RECHARGE OF VANUR AQUIFER

A proposal for the IAMWARM Project

PROJECT ABSTRACT

This program aims at maintaining a proper hydrological balance in Vanur aquifer, by recharging ground water through artificial methods. The project will be implemented in Vanur Taluk, where the groundwater resources are seriously depleting and threatened by sea water intrusion. The program targets the Vanur sandstone coastal aquifer, which is the main aquifer of the region and source of irrigation for the agriculture of Vanur block. Moreover, this aquifer is also supplying the city of Tindivanam.

INTRODUCTION

This project is situated in the heart of the area where Harvest is currently operating since 1996 with different partners. The area is part of the UNESCO Help program.

This area, consisting of the Kaluvelly watershed and a sub-watershed covering the Pondicherry territory and adjacent parts of Tamil Nadu, is the subject matter of a larger program targeting to develop and revitalize the water management in this sector, in partnership with the local authorities, the NGOs, the beneficiaries and the scientists. All the engineering and social work are shared with all the different local stakeholders. Auroville Water Harvest is one of the leading agency implementing projects in this area. Through its communication efforts and the support of international scientific organisations, this area is part of the UNESCO Help Basin Program, itself part of the International Hydrological Program of UN. The program of Harvest includes rehabilitation of irrigation tanks and drainage structures, building up some dams in canyons, awareness, social mobilization, creation of users associations, education, training to appropriate technologies in water management and soil, promotion of alternate crops and innovative agricultural water saving practices, income generation, pollution mitigation, amelioration of sanitary conditions, and scientific evaluation.

A considerable volume of water runoff is generated from the rocky area of Kaluvelly watershed. Due to poor storage facilities and meagre infiltration potential, this water is massively lost to the sea after passing through Kaluvelly swamp where it is drained to. At the same time, the sedimentary area of the watershed, and chiefly the Vanur outcropping formation, is offering great scope for groundwater recharge and storage while it is nowadays heavily depleted due to over extraction.

The need for aquifer recharge

Increasing demand for water, particularly in arid and semi-arid regions of the world, has shown that the extended groundwater reservoirs formed by aquifers are invaluable for water supply and storage. Natural replenishment of this vast supply of groundwater is very slow. Therefore, exploiting groundwater at a rate greater than it can be replenished causes groundwater tables to decline and, if not corrected, eventually leads to mining of groundwater. Artificial recharge as a means to boost the natural supply of groundwater aquifers is becoming increasingly important in groundwater management.

Groundwater can have a wide range of beneficial uses. For example, it can be used for irrigation of parks or agricultural land, industrial application, or to provide a potable water supply (i.e. one that is suitable for drinking).

Types of recharge

Artificial recharge involves augmenting the natural movement of surface water into underground formations. The recharge can be either direct or indirect. In direct recharge, water is introduced into an aquifer via injection wells. The injected water is treated to ensure that it does not clog the area around the injection well. Indirect recharge involves spreading surface water on land so that the water infiltrates through the vadose zone (the unsaturated layer above the water table) down to the aquifer. Methods for spreading water include over-irrigation, creating basins using construction methods, or making artificial changes to natural conditions (e.g. modifying a stream channel). An advantage of indirect recharge is that the vadose zone acts as a filter, treating, and therefore improving the quality of, the water percolating through the soil. This process is referred to as soil aquifer treatment.

Recharge can be intentional or unintentional. Injection of treated wastewater would be an example of direct intentional recharge; whereas, infiltration of water used for agricultural irrigation would generally be an example of unintentional indirect recharge. Unplanned indirect reuse for potable water supplies is increasing, due to municipal water intakes located downstream from wastewater discharges or increasingly polluted rivers and reservoirs.

OBJECTIVES

It is proposed to investigate the potential for massive groundwater recharge and to develop the necessary structures to divert part of the runoff to the potential recharge area and to recharge safely the aquifer.

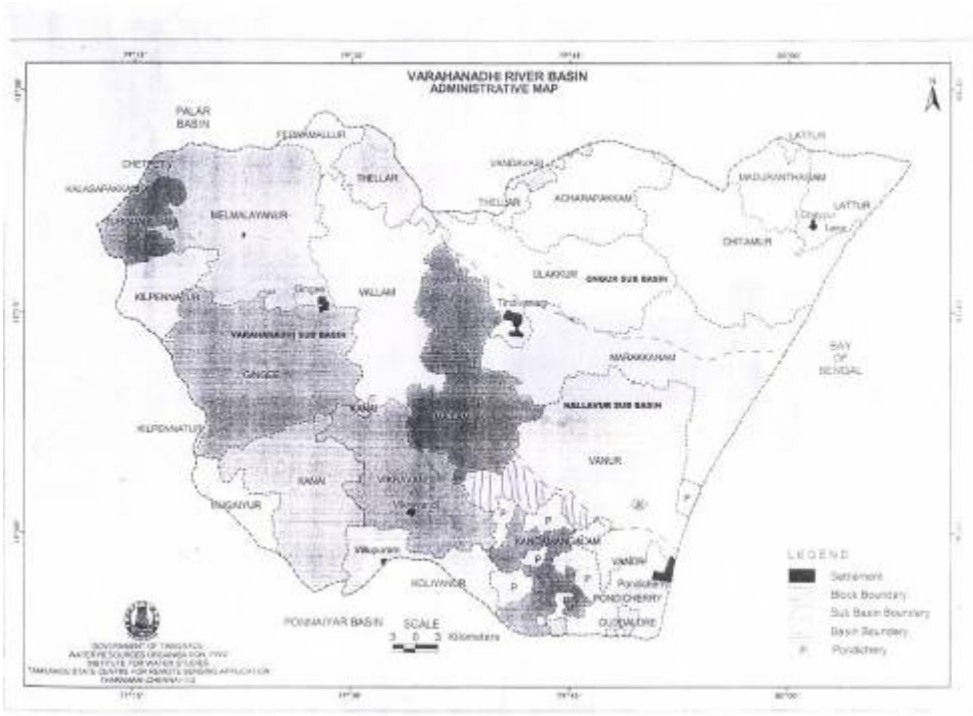
The initiatives taken within this project will act on the global ecological system. The project aims to modify the natural resources capacities as well as their usage. The actions implemented will directly improve the water resource situation as the project considers environmental and social aspects, and targets all the parameters of the problem. The scientific knowledge developed on the hydrogeological conditions of this region will help to define suitable and practical solutions. We will tackle the surface runoff, thus leading to a maximization of rainwater harvesting capacities in the area, and large increase of groundwater recharge by appropriate recharge structures on the waterways and in the fields.

The project area is the natural recharge zone of the main aquifer of the region, Vanur sandstone aquifer. This aquifer is severely threatened by over exploitation and potential future sea water intrusion.

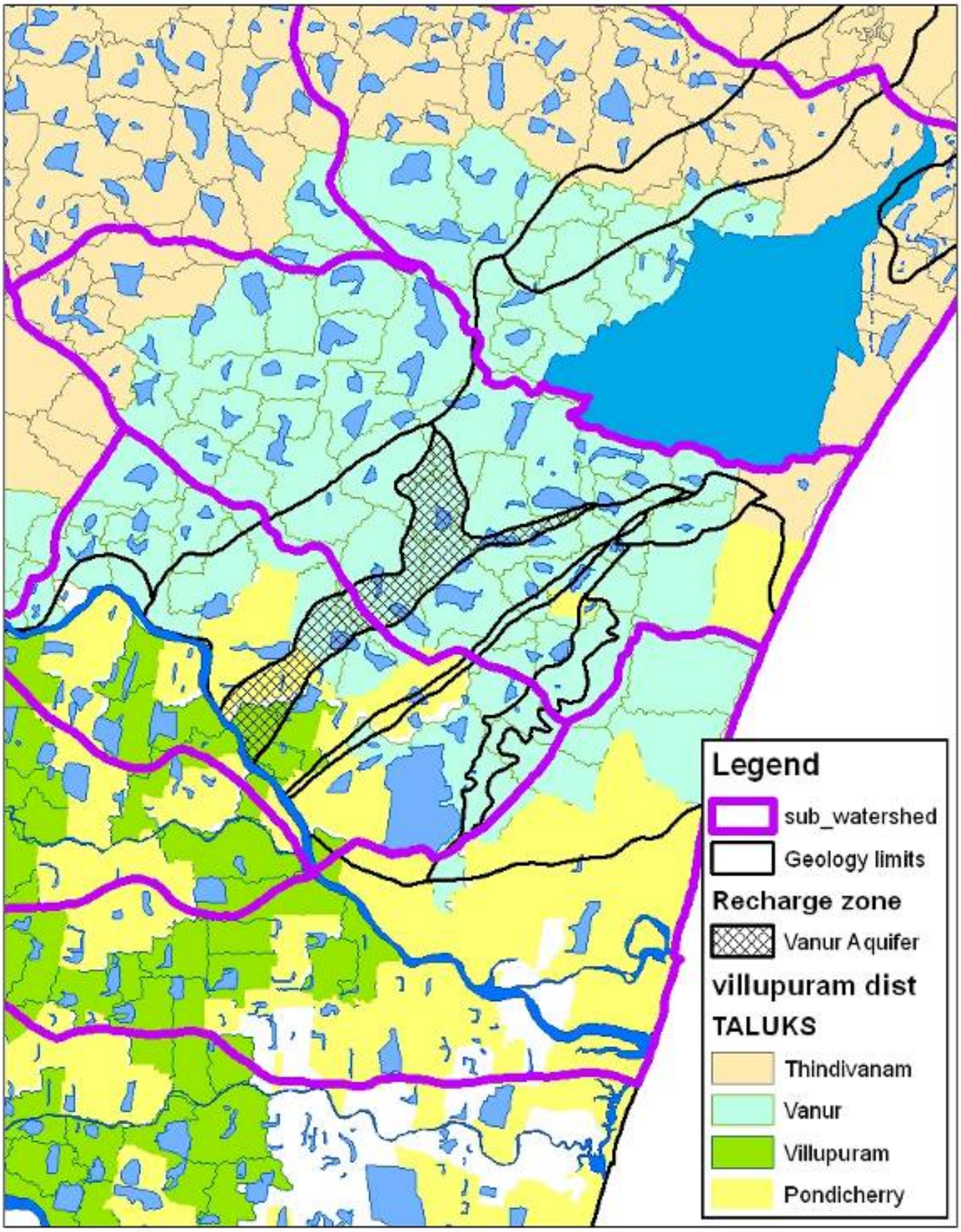
At the environmental level, the impact of the project will be strengthened by these geographic characteristics and should improve the groundwater situation on an area evaluated to 5 to 10 times the project area, with the related population. The benefits of the project will hence be extended to a much larger area due to the general improvement of the whole local ecosystem.

