

Interim report on the changes in the quality of groundwater in the coastal villages affected by the Tsunami around Auroville

Study conducted by the Auroville Water Harvest on behalf of Auroville Tsunami Relief Committee.

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Social Survey

Introduction

The Tsunami, which occurred in an unexpected time on The 26th of December 2004, has caused a major disaster in the coastal villages of Pondicherry and Tamilnadu. In the coastal areas the major community is the fishermen who dwell just near the seashore. These villages where the fishermen live are known as “**Kuppam**”. The damages in these villages were severe which includes death of human beings, loss of boats, fishing nets and houses. This is resulting in an alarming situation for the fishermen community who depend on the sea for their livelihood. The Tsunami has not only taken the life of people and destroyed materials but has also caused serious changes in the environment. A fast social investigation was done in order to assess the changes in the quality of drinking water source in the coastal villages. The findings in this report are based on the discussions held with the affected community in the villages. The physical assessment is given below in this report (waves extend, salinity level, bacterial contamination, time evolution).

A quick social investigation was done in order to assess the changes in the quality of drinking water source in the coastal villages.

The findings of this part of the report are purely based on the discussions held with the affected community in the villages. The qualitative assessment (salinity level, pH, E-coli) is partly developed in the second part (see maps) and will be completed soon.

Location of the investigation area

The villages selected for investigation are located between Muthialpet and Marakkanam in the eastern side of the east coast road. The total number of villages covered are 25 and correspond to 35 Kms of coast. The name of the villages are mentioned below.

SN	Village	SN	Village
1	Muthialpet(Solai nagar kuppam)	14	Anichankuppam
2	Solaithandavan kuppam	15	Mudaliar kuppam
3	Kottakuppam	16	Koonimedu kuppam
4	Nadu kuppam	17	Chetti nagar
5	Thanthirayan kuppam	18	Anumanthai kuppam
6	Chinna mudaliar chavady	19	Keezh pettai kuppam
7	Periya mudaliar chavady	20	Panichamedu kuppam
8	Bommayar palayam	21	Mandavai Pudu kuppam
9	Pillaichavady	22	Ekkiyan kuppam
10	Chinna kalapet	23	Kaipeni kuppam
11	Periya kalapet	24	Vasavan kuppam
12	Kanagachettikulam	25	Muttukadu alagan kuppam
13	Keezh puthupattu		

A brief survey report on infrastructure facilities for drinking water and sanitation in the villages mentioned above is provided in the **Annexure II**.

Tsunami and its effect in the inland areas

In all the villages it was seen that the fishermen have lost their boats and fishing nets which costs about 3 to 4 lakhs for each boat and set of nets.

Drinking water situation in the villages

In all the villages visited public water facilities exist and supply people from the public over head tanks through street taps. Many houses have individual taps also. Apart from this, the villagers also have individual shallow hand pumps, due to the short volume available from the public facilities and the limited number of supplied hours. The depth of shallow hand pumps ranges between 20 to 30 feet and are hence tapping the so called Dune formation. It is evaluated that 40 to 60% of the water supply was coming from these individual hand pumps.

Before the occurrence of Tsunami the quality of water from these hand pumps was good as per people feedback (this is not true as per chemical and bacterial content are concern) and people used that water for drinking, cooking and bathing purpose. These hand pumps supplemented largely the water requirement of the community.

But now the situation is totally changed as all the water supplied from these hand pumps has turn heavily saline. People feel that it is not even fit for bathing purpose. The drastic change in the quality was mainly due to the percolation of the seawater in the shallow fresh water aquifer. In our observation we could find only one village (Muttukadu Alagan kuppam) were the quality of water (as per taste) in the hand pumps remains the same as before.

The people told that they do not find any difference in the quality of water supplied from the over head tanks. The reason is that the over head tanks are located at a distance more than 500 m from the seashore and sunk in the deeper aquifers. Even then, the water is actually treated with chlorine as a preventive measure to avoid diseases that may happen because of contamination in water. This is anyhow not the usual practice but happen only after the Tsunami. Since the people do not have the practice of drinking chlorinated water and the dosage was also not in proper ratio, initially they felt somewhat difficult in consuming the water. But now the situation seems alright and people use this water for drinking purpose and others.

