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SUSTAINABLE MANAGEMENT OF DRINKING WATER SOURCES OF COASTAL AREA IN TAMIL NADU –AN OVER VIEW

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ABSTRACT

This paper is aimed at understanding the drinking water status and management approaches adopted in coastal area of Tamil Nadu. 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.

1. INTRODUCTION

Groundwater plays a vital role as important source of drinking water in rural and urban areas of India. According to some estimates, it accounts for nearly 80 per cent of the rural domestic water needs, and 50 per cent of the urban water needs in India. Naturally surface water bodies are highly subject to contamination and pollution whereas groundwater is less susceptible. Over exploitation of groundwater is causing pollution of this priceless resource. Groundwater pollution is a challenging global problem. Particularly people, who are living near to coastal areas, are facing a struggle to have safe drinking water. Nearly 25% of the population of India lives along the coastal zones.

Coastal regions are having both spatial and temporal variations in the groundwater characteristics. In these regions, the groundwater system is influenced by many factors in a particular site. Rainfall, landform, soil, litho logy, seawater intrusion and other anthropogenic activity are some of the factors determining the ground water quality in coastal region. The quality of ground water has become vulnerable in coastal areas mainly due to salt water intrusion. This is because of rigorous pumping of fresh ground water. In India, sea water intrusion is observed along the coastal areas of Tamil Nadu.

The Stalinization processes in coastal area is very complex which may be due to multitude of factors viz., sea water intrusion, prawn culturing and pollution phenomena.(Morell et al., 1996).

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 a resource 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 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 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 groundwater was observed in Mangrol - Chorwad areas and coastal Saurashtra of Gujarat, Minjur in Tamil Nadu, 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 in sights. 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 have been local, it is important to understand that the problems need to be addressed from a larger perspective to curtail long-term effects.

2. TAMIL NADU COASTAL AREAS

Coastal environment plays a vital role in nation's economy by virtue of the resources, productive habitats and rich biodiversity. India has a coastline of about 7,500 kms. The coastline of Tamil Nadu has a length of about 1076 kms constitutes about 15% of the total coastal length of India and stretches along the Bay of Bengal, Indian Ocean and Arabian Sea. The Tamil Nadu coast is straight and narrow without much indentation except at Vedaranyam. Fringing and Patch reefs are present near Rameswaram and Gulf of Mannar, Pitchavaram, Vedaranyam and Point Cali mere have well developed mangrove systems .In Tamil Nadu about 46 rivers drain into Bay of Bengal forming several estuaries adjoining coastal lagoons. The Cauvery River and its tributaries form a large delta supporting extensive agriculture. The other landforms of the Tamil Nadu coast are rock outcrops of Kanyakumari, mudflats, beaches, spits, coastal dunes and strand features. Deposition is observed at Point Cali mere, Nagapattinam, South Madras, etc.**(Anon, 2005. To review the coastal regulation zonenotification 1991. Ministry of Environmental Forests, 116pp.)**

3. RAINFALL IN TAMIL NADU

Tamil Nadu has 3 distinct periods of rain fall. It receives a little rainfall during the monsoon season (from June to September). It receives its maximum rainfall during the North-East monsoon or what is popularly known as winter rains (from October to December).It also receives a little rainfall during the dry season (from January to May).Under normal conditions the state receives bout945 mm (37.2 in) of rain. Since the state is entirely dependent on rains for recharging its water resources, monsoon failures lead to acute water scarcity and severe drought.

A little about Tamil Nadu's water resources:

Though Tamil Nadu is largely a dry region it has several perennial rivers - Palar, Cheyyar River, Ponnaiyar, Kaveri, Meyar, Bhavani, Amaravati, Vaigai, Chittar River & Tamaraparani and afew non-perennial onestoo - the Vellar, Noyal, Suruli, Gundar, Vaipar, Valparai and Varshali.Canals, tanks and wells are the main sources of irrigation for farmers in the state. As of2005-2006,the state had 2395 canals with a length of 9,747 km, 40,319 tanks, 670ordinary government wells, 1,620,705ordinary private wells and 290,611 tube wells.

Method and techniques of groundwater recharged

There are many methods and techniques to recharge groundwater aquifers. These techniques can be designed to function in most settings, from hard surfaced areas to soft landscaped features. There are a variety of design options available which allows us to tailor and customize it to local land use, future management and the needs of local people. The range of options means that the various options have to be actively considered keeping in mind the needs and wishes of the local users and stakeholders and the specificity of the region and conditions. A quick look at the some of the different techniques:

Pits: Recharge pits are constructed for recharging the shallow aquifer. These are pits constructed 1 to 2 metres, wide and 3 metres deep which are filled with boulders, gravels, coarse andinlayers.