Looking at the geographical and social context, this project will have major impact on a much larger area as it is situated on the recharge area of the main local aquifer, supplying about 260sq.km with its rural population, about 80 000 people, and also supplying the city of Tindivanam. It is also a key area as far as seawater intrusion risk concerned, as it is locking the groundwater flow.

The Vanur aquifer recharge zone is directly under the Varahanadi river basin included in the IAMWARM project.



Map 1: location maps Varahanadi river basin - IAMWARM project



Map 2: Project Area

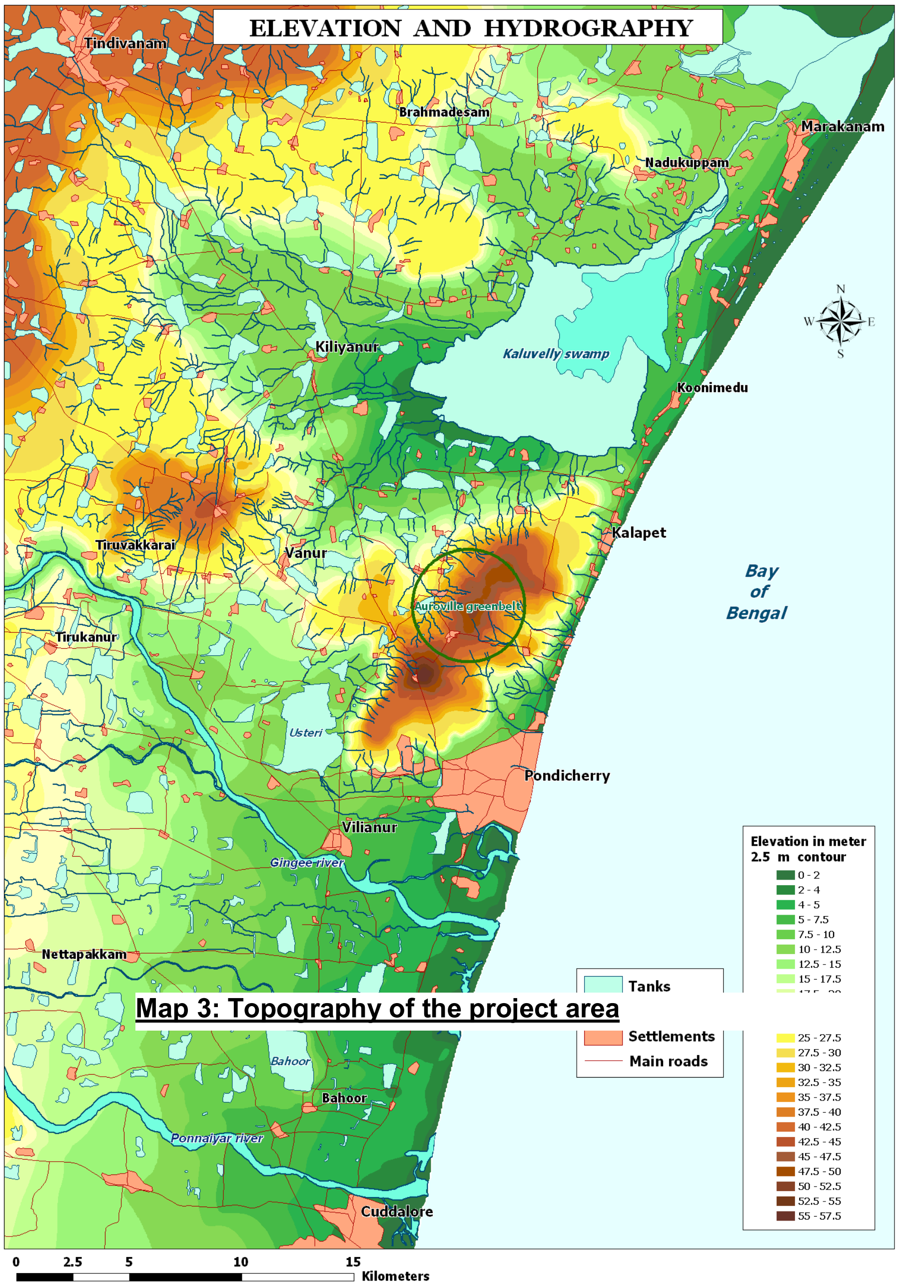
PROJECT CONTEXT

SCIENTIFIC ASSESSMENT ON THE PRESENT SITUATION

1.1 Physiography and drainage

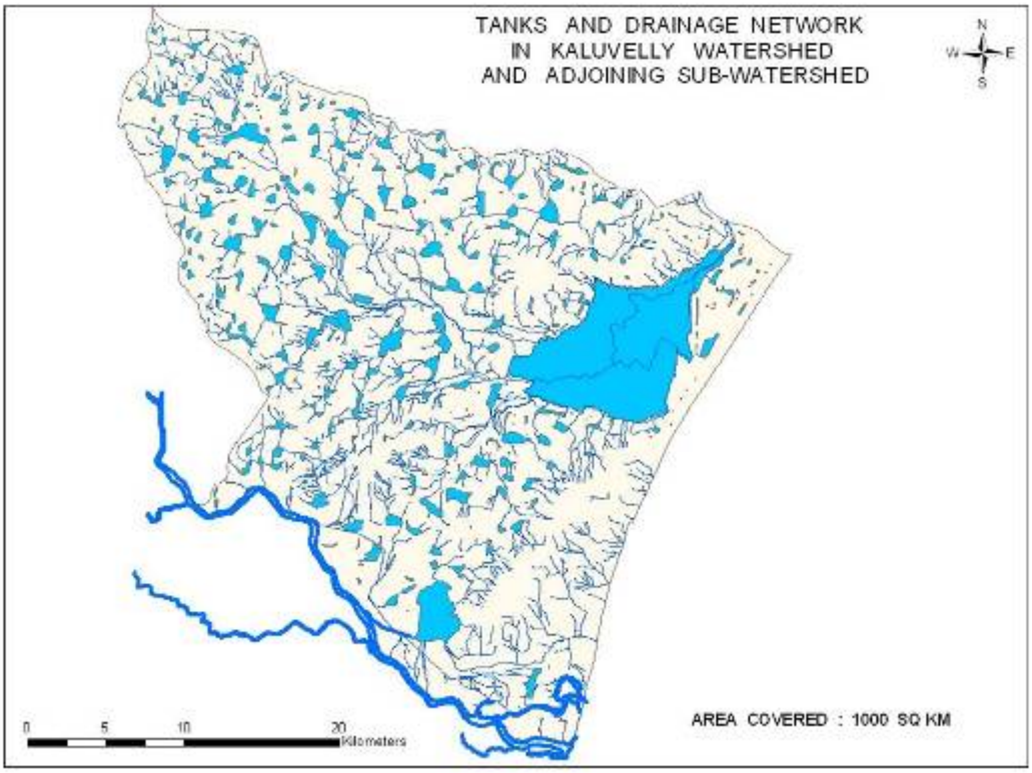
Apart from a small portion on the plateau of Auroville, the entire watershed area is flat lands, with an average slope of 0.7%, more favorable for infiltration and siltation.

The average altitude is of 15 m above mean sea level (msl).



Map 3: Topography of the project area

The watershed has no perennial river. The run-off is happening during rainfall events of the monsoon season. The drainage is constituted by the network of the village irrigation tanks, where water flows through the channels that link one to another, by feeder channels and surplus outlet channels towards the Kaluvelly swamp, which is located northeast of the project area. The swamp serves as the ultimate drain for the runoff water from the project area from where the water goes to the sea.



Map 4: Drainage network

Each tank and channel has a direct catchment area and a combined catchment area including the upstream tanks and their catchment. The geographic shape of the watershed can induce heavy run-off at the outlet of the watershed due to the concentration of flows, with run-off water from all the micro-watersheds reaching the outlet during the same period of time.

Lots of tanks have a limited capacity and need to be rehabilitated. This is due to the natural siltation process of the storage lake and its feeder channels, as well as open breaches happening in the bunds and channels. Encroachment by farmers on the catchment areas and channels are also reducing the storage capacity. Through time this tank network system has slowly degenerated, affected by various natural process combined with a severe lack of maintenance. The result today is a hydrological system affected by degradation, with various problems taking place.

- An important siltation due to the topography, the change of land cover and agricultural practices, resulting in changes of flow.
- Higher risks of flood as a consequence of changes in land use , deforestation, change in the regulation of flows, degradation of the channel network system.