As the water from hand pumps has become unusable, the entire community is forced to depend on the water from the public over head tanks, which as such is not enough as far as quantity is concerned. In order to provide sufficient and safe drinking water to the households in the village, the NGOs and Government departments have installed temporary plastic tanks in the streets and are filled with the water brought by tankers from neighbouring places and chlorinated with bleaching powder. As this is only a temporary measure which will not be sustainable for a long run, alternative strategies have to be developed for sustainable supply of safe drinking water.

Our major concern should be to consolidate drinkable water supply from protected sources in appropriate quantity and on trying to rectify the saline water percolated in the shallow fresh water aquifer along the coast.

The results of the earlier investigations on ground water made in these coastal villages reveal that there is anyhow a slow intrusion of sea water into the fresh water aquifer system.

Sanitation situation in the villages

It is commonly observed that in all the villages, people go in for open defecation that too just near the shore polluting the environment. Individual toilets are rarely seen in the villages. People do not have even the common public toilet facilities except some villages. The women also go in for open defecation in some privacy places such as coconut grooves in the seashore.

The villages which belong to Pondicherry have masonry side drains for sewage water draining. But in the villages of Tamilnadu, the sewage water runs in open channels. Stagnation of this sewage water is also observed in several villages.

As per international reports, diseases are at more than 80% from water origin in India, and 40% of death come also from water related aspect. Uncontrolled defecation is the direct cause for fast spaying of diseases like diarrhea, hepatitis, cholera, typhus, not to speak of the endemic worms, bacteria, ...

It is essential to give more emphasis to health education, sanitation and disposal of human waste by constructing appropriate sanitation facilities, appropriate drainage systems, solid waste management and create mass awareness on the same. If properly conducted, we may expect that the problem of pollution of water from wild defecation and uncontrolled waste disposal will be tackled, turning the coastal in a clean, hygienic and more pleasant area.

Incidence of disease after Tsunami

It was heard that in some villages, people were affected by fever and diarrhea immediately after the occurrence of Tsunami. Curative and preventive measures have been provided by NGOs and Govt. departments. Now there is no major incidence disease in the villages. It must be mentioned anyhow that skin problems seems to spray fast and is a subject for concern.

Response from the people in the villages

- In general, during the survey work the response from the people was very good.
- The people in the Pondicherry villages expect more from the Govt. as well as from no governmental support.
- The people in Tamilnadu villages are more concerned about boat and fishing nets and they expect govt. relief fund based on the intensity of damages.
- At present, people don't pay much attention to sanitation and drinking water as their main aim is to get new boats and nets to restart their source of livelihood. This is indicating the lake of awareness of the population on the public health and also how they prioritized there needs.
- Even though they are getting some relief items such as money, rice, cloth, stove, etc. they are not satisfied with that since they can not depend on these temporary provisions for a long run.
- The fishermen told that even now the sea is sometimes rough and they have the fear to go into the sea. Psychological support is needed.
- The women in the villages are particularly traumatized and need to be paid attention and they require counseling.

- A very important point is that they want new settlement and houses to be constructed in an elevated place from the seashore by the Govt. They have already given representation regarding this to the District Collector.
- The people told that the water that came into the inland during Tsunami is not the usual sea water. It looked in black muddy colour and was poisonous. The think that people died only because of consuming that water while they were washed away by Tsunami.
- During the survey, we could see only one fisherman who was weaving a new net for keeping the fish. His attitude was very positive and he told that this was a natural calamity and nobody can prevent it. In all the other villages we saw the fishermen community who were just chatting, playing cards and reading news papers. They say that they know only fishing and they don't know any other job. They think that if they repair their damaged nets they may not get relief amount from the Govt.