Trenches: These are constructed when the soil conditions are such that water easily percolates into the ground. Trench may be0.5 to 1 metres wide, 1 to 1.5 metres deep and 10 to 20 metres long depending up availability of water. These are filled with different filter materials like boulders, gravels, coarse sand in layers.

Dug wells: Existing dug wells maybe utilized as recharge structures and collected water can be directed into them. The water should pass through filter media before directing into dug well, so that only clean water goes into the well.

Hand pumps: The existing hand pumps may be used as recharge structures for recharging the shallow/deep aquifers, if the availability of water is limited. Care The collected water should be filtered before diverting it into hand pumps.

Recharge wells: Recharge wells of 100to 300 mm. diameters are generally constructed for recharging the deeper aquifers and filtered water is directed into these.

Recharge Shafts: These are ideal in regions with clayey soils and where the aquifer in located underneath these clayey surfaces. Recharge shafts of 0.5 to 3 metres diameter and 10 to 15 metres deep are constructed and filled with boulders, gravels& coarse sand and collected water is directed into these.

Lateral shafts with bore wells: For recharging the upper as well as deeper aquifers lateral (horizontal) shafts of 1.5 to2 metres wide &10 to 30 metres long are constructed. The lateral shaft is filled with boulders, gravels & coarse sand to ensure that clean water gets into the shaft.

Spreading techniques: These techniques are used when soil is loose and easily permeable. Water is spread the by constructing streams, check dams, nala bunds, cement plugs, gabion structures or a percolation pond etc.

4. TAMIL NADU GROUND WATER QUALITY

Tamil Nadu has its share of problems with ground water quality. The main problems it faces are of salinity (inland salinity as well as coastal salinity) and Fluoride content in its ground water resources. The districts most affected by salinity are Karaikal and Pondicherry, Nagapattinam, Pudukottai, Ramanathpuram, North Arcot, Dharamapuri, Salem, Trichy and Coimbatore. The fluoride content is high in the areas of Dharampuri, Salem, NorthArcot, Villipuram, and Muthuramalingam.

5. THE TAMIL NADU GOVERNMENT'S POLICY ON CONSERVATION AND MANAGEMENT OF WATER

The following paragraphs have specifically been included to show the seriousness with which water conservation and management issues are being perceived at different levels. Traditionally, there have been many systems for managing water. In contemporary times many NGOs have done excellent work in promoting awareness on water issues and provide alternatives and solutions to the same. Now the government has included water conservation and management in its agenda and we can only hope for the best. The State Government of Tamil Nadu has passed an Act namely "Tamil Nadu Ground Water (Development and Management) Act, 2003" which includes provision of Tamil Nadu Ground Water Authority to regulate and control water development in the State of Tamil Nadu.

It provides for Ground water development and states that:

1. There should be a periodical reassessment on a scientific basis of the ground water potential, taking in to consideration the quality of the water available and economic viability.
2. Exploitation of ground water resources should be regulated so as not to exceed the recharging possibilities, as also to ensure social equity. Ground water recharge projects should be developed and implemented for augmenting the available supplies.

3. Integrated and coordinated development of surface water and ground water and their conjunctive use, should be envisaged right from the project planning stage and should foreman essential part of the project.
4. Over exploitation of ground water should be avoided near the coast to prevent ingress of seawater into sweet water aquifers.

Norms for providing drinking water:

Under the Rural Water Supply Programme, the norms are to provide 40 liters of water per day per person, in the rural areas. These norms are arrived at with the following breakups: 3 liters for drinking, 5 liters for cooking, 15 liters for bathing and 17 liters for other purposes. It also states that "wherever sources permit, a norm of 55 lpcd is adopted with provision for individual house service connections in such habitations".

Status of Rural Water Supply

The policy notes state that periodical surveys are conducted in the rural areas to assess the status of water supply. Based on the levels of supply, rural habitations are classified into four categories as 'not covered', i.e. habitations with no supply; 'no safe source', i.e. habitations affected with quality problems; 'partially covered', i.e. habitations with supply below 40 lpcd; and' fully covered', i.e. habitations provided with40 lpcd.