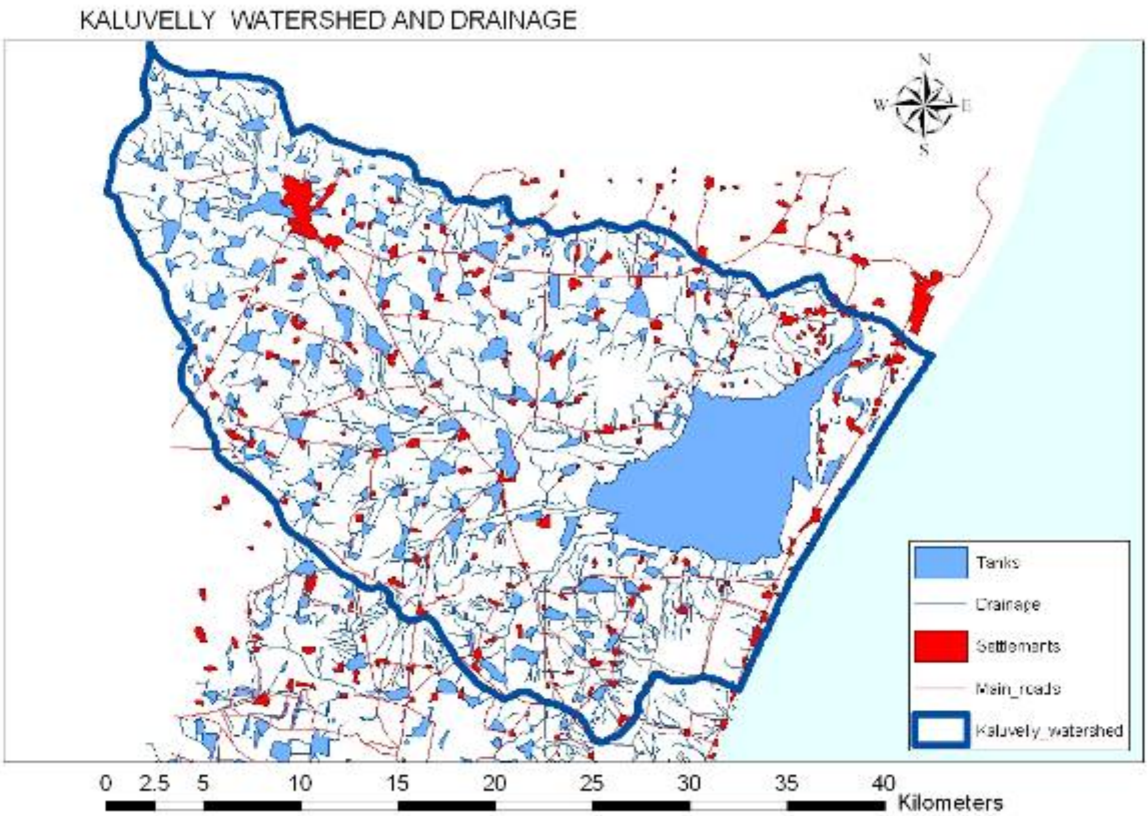
1.2 The Kaluvelly Swamp

The Kaluvelly Swamp is the second largest wetland of South India. It is a large triangular coastal swamp near Marakanam of Tindivanam Taluk of Villupuram District and is formed by a natural low-lying area boarded at the downstream side by a defunct gated weir. The surrounding area is a plain terrain with gentle undulating slopes towards east, having a number of small streams and channels. The swamp is fed by rainfall directly through these channels, via excess flow from other tanks or from irrigation return flow from surface and groundwater schemes. From the gated weir, the water flows northward through a 8 km tidal creek into Yedayanthittu Swamp (or Kodhadu Swamp) and subsequently mounds into the sea about 10 km north of Marakanam. The Kaluvelly swamp is a non tidal seasonal brackish water habitat. It is usually fills up totally during the winter monsoon but gets drained after a few weeks only.

Map 5: General Context

1.2.1 Hydraulic Particular of Kaluvelly Swamp

Free Catchment	116.40 sq. km
Combined catchment	754.69 sq.km
Intercepted catchment	638 28 sq.km
Equivalent catchment	744.07 sq.km
Storage of Swamp	33.82 M cu.m
Area of Swamp	70.47 sq.km
Total number of tanks in the catchment area	196 numbers



Map 6: Kaluvelly watershed & Drainage

At its highest level, the swamp has a water surface of 70.5km^2 with a largest width of 10.5km and a largest length of 12.8km. The total run-off from the 755km^2 catchment area is 250Mm^3 whereas the storage capacity of the swamp is only 34Mm^3. The mean water level is about 0.91m.

The function of the gated weir was to protect the wetland from high tidal. As the swamp is very shallow, the water flush very rapidly to the sea and the left over evaporate quickly.

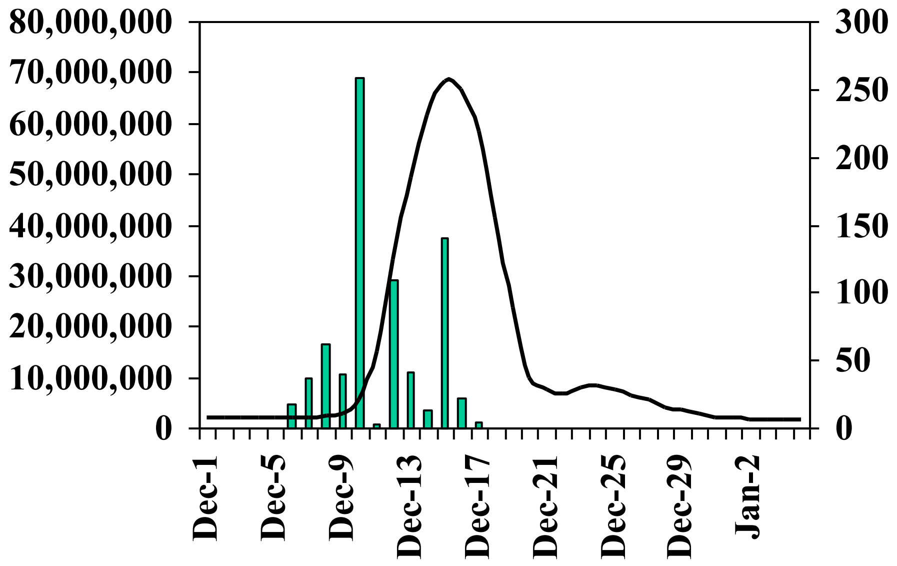


Figure 1: Runoff measurement vs. rainfall in liter/day at Kaluvelly swamp shutter in 1999

The lake and the estuary are state owned; adjacent land is partly private and partly owned by the state, and there are many areas of encroachment around the lagoon.

Many old-timers testify that Kaluvelly once supported a large and lush mangrove forest which was gradually cleared to make way for agriculture. There are now a variety of sedges, grasses, shrubs, trees and herbs interspersed with barren sandy areas and muddy margins. Aquatic plants germinate and grow when the lake receives rainfall during October and November.

The tank plays an important role in the migratory patterns of many bird species. Not only is it a staging point on the migratory flyway, but is also a breeding site to some migrants.

1.2.2 Runoff to Kaluvelly swamp

2005 water balance on sediments

- Rain (measured)	1647,1m	eq. 100%
- RET (Thornwaite formula)	872,9mm	eq. 53%
- Effective rainfall	772,2mm	eq. 47%
- Runoff (measured)	251mm	eq. 15%
- Infiltration & Storage	521,2mm	eq. 32%

We can then extrapolate the runoff for the entire watershed area for an average year, knowing by direct observation that the runoff is very fast and of short duration on the catchment area located on the rocky formation (limited infiltration, thin soil, shallow tanks).

Rainfall (average)	1250	mm
Total Catchment area	750	Sq.km
Catchment on rock	450	Sq.km
Catchment on sediments	300	Sq.km
Run-off on rock (25 %)	140.6	Mm3
Run-off on sediments (12 %)	45.0	Mm3
= > Run-off generated from the watershed	**185.6**	Mm3
Kaluvelly Tank Storage =	33	Mm3
Excess run-off from Kaluvelly watershed	**152.6**	Mm3

This is the volume of fresh water lost to the sea every year!

1.2.3 Traditional Subsistence

The villagers make diverse use of the wetland in traditional activities including

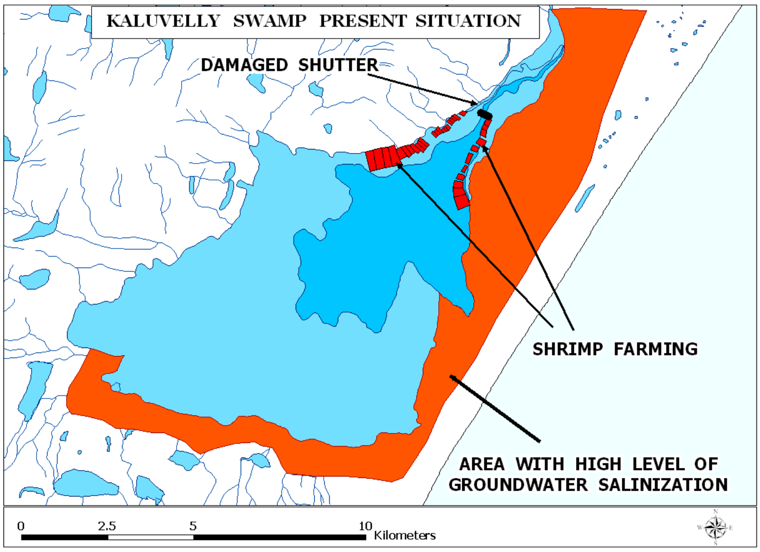
- Extensive fishing, especially during the high water level period.
- Reed and grass harvesting for building purposes, firewood and fodder.
- Cultivation of crops (mainly paddy) in the drier parts.
- Catching fresh and brackish water fish and prawns for consumption.
- Many species of plants are of economic importance to the local population.

The villagers have also used much of the flora in traditional systems of healing. The Kaluvelly watershed is also the protector of many temple tanks, associated legends and stories. There is an inherent symbiotic relationship between the Kaluvelly, its ecosystem, biotic components and the surrounding villages that has its basis in a rich spiritual tradition.

1.2.4 Threats to the Wetland

The fragile balance of the Kaluvelly ecosystem is being threatened by increasing commercial interests. The watershed area has greatly shrunk and continues to do so at an alarming rate due to encroachment by rice farms. Intensification of agriculture along with overgrazing and an increased use of fertilizers and pesticides in the vicinity and water drainage area of the lake have led to further contamination. It is a fragile micro-ecosystem and is highly vulnerable to inappropriate developmental activities.