Particulars	Village					
	Muthialpet- Solai nagar kuppam	Solaithandavan kuppam	Nadu kuppam	Kottakuppam	Thanthirayan kuppam	Chinna mudaliar chavadi & Periyamudaliar chavadi
Date of survey	12.01.05	12.01.05	12.01.05	12.01.05	12.01.05	12.01.05
Drinking water source						
Over head tank(Nos.)	1	1	1	1	1	1
Street taps	Available	Available	Available	Available	Available	Available
Individual taps	Available	Available	Available	Available	Available	Available
Hand pumps						
Shallow pumps	Nil	Nil	Nil	Nil	Nil	Available
IM-II						
Temporary water supply Sintex tanks	Nil	Nil	Nil	Nil	Nil	1
Quantity available	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation
Quality of water (by taste only)						
OHT water	Good	Good	Good	Good	Good	Good
Hand pump water						Good
Sewage water & drainage	Open drainage	Open drainage	Open drainage	Open drainage	Open drainage	Open drainage
	Open cement channels					
Sanitation	Public Toilets					
	Individual toilets	Individual toilets	Individual toilets	Individual toilets	Individual toilets	
Diseases occurred,if any	Fever, diarrhea	Fever, diarrhea	Fever, diarrhea	Fever, diarrhea	Fever, diarrhea	Fever
No. of households	800	400	250	600	250	950

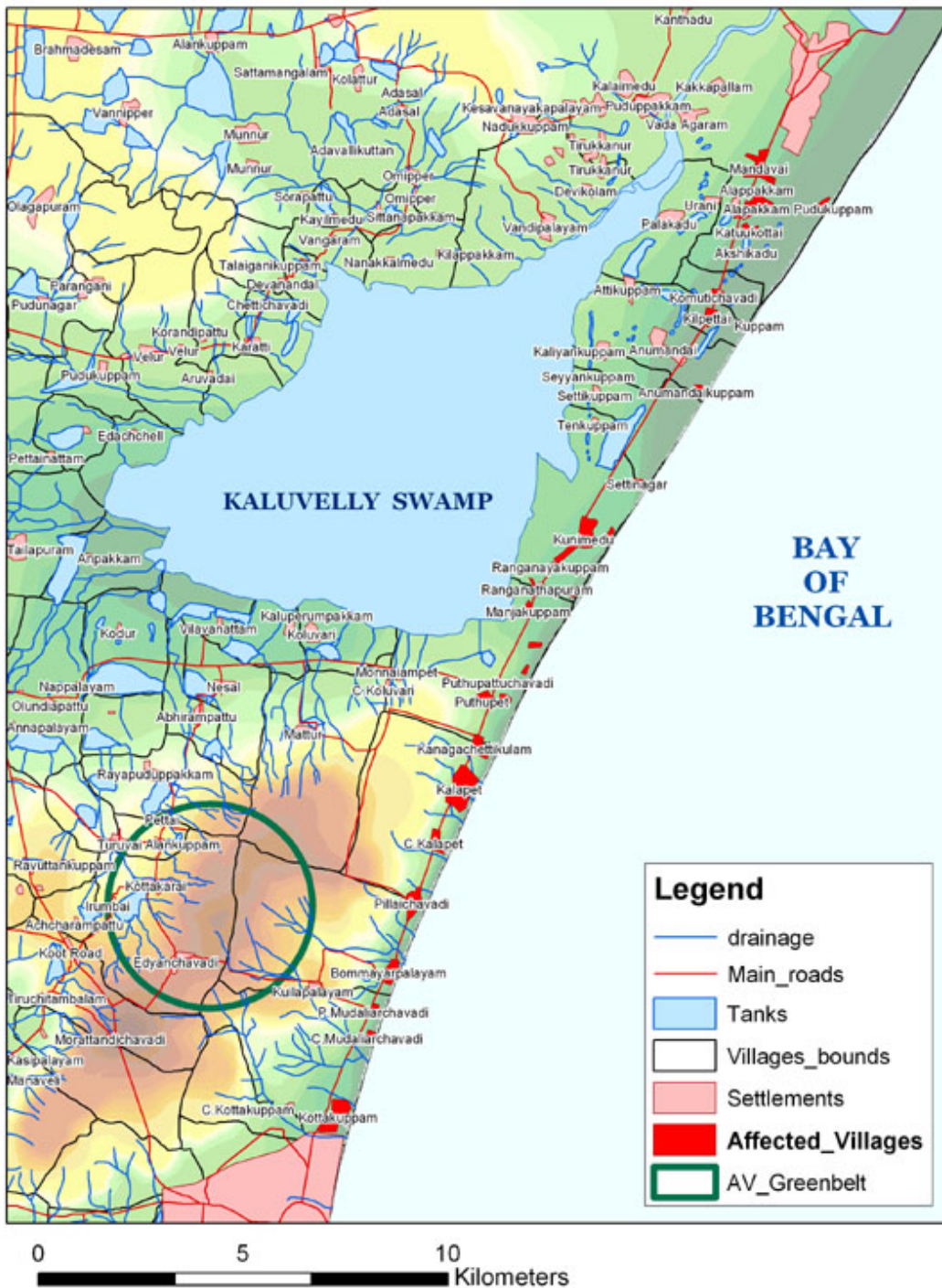
Particulars	Village					
	Bommaiyar palayam	Pillaichavadi	Chinna kalapet	Periya kalapet	Kanaga chettikulam	Keezh Puthupattu
Date of survey	12.01.05	12.01.05	10.01.05	10.01.05	12.01.05	10.01.05
Drinking water source						
Over head tank(Nos)	1	1	1	1	1	1
Street taps	Available	Available	Available	Available	Available	Available
Individual taps	Available	Available	Available	Available	Available	Available
Hand pumps						
Shallow pumps	Available	Available	Available	Available	Available	Available
IM-II						
Temporary water supply Sintex tanks	8	3	3	4	5	2
Quantity available	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation
Quality of water (by taste only)						
OHT	Good	Good	Good	Good	Good	Good
Hand pump water	Salty	Salty	Salty	Salty	Salty	Salty
Sewage water & drainage	Open drainage	Open drainage	Open drainage	Open drainage	Open drainage	Open drainage
Sanitation	Individual toilets	Individual toilets	Individual toilets	Individual toilets	Individual toilets	Individual toilets
	Open defecation	Open defecation	Open defecation	Open defecation	Open defecation	Open defecation
Diseases occurred,if any	Fever	Fever	Fever	Fever	Fever	Fever
No.of households	400	320	250	300	750	68

