapid development. It has also led to an influx of population making it a transit point for many to commute to other places to seek employment. Non- Resident -Indian's (NRI) and caretakers of their properties also live here. It is important to describe the village, as it can be divided into various segments in terms of its development. Households located in the core of the village are small and the area is congested. The village is very urbanised with good access to infrastructure facilities. Access to amenities, particularly water supply also is determined by economic status.

Earlier, the main source of drinking water was open wells and water availability was not a problem. With expansion, the village benefited from various schemes, borewells with handpumps, MWS and PWS. Water is supplied for two hours, which has led to dependence on public taps. Currently the village is facing water scarcity during summer and several management problems like uneven distribution of water, non-functioning of meters and inequity. Conflicts are common. People often purchase water by the tankers.

To resolve the water scarcity problem, various schemes were introduced by the VWSCs. However, they have their own complexities and process related problems indicating institutional failure. In Bajpe, there are 5 VWSC's. Based on discussions with presidents and members of these VWSC's it was observed that

- Awareness levels of roles and responsibilities was poor among the presidents and majority of the members.
- Regular meetings were not conducted which formed a weak base for sustenance.
- Not keen on becoming the president. For instance, one of the presidents was involved in business and was forced to be the president. He strongly expressed that GPs should manage water supply and there was no need for VWSC.
- Presidents expressed difficulty in handling the responsibilities particularly in collecting charges.

Huge investments through various schemes failed due to lack of appropriate approach to address a village, which was large in terms of both population and size. There was chaos and mismanagement. Poor accountability and transparency were common. Wastage of water was witnessed, as there was inequity in water supply in certain areas of the village. The institutions had failed to address the problems thus proving that schemes alone would not resolve the crisis.

Key issues

Seasonal Scarcity – Seasonal scarcity was common across all the four study villages. Scarcity during summer ranged between 3-6 months causing severe hardships. Drying up of open wells and bore wells was a common problem. This forced people to purchase water. In Kote, the initiative on rainwater harvesting was a positive one. The approach could have been more participation-oriented. This would have prevented discontentment among the rest of the people. Awareness creation was absent and caused ambiguities. Financial contribution was partial and people had no sense of ownership and responsibility.

Accessibility – Accessibility was a problem not only during the scarcity months but also throughout the year, specifically for drinking water. Access to required quantity of water was limited, as they had to walk 1 to 3 kms to get water. Among the case study villages, Indiranagar had limited access to drinking water[7] throughout the year and it would worsen during the summer. Bajpe had accessibility problems only during the summer. Private open wells located within the households compensated for the scarcity. In Yanegudde, the distance to potable water ranged between 1.0 to 1.5 kms depending upon the location of the households. However, they have overcome this problem through a collective initiative. In Hosangadi, people faced scarcity only during summer and it was not uniform within the village. The land was uneven and hence the distribution of water through pipelines varied.

Inequity – Inequity within the villages was prominent in the two study villages (Bajpe and Indiranagar). The reasons for this in Bajpe were mainly the location of the households and the natural undulation

[7] In Indiranagar, there are limited number of open wells (2 - used for drinking) while only one borewell is used for drinking. Both are private open wells and not a part of the GP management.

in land making it convenient only for few households. In Indiranagar, it was mainly the limited access to drinking water wells.

Natural barriers – In the coastal villages, one of the major problems was the terrain, which made it difficult to lay pipelines and supply water. Distance between households was another barrier as it varied between 500 meters to 3 kms. Bajpe village being a hilly region allows for less percolation and less water retention. In Yanegudde, the association invested on installing meters, but corrosion of meters due to close proximity to the river made them dysfunctional. Funds allocated to these villages did not meet the location-specific requirements making it difficult for the VWSC's to implement the schemes.

Water Quality – Salinity was the main problem faced by the villages except in Hosangadi. Excessive drilling of borewells is one of the main reasons. A key source of contamination in many coastal areas is saltwater intrusion. At some depth, the freshwater aquifers and saltwater intermingle in a transition zone. Any changes to the system, however, can cause saltwater from the sea to intrude into freshwater aquifers.

Institutional aspects –Two management practices are prevalent in rural areas – in some villages - GPs are directly responsible for managing water supply while in others it is the VWSC's based on the focus of the schemes implemented. For example, the Rajeev Gandhi Drinking Water Supply Scheme makes formation of VWSC mandatory with specified rules and regulations for ensuring rural water supply. Among the study villages, issues related to these two different practices will be discussed separately. Institutional lacunas in Bajpe also led to inappropriate management.

Setting up strong institutions by involving the people at every stage was common between Yanegudde and Hosangadi. Involvement enabled better awareness of the situation and resolved the crisis.

- Initiatives were taken by the VWSC and local initiatives in Yanegudde and Hosangadi, respectively. Both had strong leaders to motivate and organise. However, the leaders worked towards setting up institutions and were not leader-oriented which highlights sustainability.
- Initiatives and approaches varied between Yanegudde and Hosangadi but both worked towards strengthening institutions by enacting acceptable rational rules, conducting regular meetings and giving voice to majority of the people.
- Transparency and accountability at every stage made it simpler and easier to manage. Documentation was done meticulously and available for scarcity in both Yanegudde and Hosangadi.
- Bringing about a change in the mindset of the people in accepting water as a priced good in place of social good and a non-renewable resource was attempted largely in Yanegudde and Hosangadi. Highlighting wastage prevention added to the positives.