Lately, the swamp is showing fast development of shrimp farms. Much vegetation has been destroyed and land has been dug up and bunded. Inlets of seawater leading into the tank have been dug to increase levels of brackish water. The antibiotics in these farms seep into the tank and kill much of the natural life there. The fragile fresh and seawater balance is also being destroyed. The prowling development of this activity cause major concern because of the very negative impact it has on livelihood of the population.



Map 7: Threats to Kaluvelly

1.2.5 Various alterations to the swamp under consideration

Because of the unique feature it offers, the Kaluvelly swamp is targeted for project proposals by many agencies, governmental and non-governmental, but alos private parties. According to the angle and field of interest of these agencies, the proposed alterations are as divers than:

- Restoring the full ecological and environmental setup by growing mangrove and forestry in and around he swamp
- Turning the wet land as a reservoir of fresh water for further supply to Chennai or other areas.
- Extending shrimp farming inside the swamp
- Reactivating and extending the Buckingham Canal through or on the edge of tank.
- Developing touristic facilities

Nowadays, the wetland is classified and can only be altered if at all with the sanction of the Environment Ministry. Accordingly, such proposals have little chances to be adopted if environment considerations are not taken care of, while some others like the extension of shrimp farming would be hopefully banned.

Anyhow, one can presume that any important development within this context would need to have very careful investigations and justifications on the financial benefit for the local population but also on the preservation and enhancement of the environmental and ecological features.

1.3 Hydrogeological conditions

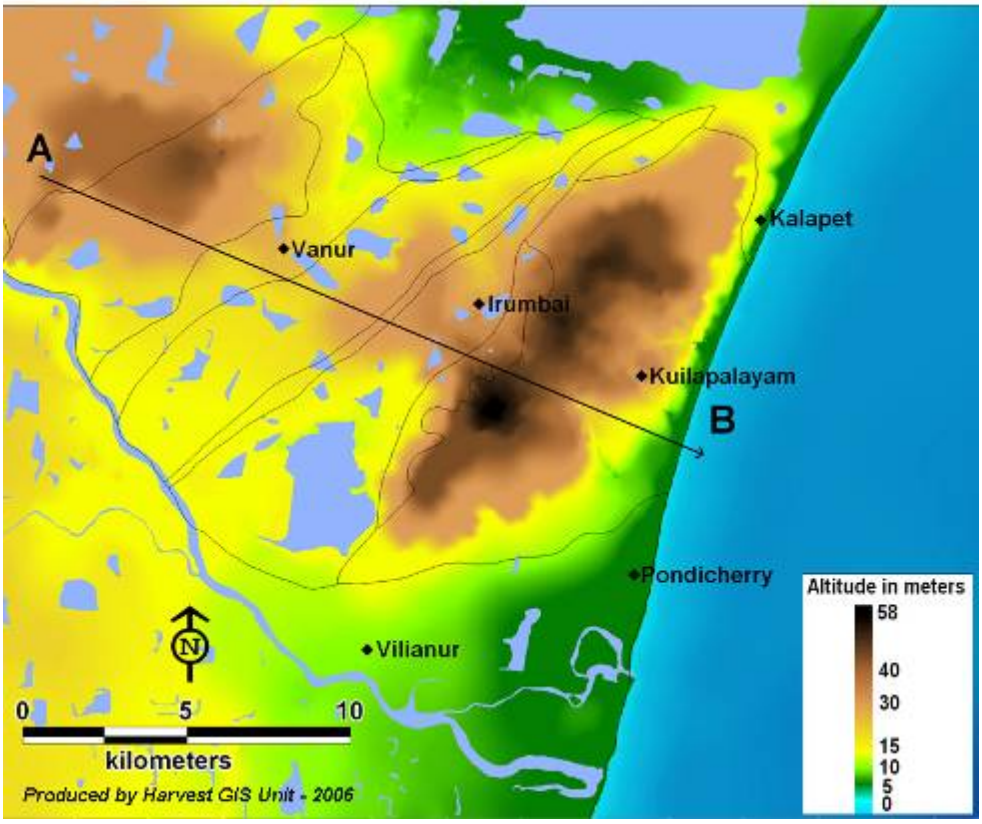
The Vanur sandstone of cretaceous period constitutes the potential aquifer in the project area. In the project area, the groundwater resource availability occurs in the intergranular pore space of the sandstone. Though some granular zone exists in the Ottai clay stone of cretaceous period, it may not form the promising aquifer because of its limited extend and poor permeability.

The Vanur formation is outcropping over 23 km^2 on the west part of the area, and is present as a captive aquifer below the Ottai clay layer on the east over 187 km^2. Its top depth on the coastal line is about 200 meters. The transmissivity ranges from $5.8*10^{-5}$ m^2/s to $2.0 *10^{-5}$ m^2/s (source NGRI 1987). Its important transmissivity is due to its high permeability and its thickness. A hydraulic connexion is possible with the Kaluvelly swamp, the sea, the rock basement and the intermediate formations.

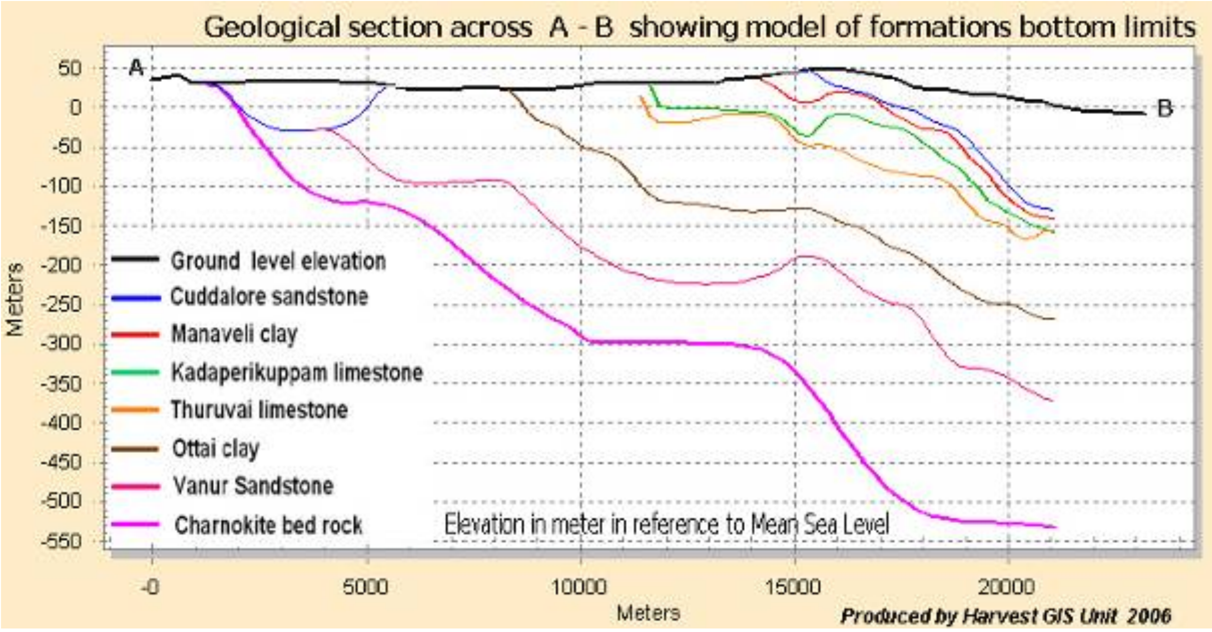
The thickness of the productive zone varies from 12-72 m. The depth of occurrence of granular zone is around 12 – 80 m and the water table varies from 30 to 70 meter below ground level. Tube wells of the project area are tapping the sandstone aquifers under confined condition with an average well depth of 95m bgl. The average discharge from the tube wells was found as 10 – 12 LPs.

The Vanur aquifer is the main source of groundwater for the agriculture of the region. Therefore, it has to be preserved from over extraction and from seawater intrusion.

GEOLOGICAL CROSS SECTION LOCATION MAP



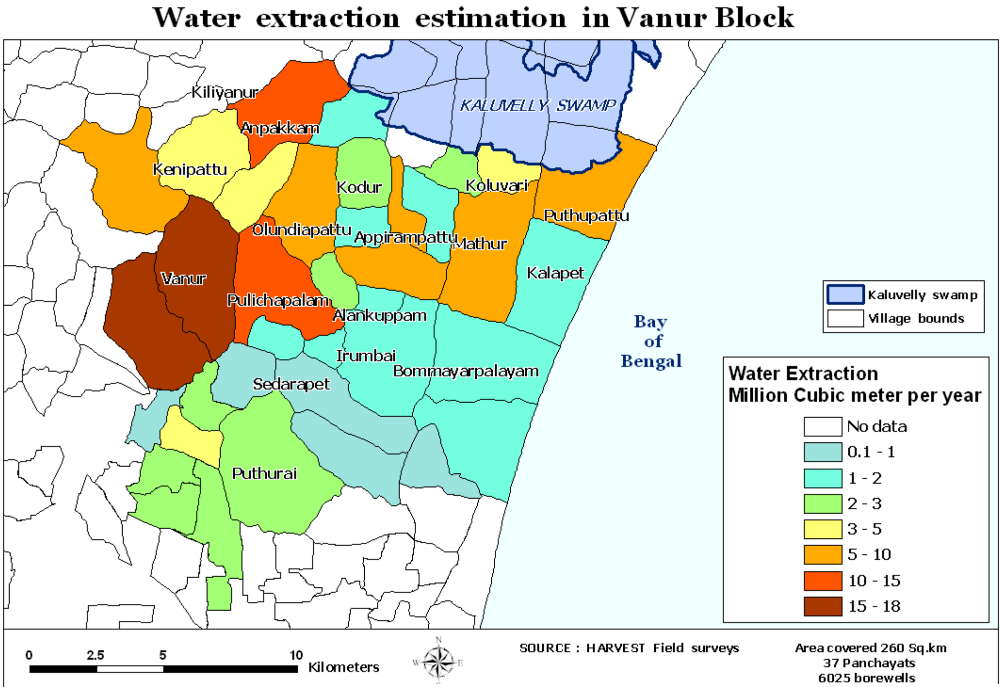
Map 8: Topography & Outcropping of geological formation