Particulars	Village					
	Anichakuppam	Muthaliarkuppam	Koonimedu kuppam	Chetty Nagar	Anumandai kuppam	Keezh pettai kuppam
Date of survey	10.01.05	10.01.05	10.01.05	11.01.05	11.01.05	11.01.05
Drinking water source						
Over head tank(Nos)	1	1	1	1	1	1
Street taps	Available	Available	Available	Available	Available	Available
Individual taps	Available	Available	Available	Available	Available	Available
Hand pumps						
Shallow pumps	Available	Available	Available	Available	Available	Available
IM-II						
Temporary water supply Sintex tanks	4	5	6	2	4	3
Quantity available	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation
Quality of water (by taste only)						
OHT water	Good	Good	Good	Good	Good	Good
Hand pump water	Salty	Salty	Salty	Salty	Salty	Salty
Sewage water & drainage	Open drainage	Open drainage	Open drainage	Open drainage	Open drainage	Open drainage
Sanitation	Individual toilets	Open defecation	Individual toilets	Open defecation	Public toilet	Open defecation
	Open defecation		Open defecation		Open defecation	
Diseases occurred,if any	Nil	Fever, diarrhea	Fever	Fever	Fever, diarrhea	Fever, diarrhea
No.of households	250	250	450	50	150	150