Institutional lacunas

VWSC's constraints – Poor awareness, lack of motivation and forced leadership was apparent among the members. Lack of management skills and role clarity made it difficult for them to handle the crisis. Financial lacunas added to the existing problem of irregular payments from the people and also inadequate allocation from the ZP.

Gram Panchayat's grievances – The gram panchayats (GP) were not equipped to manage the problems. For instance in Indiranagar, there was frequent burning of motors and the GP took 8-10 days to repair them. During such times people would spend more than 6-8 hours to collect two pots of water per household from borewells. People having household connections were very dissatisfied with the service

and were willing to pay more for better service. The GPs had a different story to narrate. It was difficult for the GPs to manage as the payments were irregular and collection was only 50 per cent. They even complained of misuse of piped water supply as a common problem. In Bajpe, 55 per cent of the people attended the Gram Sabhas and 68 per cent discussed problems. But the village is very big with too many schemes and related complexities, which has made it difficult to streamline the services.

Management issues

Management issues surfaced at various levels. One such instance in Bajpe highlighted the confusion over implementation of schemes and management of finances. Initiatives undertaken depicted chaos. It was unplanned leading to various complexities in terms of management. People were promised household connection and Rs.1,000 was collected. The management planned to build 4 overhead tanks and a dam across river so that water could be supplied to Bajpe and other surrounding villages. Construction of the tanks was under progress, but the money collected to build the tanks was partly diverted to build the dam. The problem surfaced when the dam could not be completed and the people could not afford to pay more. The GP members had no forethought before taking up such a huge project. This village is a good example of how development initiatives had interfered with the normal functioning of the village by adding pressure on the existing resources and interventions made thereafter had failed to secure the expected results. The VWSC's incapability to match the huge demands was obvious. Poor co-ordination between the GP and VWSC's caused lack of interest leading to forced leadership and poor awareness among the members of the VWSCs.

Lack of awareness among the people about the schemes was obvious. The beneficiaries who had contributed were not aware

of the rules of the scheme and the plans of the GP. Misuse was prevalent. For instance, in Bajpe, there were instances of households obtaining connection and paying Rs.50 as monthly charges but had rented houses and the water was given free of cost to tenants. The quantity of water accessed between different households varied according to their convenience. There was no regularisation regarding usage of water.

Financial issues

Wasted investments – In Bajpe, repeated investments on borewells had ended in failure mainly due to lack of technical expertise. The society collected contributions but failed miserably thrice, wasting investments of Rs. 3.25 lakhs. This highlights the poor planning and lack of awareness on the location and seeking the right interventions. Borewells were seen as the immediate solution without understanding the geological conditions. In Bajpe, problems of GP indicated that it was additional burden to the VWSC as power charges due by ZP on the investment was to be paid by the GP. Adding to it, under-pricing the households made it difficult to function.

Table 2: Issues in a Nutshell

Key issues	Yane-gudde	Bajpe	Kote (Indira-nagar)	Hosangadi
Scarcity	No	Partial	Partial	Partial
Seasonal scarcity	No	Yes	Yes	Yes
Accessibility	No	Yes	Yes	Yes
Salinity	Yes	Yes	Yes	No
Ground water depletion	No		Yes	
Corrosion of meters	Yes	Yes	Not applicable	Not applicable
Clarity of roles and responsibilities	Yes	No	No	Yes
Co-ordination between GP, VWSC and people	Yes	No	No	Yes
Management problems	No	Yes	Yes	No
Wasted investments on meters/PWS/MWS/BWHP	Yes	Yes	Not applicable	No
Metering	Yes (not functioning due to corrosion)	Partial (but not functioning)		Yes (working and charged accordingly)
Awareness on alternate methods	No	No	Yes	No
Awareness about schemes	Yes	No	No	Yes
Involvement and contribution	Yes	No	No	Yes
Inequitable distribution and access	No	Yes	Yes	No

Source: Observations based on Survey

Section IV

Some Lessons

- Setting up strong institutions by involving people at every stage was common in Yanegudde and Hosangadi. Involvement enabled better awareness of the situation.

- Irrespective of the type (GP, VWSC or local initiatives), Yanegudde and Hosangadi had strong leaders to motivate and organise. However, the leaders worked towards setting up institutions and were not leader-oriented which highlights sustainability.
- Initiatives and approaches varied between villages but both worked towards strengthening institutions by laying acceptable and rational rules and conducted regular meetings giving voice to majority of the people.
- Transparency and accountability at every stage made it simpler and easier to manage. Documentation was done meticulously and available for scrutiny.
- Water conservation was not the focus but as the institutional set up was strong, it was easier to add on other dimensions.
- Bringing about a change in the mindset of the people in accepting water as a priced good in place of social good and a non-renewable resource was attempted largely in all the villages. Emphasis on avoiding wastage added on to the positives.
- Formal formation of VWSC does not serve the purpose unless all the members of the VWSC, and particularly the president who heads the VWSC, understand its objectives and aims.
- Problems regarding operation and management needs to be sorted out more clearly. Responsibility and active involvement is lacking among the VWSC members and is evident with such instances.
- Unless there is absolute strengthening of the VWSC as an institution, it is difficult to sustain and manage water supply through the VWSC.
- Active involvement of people is important for better impact.