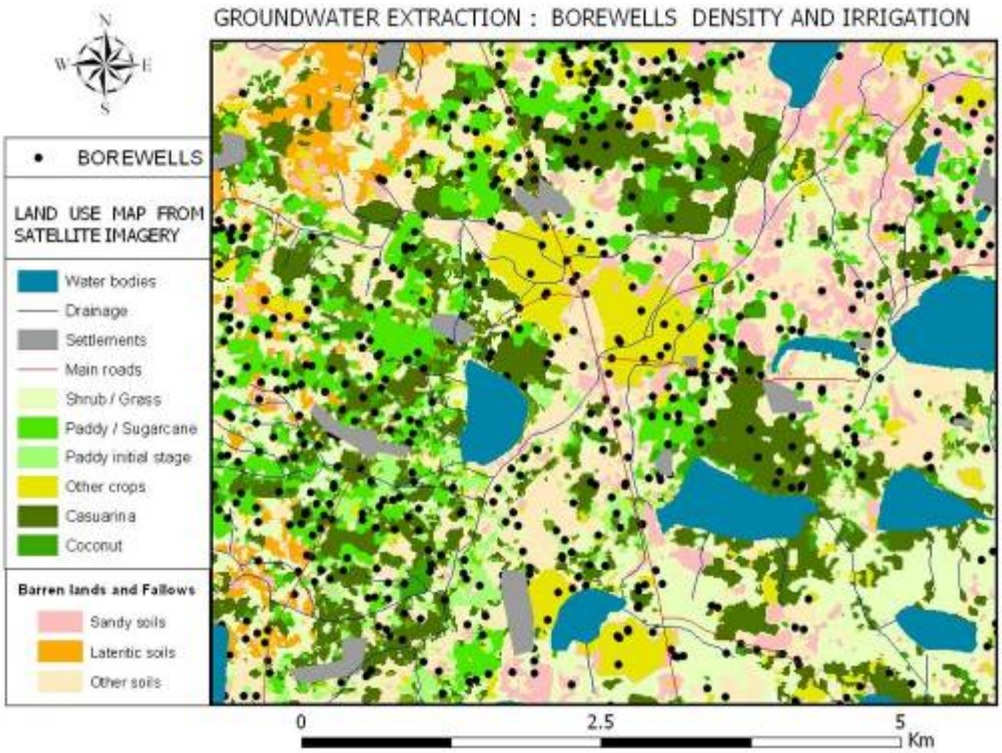
Map 9: Cross section A-B on geological formation

1.3.1 Groundwater level depletion

The heavy extraction of groundwater accompanied with poor distribution of rainfall has lowered the level of groundwater in many parts of the taluk. It is moreover assumed that the water situation could worsen in the coming future. Poor intensity of rainfall and presence of very less water in the surface water bodies could bring severe water problem.



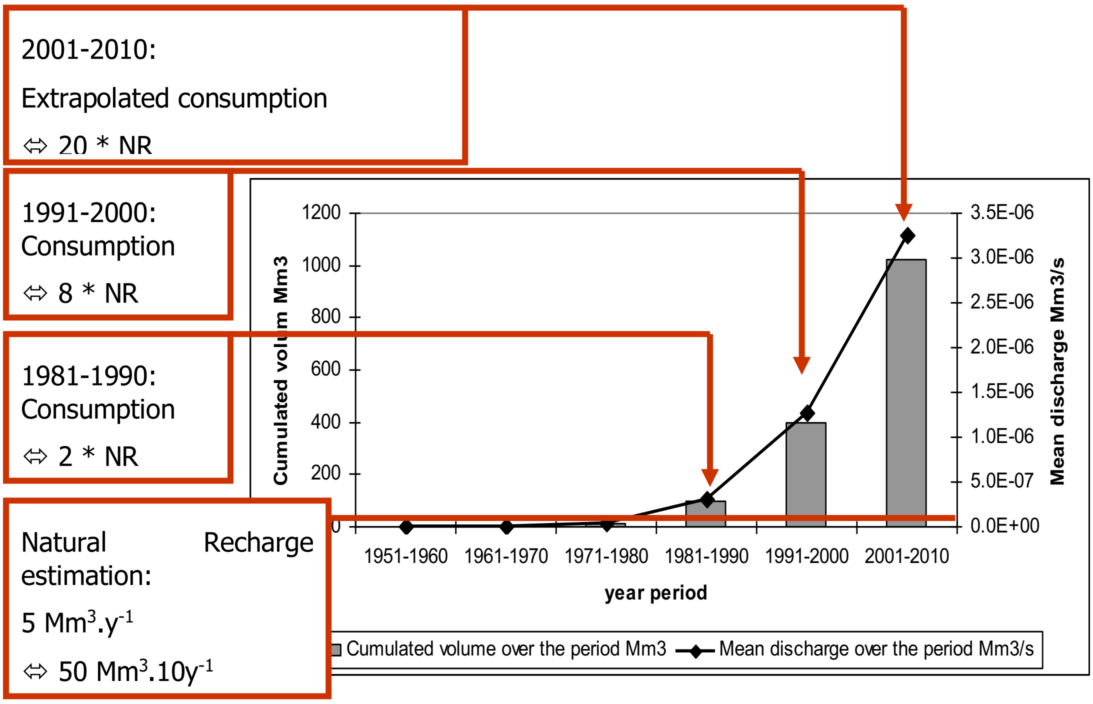
Map 11: Groundwater exploitation in Vanur Block



Map 10: Borewell density versus land use pattern

Approximately 180 million cubic meter of groundwater is being extracted annually from 6000 bore wells in 250-km^2. It is important to mention that very few wells are cased and water is generally extracted from all the different overlying layers also.

It is estimate that the actual extraction is in the order of 15 times the natural recharge, and the trend of evolution is very alarming in that regard.



<u>**Figure 2: Evolution of extraction on Vanur aquifer**</u>

Existing groundwater level of the project area is below mean sea level. Vanur is at 83.75 meters below ground level in September 2006, equal to – 56.35 meters below mean sea level.

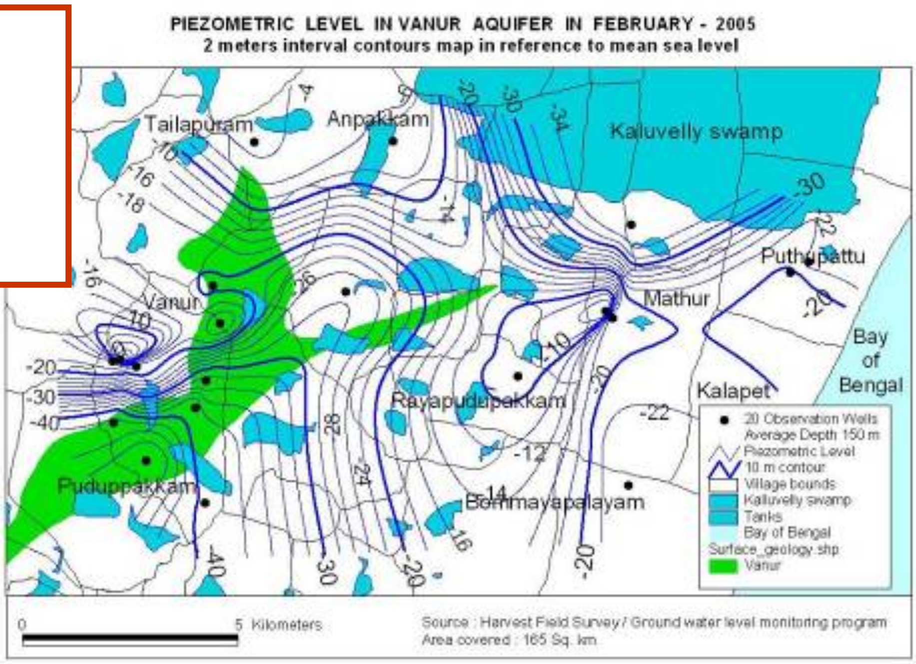
The overexploitation has changed the original groundwater flow which is now reversed and flows from the sea inland.

Vanur outcrop area water level

1975: +7 m msl

2005: -47 m msl

>drawdown ~54 m



Map 12: Piezometric map result of Vanur aquifer overexploitation

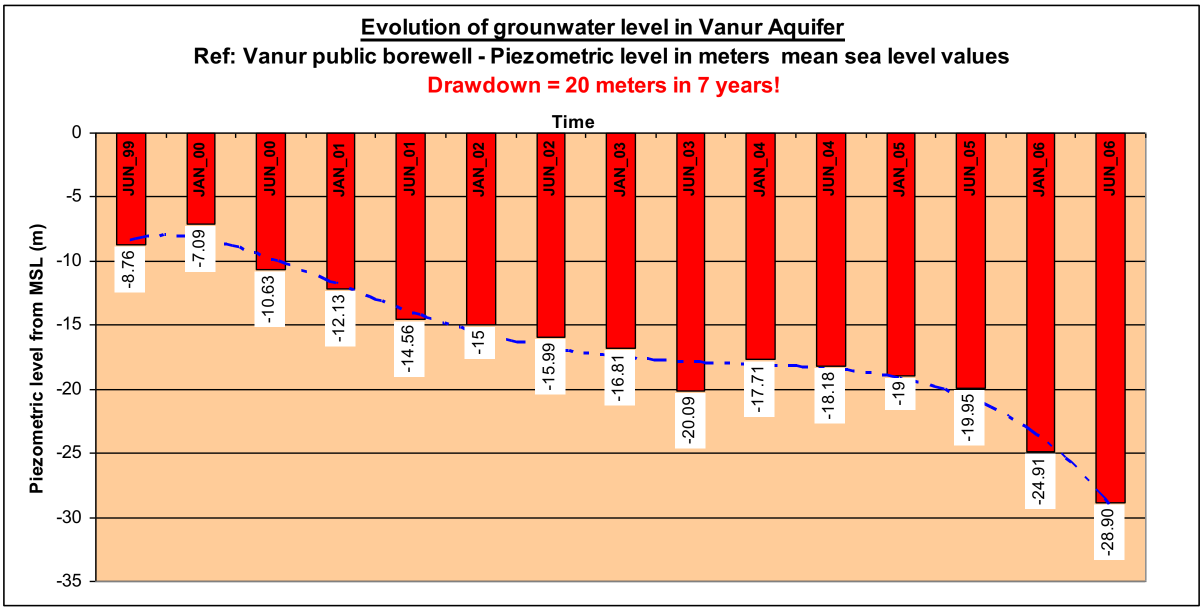


Figure 3: Evolution of groundwater level in Vanur sandstone formation

1.3.2 Groundwater quality degradation

The quality of groundwater in the villages of the Vanur block villages was tested using the ECOScan meter, and details are given below in the map. The readings shows a continuous increase of salinity threatening the quality of water for irrigation in the near future if nothing is done to fight against groundwater salinisation. The Electro conductivity values range from 1000 to 4000 micro siemens per centimeter.