Particulars	Village					
	Panichamedu kuppam- Komutti chavadi	Mandavai Puthukuppam	Ekkiyar kuppam	Kaipeni kuppam	Vasavan kuppam	Muttukadu Alagan kuppam
Date of survey	11.01.05	11.01.05	11.01.05	11.01.05	11.01.05	11.01.05
Drinking water source						
Over head tank(Nos)	1	1	1	1	1	1
Street taps	Available	Available	Available	Available	Available	Available
Individual taps	Available	Available	Available	Available	Available	Available
Hand pumps						
Shallow pumps	Available	Available	Available	Available	Available	Available
IM-II	4					
Temporary water supply Sintex tanks	2	2	3	2	4	2
Quantity available	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation	Sufficient for emergency, not for normal situation
Quality of water (by taste only)						
OHT Water	Good	Good	Salty	Good	Good	Good
Hand pump water	Salty	Salty	Salty	Salty	Salty	Good
Sewage water & drainage	Open drainage	Open drainage	Open drainage	Open drainage	Open drainage	Open drainage
Sanitation	Public toilet	Individual toilet	Individual toilet	Individual toilet	Individual toilet	Individual toilets
	Individual toilet	Open defecation	Open defecation	Open defecation	Open defecation	Open defecation
	Open defecation					
Diseases occurred,if any	Fever, diarrhea	Fever	Nil	Fever	Nil	Fever
No.of households	170	200	700	250	350	135

Preliminary report on groundwater contamination

Location map of tsunami affected villages in Auroville bioregion



Task definition

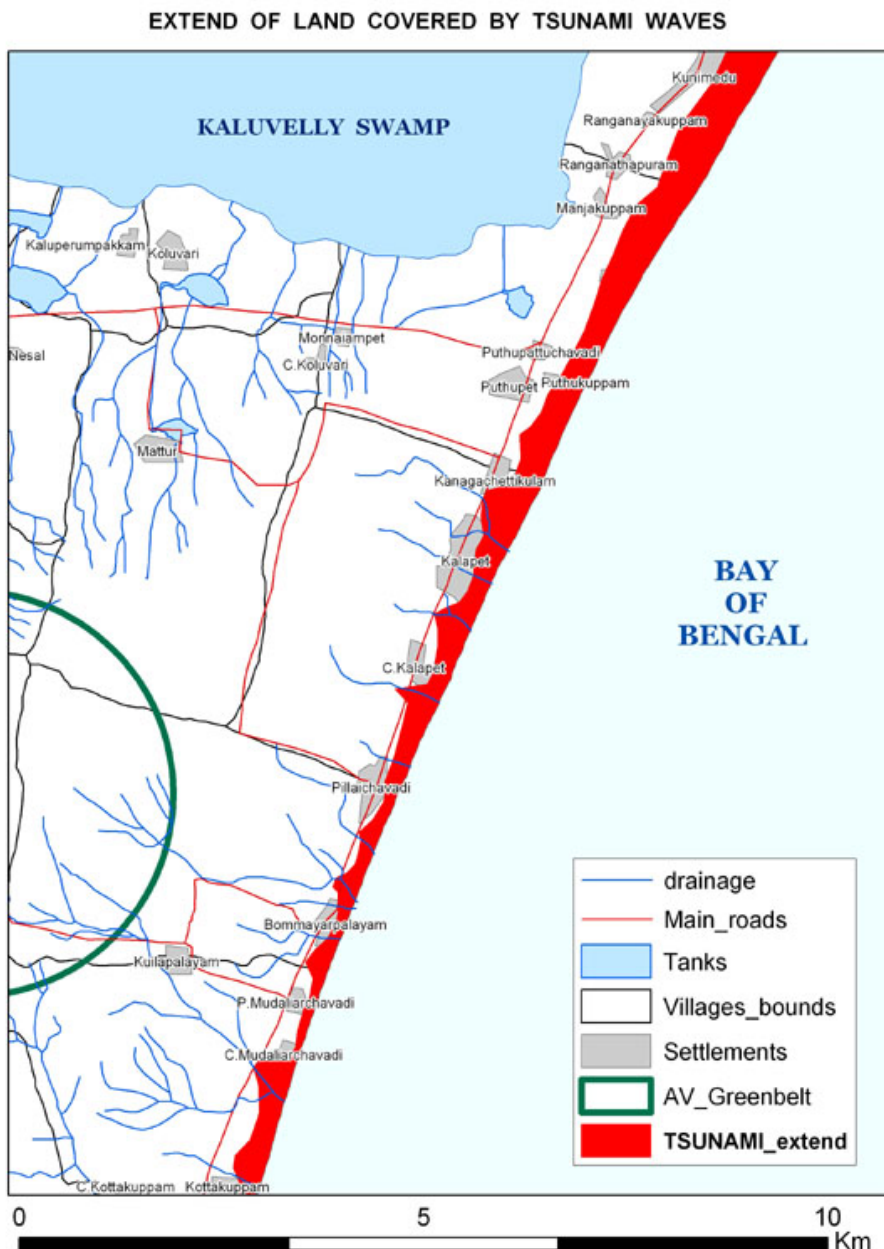
From the overall observation in the investigated area, it was found that the waves went inland for a distance up to 500 m from the seashore, and has also crossed the east coast road at some of the places.