Options

Apart from addressing the management issues, it is important to adopt relevant technologies in managing water supply problems. Some possible options are explained below.

Rainwater harvesting can play a versatile role in villages and cities. It will provide supplement water for houses, institution and industries. It will help to recharge groundwater and prevent water salinity in coastal aquifers. More awareness programmes can be initiated by involving experts in the field. For instance, environmentalists like Sri Padre have an impressive collection of slides and photographs, and have put up more than 200 slide shows on rainwater harvesting, mainly for farmers and students. He has done studies on 'surangas' (man-made caves for water), a unique traditional water harvesting system of Kasaragod of South India's Kerala state; and 'madakas' (traditional percolation ponds) of coastal Karnataka and Kasaragod, which have by now almost vanished. He emphasises on in-situ, low-cost methods of harvesting rain that can be implemented without subsidies and external help (http://www.farmedia.org/profiles/padre_interview.html).

Desalination plants augment the supply of scarce potable water and there is great potential for desalination in the coastal areas. A desalination plant of high capacity can be installed whereas a low capacity one can be mobile. The Bhabha Atomic Research Centre (BARC) has discovered various methods of desalination, which include Reverse Osmosis (RO), Multistage Flash (MSF), Low Temperature Evaporation (LTE) among others. BARC has set up several small desalination plants in rural Rajasthan, Gujarat, Andhra Pradesh and Tamil Nadu that produce 30,000 liters of drinking water per day. But, the cost is a factor that is still ambiguous and efforts are on to make desalination more cost-effective. The government has also realised that relying on groundwater sources will not help. Therefore it is taking

an initiative to promote desalination projects to facilitate drinking water supply in costal areas. One such project, which is being considered for implementation, is a Rs 1,000 Crore plant in Chennai. The government has also approved a Rs 9 crore desalination plant at Bheemunipatnam in Andhra Pradesh. States like Orissa, Tamil Nadu and Pondicherry are also being considered for similar projects (http://www.projectsmonitor.com/detailnews.asp?newsid=9129).

Options during power scarcity

To provide safe drinking water in coastal rural areas and islands, where power supply is limited, the National Institute of Ocean Technology (NIOT), Chennai, an autonomous body under Department of Ocean Development, has developed an experimental demonstration desalination plant of 5000 litre per day capacity, based on the Low Temperature Thermal Desalination Process. This technology will use cold deep-sea water and warm sea surface water for desalination at much lower temperatures. This technology is relatively clean, as it does not require any chemical treatment and expected to be cost effective in remote coastal areas. During the next few months, NIOT will establish a one lakh litre per day capacity desalination plant in Kavaratti, Lakshadweep. (http://dst.gov.in/whats_new/press_releases05/upagov.htm)

Desalinating cooling water from power plants - Girye in Maharashtra, Tadri in Karnataka and Mundra in Gujarat are coastal areas where water for cooling purposes can be drawn from the sea. The normal practice in 'once through cooling' process for turbines is to let the extra water at higher-than-normal temperature to flow into the sea. However, with serious water shortage, it is also becoming economically viable to desalinate the cooling water with power drawn from the power plant itself. One by-product of the process is salt, which can be put to industrial use (http://www.thehindubusinessline.com/2006/06/21/stories/2006062100391000.htm).

Developing saline/brackish aquifers - Yields of many crops, vegetables and fruit plants e.g. barley, dates and pomegranate, when irrigated with saline or brackish water are not significantly affected. Saline/ brackish water can be successfully used to irrigate such plants and fresh or good quality water can be saved for use by other sensitive crops or for other uses. However, there is need to develop new salt-tolerant crops and improve the tolerance capacity of existing crops. Studies conducted by various workers have revealed that poor quality water could be used in drip irrigating tomatoes and potatoes without much deterioration in yield and quality. Using a blend of fresh water and saline water for domestic water supply saline water can be used after blending with fresh water for uses other than drinking (http:// cgwb.gov.in/KnowledgeBase.htm).

Proper regulations needed- Erosion of land, whether by the sea in coastal areas or by river waters inland, should be minimised by suitable cost-effective measures. The States and Union Territories should also undertake requisite steps to ensure that indiscriminate occupation and exploitation of coastal strips of land are discouraged and that the location of economic activities in areas adjacent to the sea are regulated. Each coastal state should prepare a comprehensive coastal land management plan, keeping in view the environmental and ecological impacts, and regulate developmental activities accordingly. (http:// ces.iisc.ernet.in/energy/Lake2002abs/ses186.html)

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