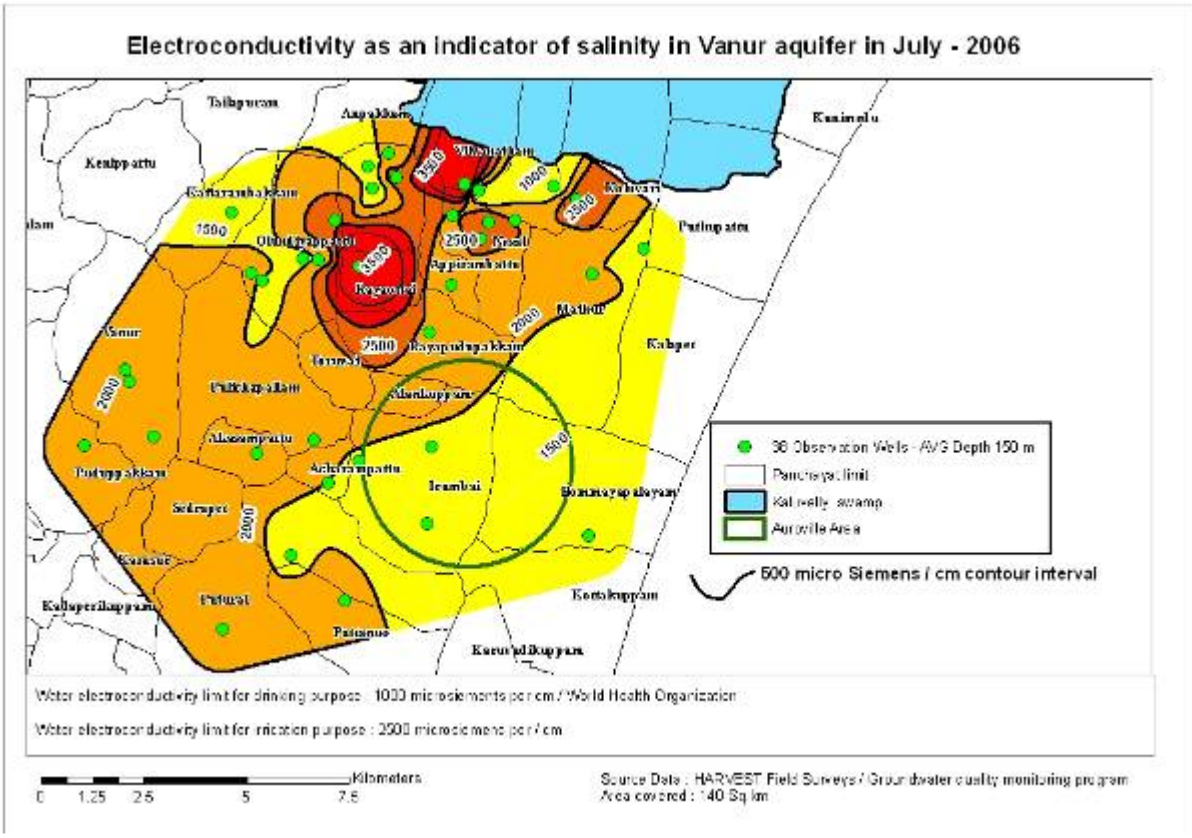
Main reasons for groundwater salinisation

1) Upward leakage of highly mineralized water from below aquifer caused by head differences due to the pumping

2) Downward transfer of salty evaporated irrigation water

3) Through brackish water from the Kaluvelly swamp

So far there is no proof of direct paleo or present seawater intrusion



Map 13: Electro conductivity in Vanur aquifer

2. POTENTIAL SOLUTIONS: DIVERSION OF RUNOFF WATER TO RECHARGE AREA, BUFFER ZONE, BIOREMEDIATION ...

2.1 REASONS FOR A PROJECT IMPLEMENTATION IN VANUR AREA

1) Higher level of extraction

2) Immediate possibilities of sea water intrusion as the surrounding villages are already affected. Over exploitation of groundwater has increased the possibilities of seawater intrusion in the coming years.

3) The project area sits directly on the outcropping part of the Vanur sandstone, one of the main aquifer of the area, and is an ideal location for artificial recharge.

4) Adequate rainfall

5) Availability of wide water spread area in the storage structures like tanks etc.

6) Sufficient rate of inflow of rainwater to the storage structures to meet the demands of irrigation and artificial recharging.

7) Geologically viable aquifers.

8) Well documented area

9) Presence of the Tindivanam pumping station in the project giving drinking water to around 200,000 people.

10) International concern is turned to this area because of the recognition under the UNESCO program and the sensitive ecological system in the near by swamp.

2.2 Objective

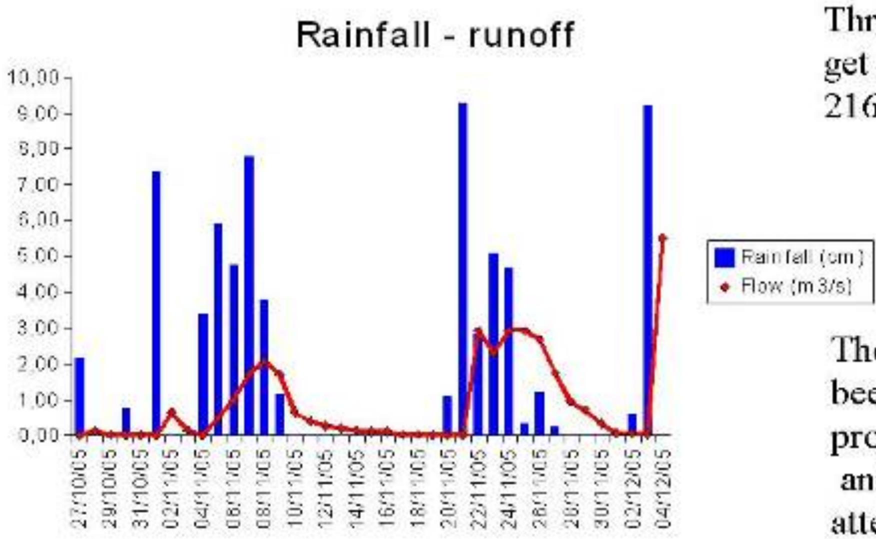
The objective is to maintain a proper hydraulic balance between the extraction and the recharge. It will help to stabilize the system and preserve the water resource potential and its quality. This can be achieved by augmenting the recharge potential by artificial adequate methods. To recharge the aquifer, it is therefore needed to focus on two main objectives:

1. Concentrate and maximize the flow reaching the suitable recharge zone on the outcropping areas of Vanur sandstone aquifer.
2. Improve and facilitate the groundwater recharge through appropriate structures such s percolation ponds and recharge wells.

The heavy run-off happening during monsoon and reaching Kaluvelly swamp can be partly diverted and concentrated to the recharge zone of the aquifer. A large amount of excess water is presently flowing to the sea and this volume of water can be saved and used for direct recharge of the Vanur Aquifer. This can be achieved through various means including check dams, field bundings and diversion channels. A Large buffer zone could be created up stream of the Kaluvelly swamp to harvest the excess water flow reaching the tank.

2005 monsoon

2005 rainfall so far: 1506 mm (interannual mean 1260 mm), 879 mm in October and November.



Threshold value to get some runoff: 216 mm in 9 days.

The erys filling up has been much more progressive than in 2004, and has similarly attenuated the first runoff event.

2.3 <u>Recharge Potential</u>

Vanur Aquifer Recharge

Vanur formation is the most important groundwater source for irrigation in Kaluvelly watershed. It is also feeding the city of Tindivanam. It is also heavily overexploited.

Therefore, recharge of groundwater should aim at compensating this annual lost and if possible restore the initial groundwater level.

As explained above, the Kaluvelly watershed generates a large runoff to Kaluvelly swamp, ultimately lost to the sea.