The distance of inland intrusion shows high variations from village to village. In Muthialpet area the extent of damages to the houses is less, as there is a stone boulder protection wall

along the seashore. The damages are more in the villages between Bommaiarpalayam and Koonimedu.

Accordingly, strong contamination of the so called Dune formation, along the seashore is expected. Further contamination is as well probable as the wave went locally further that the boundary limits of this formation , and also because of the multiple wells perforating the clay layer who separate the Dune formation from the underneath, the so called Cuddalore formation. If it is so, the impact on fresh water resources may be even more dramatic because of the very large population depending on this particular aquifer.

It was hence decided to conduct a survey to determine precisely how far the waves went inland, and to conduct sampling in order to assess the extend and importance of the pollution, both in term of salinity and bacterial contamination.



At a second stage, a new sampling will be conducted to determine the time evolution of this contamination. This sampling will as well be extended to the periphery of Kaluvelly swamp as similar problems are expected.

Parameters and Sampling method

The main objective is to assess the level of contamination of the groundwater, both for salinity and bacterial contamination. The parameters are the conductivity as an indicator of salinity, and the quantity of E-coli and total coliform. The conductivity is expressed in micro siemens per centimeters ($\mu\text{Sm}/\text{cm}$). As per Indian Standard, the upper limit is 1000 $\mu\text{Sm}/\text{cm}$ for drinking water. 2500 $\mu\text{Sm}/\text{cm}$ is considered as the upper limit for most of the plants while salt resistant species can handle higher level. The of E-coli and total coliforms are counted in lab. The maximum limit for drinking purpose is 0.

The water is sampled from various sources used so far for dinking or general purpose. The conductivity, but also the pH and the temperature is measured on site, while the sampling point is localized by GPS. The sample is bring then to the lab in appropriate container for bacterial analyses.

According to on site reading, other sampling is conducted further inland to determine the later migration of salt if any.

In the same way, a ground survey is conducted to determine the extend of the waves impact and its spatial variation.

Afterward, the results are integrated and processed on GIS and maps are generated to facilitate the readability of the data and visualize the area affected and the level of pollution.