Traditional Systems of harvesting rainwater

Every village in Tamil Nadu had three water bodies: one for irrigation, one for cattle and an Oorani (pond) for drinking water. All three are rain-fed. Many villages' have survived centuries because of the secatchment bodies.

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The traditional systems are a well recognized fact, as this has been given as an example in the - Xl-five-year-plan (Rural Drinking Water and Sanitation in the Eleventh Plan period - Excerpts).

Lifelines of Tamil Nadu: Kanmo is and Ooranis

Kanmois are traditional tanks with earthen bunds constructed many centuries ago. They are large surface water stores that collected and stored surface water run-offs. They largely supported and were used for agricultural purposes as well as for drinking water. Ooranis are small ponds that have collected rain water from rains and from surrounding catchment areas. These Ooranis traditionally were used for various needs of drinking, washing, bathing needs of the villages around it. Oorani is a Tamil word meaning village pond. It is an institution as old as Tamil society. Poet Thiruvalluvar referred to them2000 years ago. Ooranis were usually endowed by ruling or merchant princes. Beneficiaries were involved in excavation and maintenance. They developed a sense of ownership. After Independence thegovernment departments took over every aspect of village management and Ooranisfell to neglect. Perumthottam Tank, Sirkali Taluk A pond - Oorani - in a village - defunct and unused

6. ROOF-TOP RAIN WATER HARVESTING

A Rainwater harvesting system is made upof the cycle of "Harvesting - Carrying -Filtering -Storage - Use".

1. Harvesting

We normally come across two types of harvesting structures, one is RCC slab flat roof and the other is traditional sloping roof system. However for this example we are considering flat roofs of roughly 35 square meters (350 sq Feet) that have been typically built in the Tsunami reconstruction effort.

2. Carrying

In case of a flat-roof, a PVC pipe or Cement pipe is appropriate and advisable

3. Filtering

Rainwater is a pure form of water, free of any biological & bacterial contamination. However, when it rains some suspended impurities in the atmosphere get dissolved in the rain. To prevent any form of contaminations of the water stored in the tank, these impurities need to be filtered out. This filtering is carried out in two stages:

First-Rain separator:

The first rain separator is a built-in plumbing system that separates the first few minutes of the rain.

4. Filter:

After the first rain separator, the rain water will still carry suspended impurities. These need to be filtered out. This can be done with a simple sand - stone- charcoal filter. Even a clean folded cotton cloth placed in a sieve acts as an effective filter. Storage The last component which completes the Rainwater harvesting system is the storage system. The water from filter is directed and stored in the storage-system for day to day use. Typically one can go for either of the following types of storage systems:

a. Individual tank based system where the water is stored into brick/stone masonry tank or pre-cast Ferro cement tanks or Polypropylene tank (popularly known as Sintex tanks)
b. Surface Storage systems like ponds, tanks, etc.
c. Underground storage systems: mainly charging the existing aquifers through directing the water into hand-pumps, Dug wells, Pits and / or Trenches

5. Use

Water stored in any of the systems is fit for use. It can be used on a day to day basis for all needs. For drinking and cooking, one will need to take standard care processes to clean and decontaminate the water.

Storm water run-off

Storm water run-off is the volume of water generated by a storm that does not infiltrate in to the ground or is not retained in storage as surface water. As the name suggests, it runs off. Run-off flows overland during and following a rainfall, picking up material along the way as it moves downgrade to a river, stream, lake or reservoir. The volume of storm water run-off is related to the amount of impervious surface areas in a watershed. Impervious areas are those areas which do not allow water to seep into the ground. Urbanization and the resulting increase inland area devoted to parking lots, rooftops, and additional roads is the primary source of increases in storm water run-off. Storm water run-off occurs over a very small percentage of the total land area, yet it is responsible for a majority of the surface water pollution.

As urbanization occurs, the speed with which a drop of water in a remote area of the watershed can make its way to the receiving surface water (i.e., streams or lakes) is increased considerably. Not only is it quicker for water to flow over paved surfaces versus natural soil, but storm sewers further expedite drainage into the nearest lake or river. A drop of water that used to take hours or days to make its way through a watershed to a channel is now there in a matter of minutes or hours.

Effects of increased storm water run-off

The increase in storm water run-off has its consequences. The increased speed with which the storm water run-off enters the receiving rivers and streams means that channels flood more frequently in response to relatively small storm events. This concept is easily illustrated by a stream hydrograph, a measure of the amount or volume of water passing by a point on a stream over time. As seen on the conceptual hydrographs presented, increased run-off causes the volume of water to increase rapidly, pushing the peak discharge of the stream much higher for the same storm event. The higher the discharge the more power the stream has for erosion, and thus the channel becomes unstable and begins to incise or widen to accommodate the new peak discharge. Unstable channels jeopardize the stability of bridges and other structures located along stream channels.