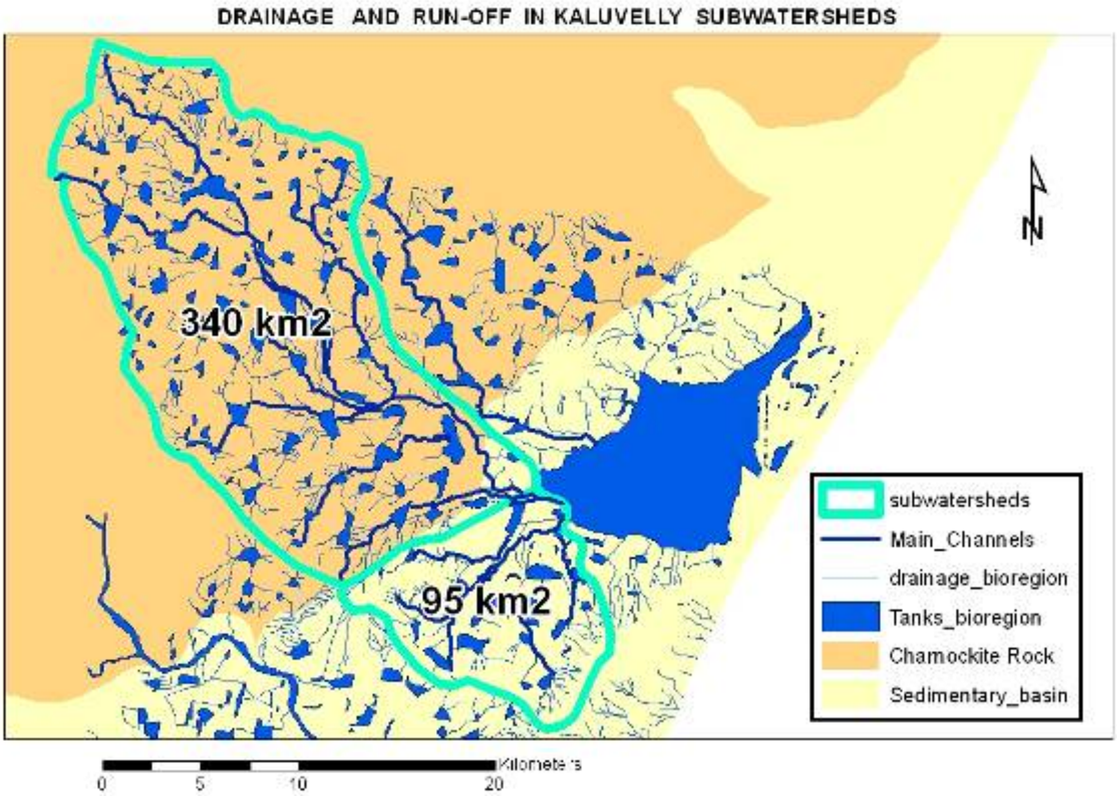
<u>Basic parameters</u>

– Vanur Aquifer yearly average extraction	90	Mm3
– Vanur Aquifer actual recharge (for an outcropping recharge area of 23 sq.km)	9	Mm3
– Return flow on Vanur Aquifer from irrigation (estimated)	14	Mm3
► **yearly net extraction from Vanur aquifer**	**67**	**Mm3**
– Excess runoff water available from Kaluvelly watershed (see 1.2)	186	Mm3
– Kaluvelly swamp storage	33	Mm3
► **Remaining surface water potential (actually lost to sea)**	**153**	**Mm3**

Keeping in mind that the swamp is a fragile ecosystem and an important part of the livelihood for the surrounding population, it is necessary to evaluate how to preserve the salinity gradient through the swamp and at the same time harvest fresh water for further use.

The advantage of the hydrographic network of the watershed is that a large part of the runoff concentrates on one single corner of the swamp close to the Vanur outcropping area, helping tremendously to divert the flow to the potential recharge area.

Out of the 750sq.km of the watershed, the runoff generated on 435sq.km reach the southwestern corner of the swamp, a few kilometers away from the Vanur outcropping area.



Map 14: Potential area of collection for groundwater recharge

By looking at the runoff generated in this area we come to the following figures

Rainfall (average)	1250	mm
Targeted catchment area	435	Sq.km
Catchment on rock	340	Sq.km
Catchment on sediments	95	Sq.km
Run-off on rock (25 %)	106.3	Mm3/y
Run-off on sediments (12 %)	14.3	Mm3/y
= > Run-off generated from the watershed on the southwestern corner of the swamp	**120.5**	**Mm3/y**

Knowing that the actual extraction on the Vanur formation is around 90Mm3/y, and that the local natural recharge is around 9Mm3/y (see above), we come to the following conclusion:

Volume required to compensate the over extraction on Vanur formation	**67**	**Mm3/y**
Volume of water runoff potentially available from selected catchment area	**121**	**Mm3/y**

2.3.1 Conclusion

The volume of runoff available from the targeted catchment area represents 180% of the yearly extraction on Vanur sandstone formation.

It is hence sufficient to compensate the over extraction but also to regenerate the water level to initial conditions though time.

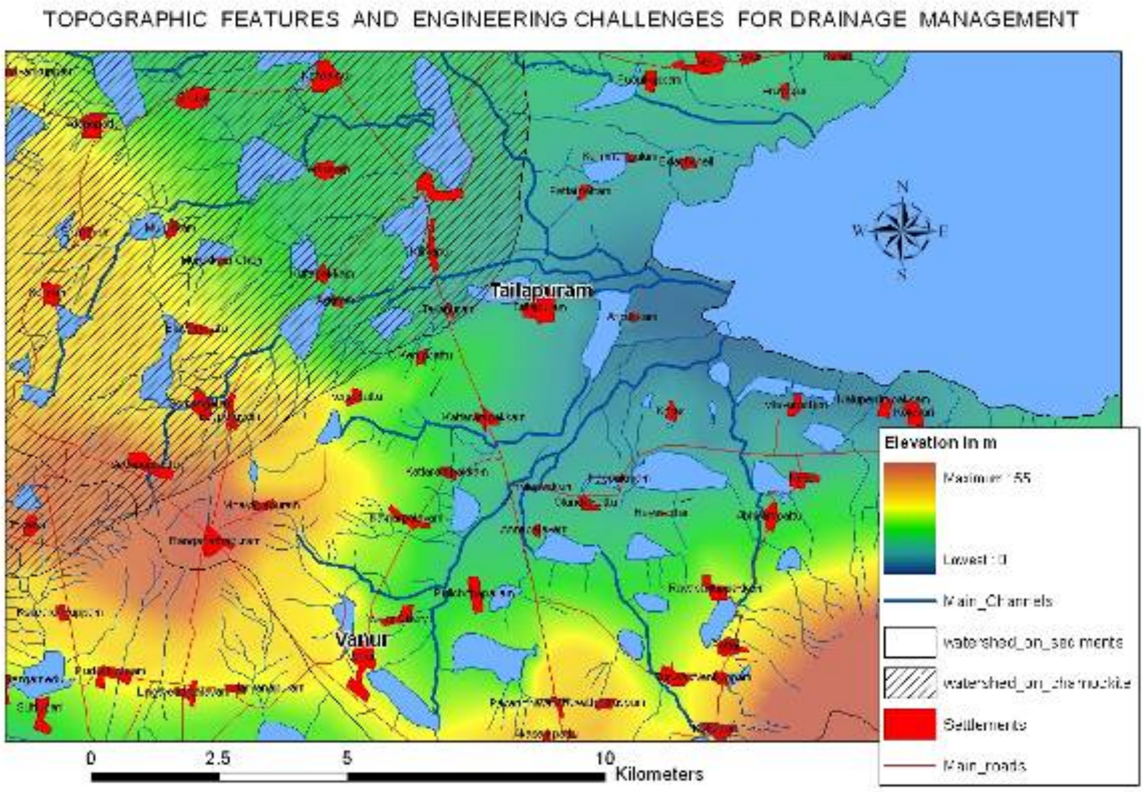
It must be noted that if all this water would be diverted for groundwater recharge purpose, still around 63Mm3/y of freshwater could reach the wetland, or about twice the tank storage capacity. As well, the exceeding runoff available after compensation of annual over extraction (54Mm3/y) could be partly or fully diverted to the tank.

We can hence presume that the ecological and environmental balance would be properly preserved in such scenario.

Figure 4: Surplus water from the tanks going to Kaluvelly swamp. Olundiapattu village, Vanur Block, October 2005.

2.4 Diversion

The runoff coming from the targeted catchment area is drained to a zone (near Tailapuram) very close to the potential recharge area. A stretch of 7kms only separate the two zones and the topography is generally favorable for allowing the water to flow in the proper direction.



Map 15: Physical setup and appropriateness

By installing diversion and regulatory devices in the main water ways close to Tailapuram and developing a canal of appropriate size linking the 2 areas, the water can be transferred to the recharge zone.

Of course, the very large flow of water reaching the area should be control and properly canalized in order to avoid flood and other major nuisances and at the same time generate maximum recharge of groundwater along the way.

Basically, this imply that apart of the mentioned connecting canal and related equipment, the existing canals in the recharge area would be widen and equipped in a similar way.

All together, about 25kms of canals should be open or widen and equipped.

2.5 Recharge structures

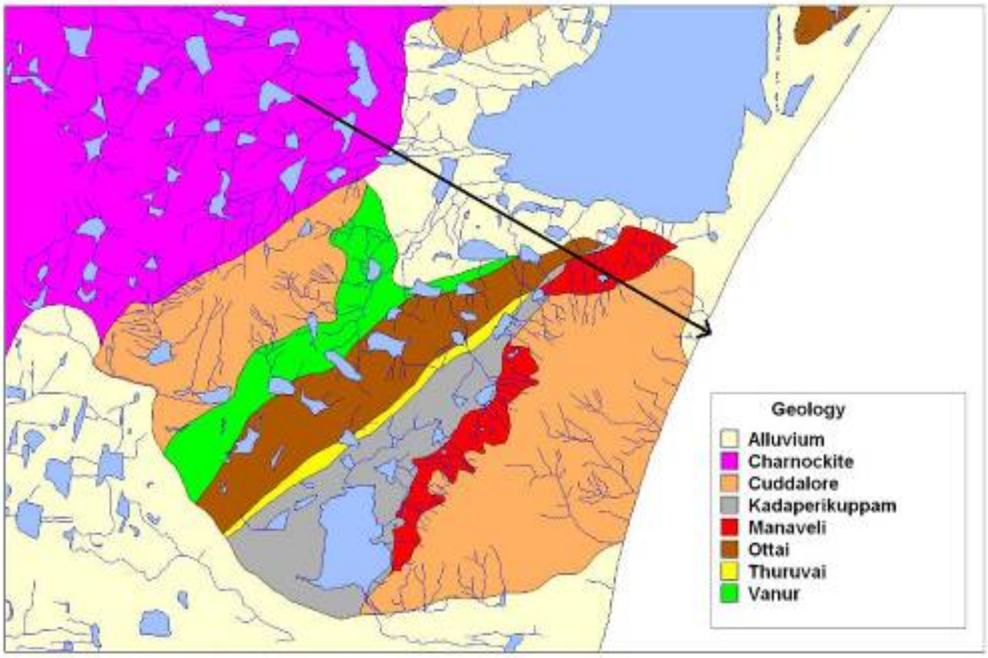
Artificial methods can be applied to improve the natural recharge of the Vanur Aquifer. Recharge structures can be installed at selected areas for direct recharge of the aquifer.