Groundwater quality prior to Tsunami

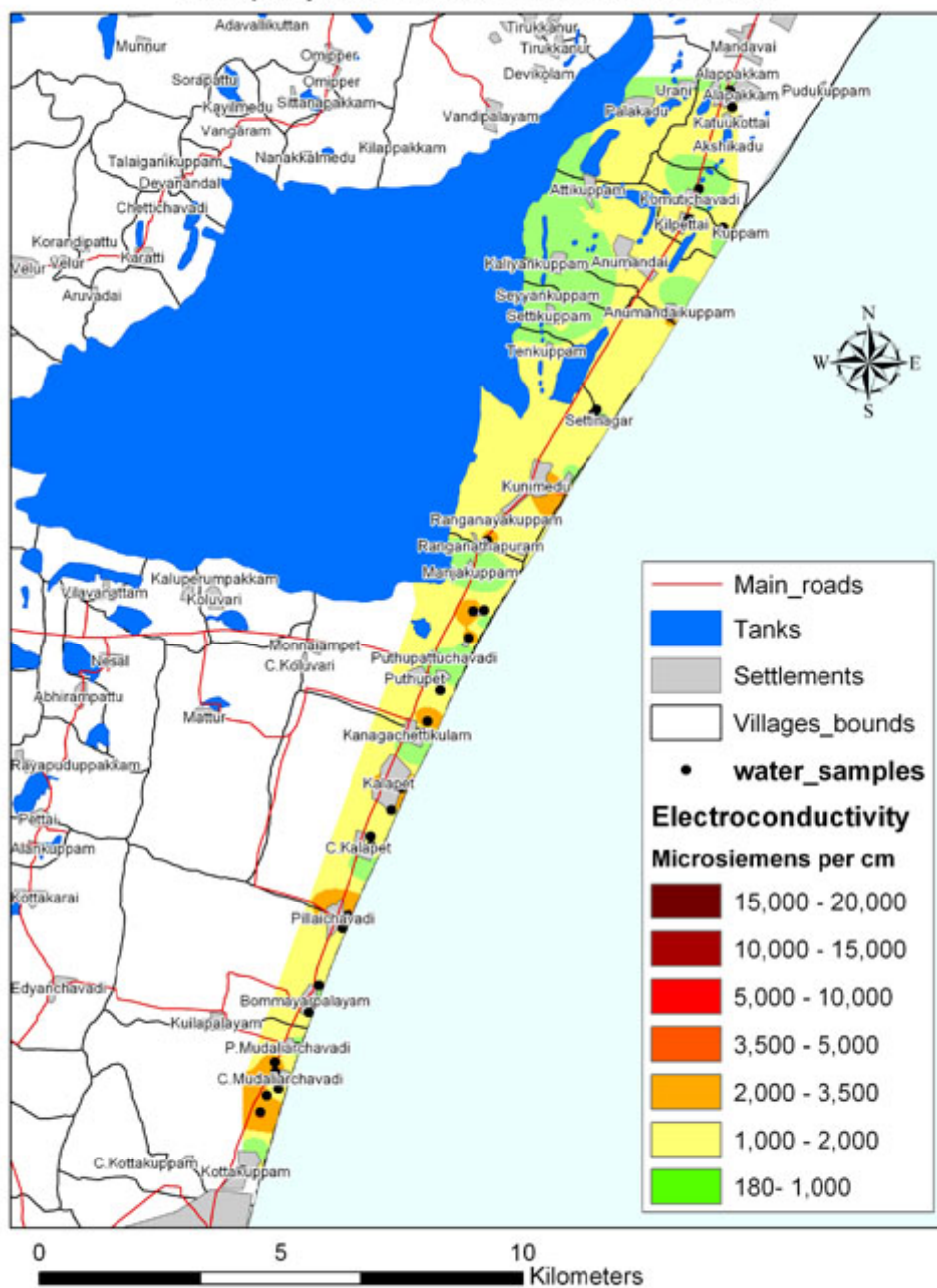
Since several years, a slow process of salinisation of the dune formation is observed. This results in undrinkable groundwater (as per Indian standard) more or less all along the coast. Nevertheless, people get us to it as long as it is not above taste tolerances. Most probably also because of the lack of available alternatives. Relatively fast changes was observed in some location, while others develop a level of salinity above 2000 $\mu\text{Sm}/\text{cm}$ which is then not drinkable at all.

In deeper aquifers, a fast and very important depletion of water level is observed due to heavy over extraction. In that context, major sea water intrusion is feared and can, as per simplified hydrogeological model developed so far, happen within a very short time (few years)

It is not possible anyhow to determine precisely the risk level as accurate data on the geological setup along the coast is not available. We can only highlight the absolute necessity to conduct the required investigations in order to secure the water supply for the larger area and its population.

About bacterial contamination, it is also monitored in many places since a long time. Anyhow, it was never monitored on a regular or systematic basis. There is hence no way to generate maps on the same.