The same storm event results in two different run-off regimes. Increased development, increases the area covered by impermeable surfaces, so the volume of storm water run-off increases and also reaches its peak volume sooner after the initiation of the run-off event. Storm water itself is a concern when present in large quantities. Storm water can be detrimental to the environment due to the sheer volume of water that falls into an area. Storm water detention measures, porous pavement, and subsurface infiltration/detention measures all reduce the volume and speed of storm water entering natural systems. Storm water management measures that promote infiltration and not just detention also promote ground water recharge, an important component often overlooked in storm water management plans. Storm water run-off picks up a variety of pollutants that degrade the quality of surface waters. Sediment is by far the most visible and common pollutant carried by storm water run-off into rivers and streams.

Sediment has drastic effects on aquatic life living in the stream and also causes increased dredging and decreased reservoir capacity over the long term. The impacts to our waterways from unchecked storm water run-off are substantial. The consequences are not only biological, but economic as well as aesthetic. Populations of fish and other aquatic organisms decrease, the capacity of the water bodies to store water decreases, water bodies get polluted etc. There are, however, steps that can be taken to mitigate these impacts. There are various measures which can be taken to manage torrid water. Storm water management measures that promote infiltration and not just detention also promote groundwater recharge, an important component often overlooked in storm water management plans; Strom waiver management constitutes filtration systems and infiltration systems.

Storm water management techniques Swales

Swales are simply shallow, low depressions in the ground designed to encourage the accumulation of rain during storms and hold it for a few hours or days to let it infiltrate into the soil. Swales ideally are tree-lined and store water for the immediate landscape as well as help cleanse the water as it percolates down. Swales can be installed separately or as part of a larger water rain catchment system with other water conservation measures. Swales on slight slopes can also be used to direct water away into percolation pits that will charge the ground water. Swales dug into even the gentlest of slopes will fill with water after every good rain and allow the moisture to percolate deep into the soil over a day or more.

This charges the subsoil over several years allowing the trees planted into the mound to thrive even during the driest of times. Also known as infiltration swales, bio filters, grassed swales, or in-line bio retention, bio swales are vegetated open channels specifically designed to attenuate and treat storm water run-off for a defined water volume. Like open ditches, they convey larger storm water volumes from a source to a discharge point, but unlike ditches, they intentionally promote slowing, cleansing and infiltration along the way.

Types of swales

Grassed Channels

These are similar to a conventional drainage ditch, with the major differences being flatter side slopes and longitudinal slopes, and as lower design velocity for water quality treatment of small storm events. Grass channels are the least expensive option. Grass channels should be designed to ensure that run-off takes an average of ten minutes to flow from the top to the bottom of the channel.

Wet Swales

These swales intersect the groundwater, and behave almost like a linear wetland cell. The design variation incorporates a shallow permanent pool and wetland vegetation to provide storm water treatment. Wet swales are rarely used in residential settings because the shallow standing water is often unpopular with homeowners.

Dry Swales

Dry swales incorporate a deep fabricated soil bed into the bottom of the channel. Existing soils are replaced with a sand/soil mix that meets minimum permeability requirements. An under drain system is also placed under the soil bed. Typically, the under drain consists of a layer of gravel encasing a perforated pipe. Storm water treated by the soil bed flows into the under drain, which conveys treated storm water back to the storm drain system

Benefits of using swales

Improves water quality Cheaper to construct than piped systems can be incorporated into the landscape
Low maintenance visible operation need for water conservation and water management cannot be over-emphasized.

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 in Tamil Nadu.

7. CONCLUSION

To conclude, the study provides evidence for holding that the institutional factors are just as important as sustainable management of drinking water source and quality - for the successful working of a sustainable demand-driven rural water supply system. This indeed provides a benchmark for analyzing the observed phenomenon of the regress in rural water supply in India - popularly known as falling back, from 'covered to uncovered villages' especially those in large scale, provide ample opportunities to put good practices in place. Reconstruction activities, also undertaken in a focused manner and in a short period of time, provide opportunities for low impact development that become examples to conventional development processes. There are many techniques and methods, traditional and modern that can go a long way in mitigating the water problems in Tamil Nadu. It requires a concerted effort and will from all stakeholders.

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