This can consist of:

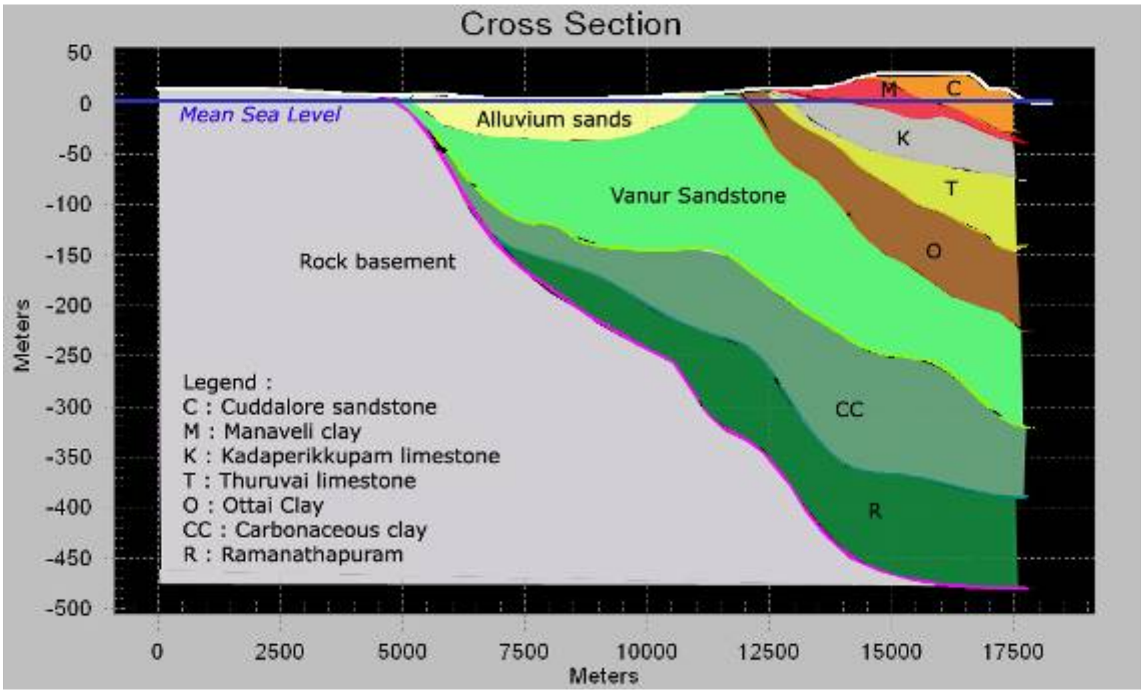
- percolation ponds
- recharge wells

- Water ways
- recharge shafts
- etc.

It is interesting to note that the entire targeted area is located on the sedimentary formations, the upper layers sitting on the Vanur formation underneath. Accordingly groundwater recharge devices can be installed everywhere and benefit the large storage offered by Vanur formation.



Map 16: Geological setup with location of section on proposed recharge area



Map 17: Section on geological profile along the proposed recharge area

The main difficulty of such program would be to handle such large volume of water in a limited period of time: due to the rocky formation on the western part of the drainage area and limited storage, the runoff events occur swiftly. Looking at the volume, time delaying structure seems very unlikely. Hence the rate of recharge potential as well as the size of the recharge structures should be properly designed.

2.6 Other benefits

The delta created by the network of drains reaching the southwester corner of Kaluvelly swamp combined with a very flat topography is generating regular flooding in this area.

By developing the infrastructure and drainage facilities together with flow diversion structures, this area covering around 35 sq.km will be better protected and can be used for further development and activities with multiple benefit for the population.

3. FURTHER STUDY REQUIREMENTS FOR LARGE SCALE GROUND WATER RECHARGE

To support the implementation of large scale rain water harvesting programs, research and development programs need to be set up in the region. The complex hydrogeological system and its dynamics need to be better understood and studied in depth. This can include the installation of deep observation wells to study the groundwater level fluctuations and its quality. The existing risk of groundwater pollution and salinisation can be evaluated and prevented from regular monitoring programs.

At the same time investigations on water saving and alternative sustainable use can be investigated. The scope for using Kaluvelly swamp as afresh water resource reservoir can be studied further.

4. OUR ONGOING REMEDIATION EFFORTS

The development of large scale rain water harvesting and watershed programs are based on an integrated approach, which comprises water, land, ecology, sanitation livestock and people.

4.1 Tank rehabilitation programs and User-based Watershed Development

In Tamil Nadu, Harvest has completed the rehabilitation work of irrigation tanks and village ponds under various schemes, including large excavation work, desilting and clearing of feeder channels, reparation of irrigation structures.

4.2 Augmentation of Groundwater through Artificial Recharge

Construction of percolation ponds

Construction of check dams in channels

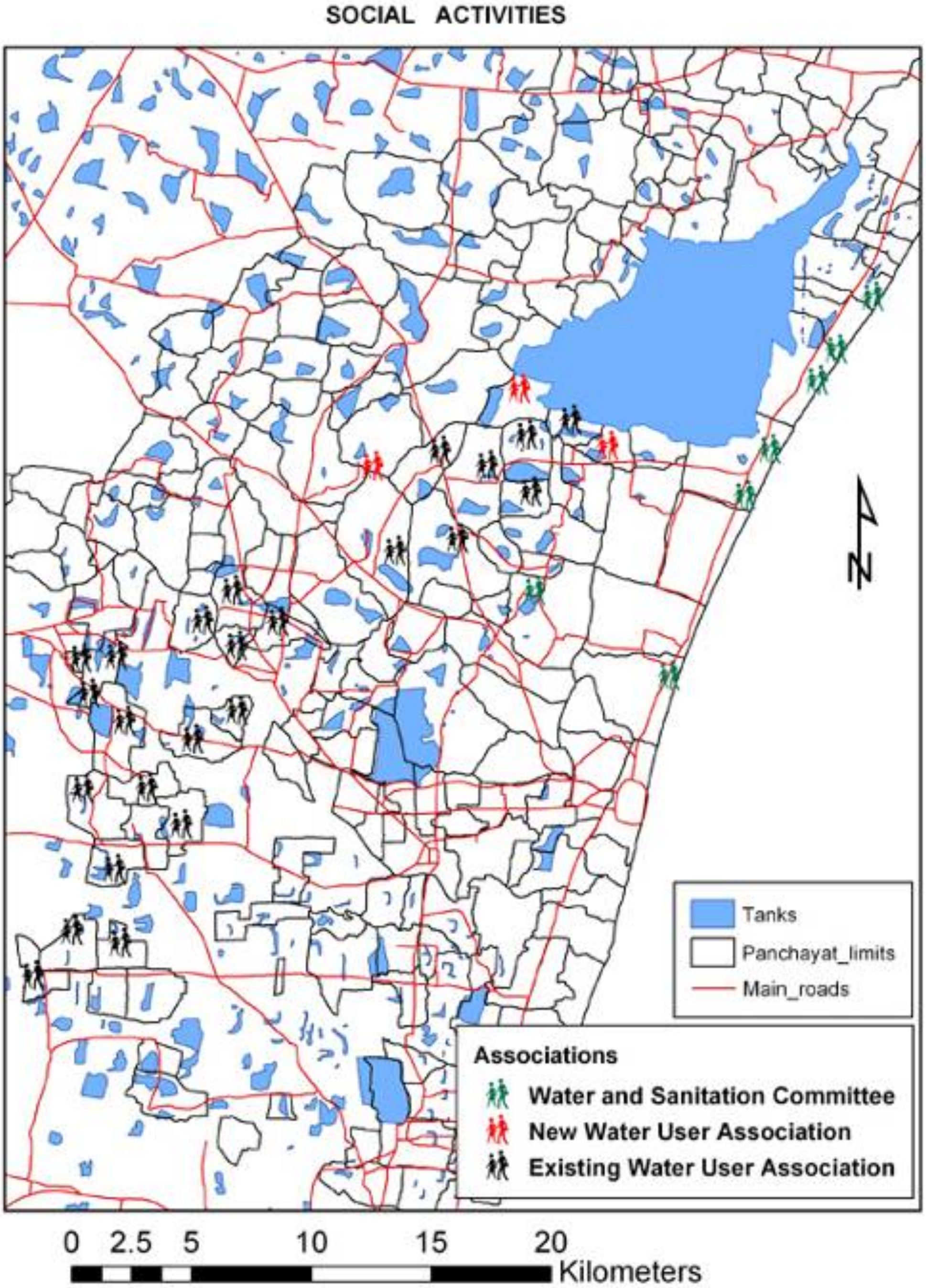
Installation of recharge wells

Construction of field bunding structures

4.3 Society mobilisation and community based activities

As education is the basis of societal change, most of Harvest's projects include some components of education and public awareness. Though the social team runs most of these components, all of the teams are at least partly involved in them. Village meetings, displays at the weekly market in the main villages, dramas, staff trainings for other NGO's, and exposure visits take place regularly. There will be the formation of various committees like sanitation and land development at the village level to take care of the work at that level.

Projects include conducting in-situ and ex-situ trainings to the members of Users Associations and farmers on modern Agricultural Technology, irrigation management aspects and related income generating activities is designed.



Map 18: Auroville Water Harvest social mobilization efforts