Water quality in coastal area on December 20th , 2004



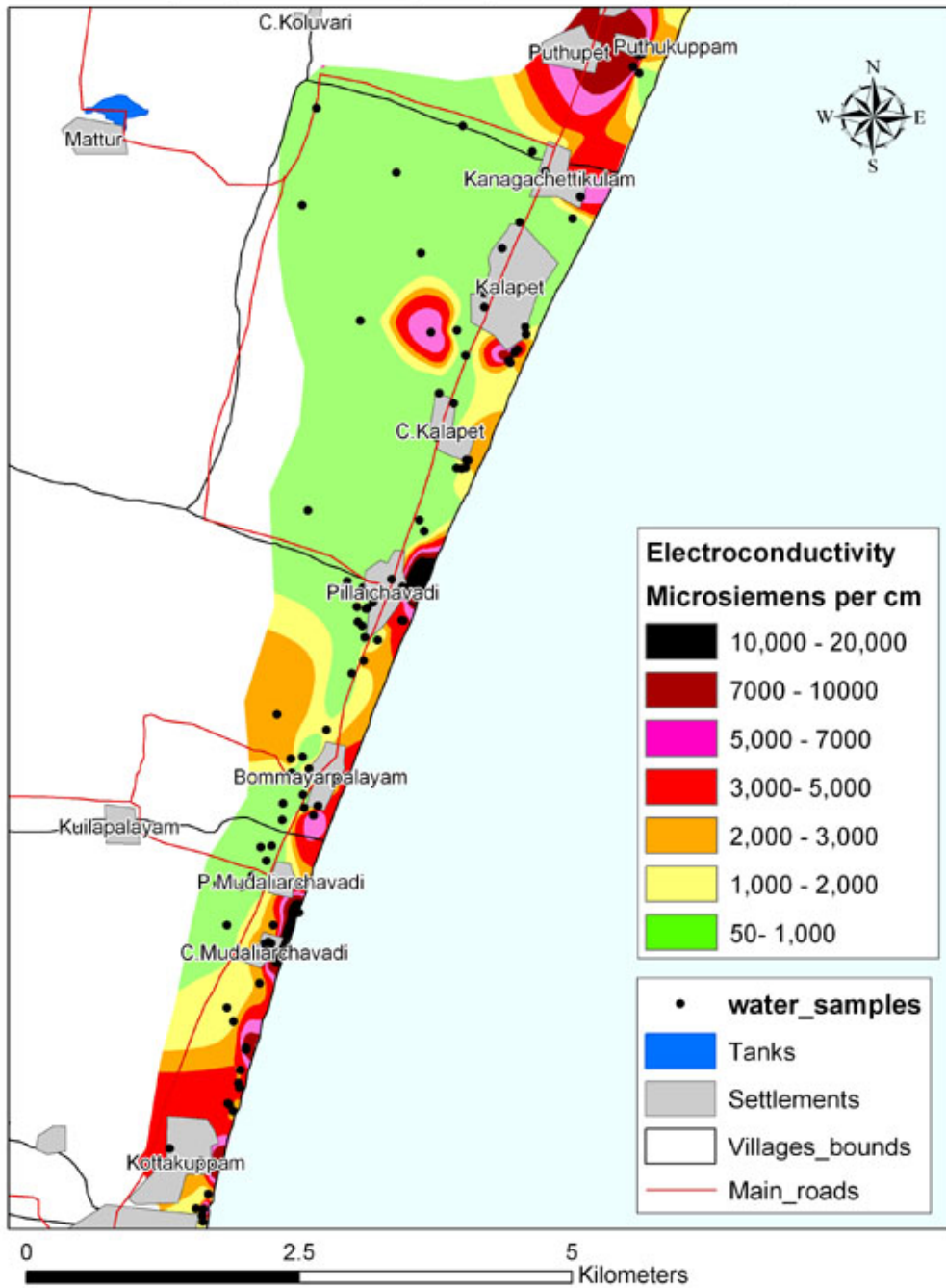
Groundwater quality after Tsunami

It can be seen that the salinity level has drastically increased, with levels turning around 3,500 $\mu\text{Sm}/\text{cm}$ and more everywhere, and up to 19,000 $\mu\text{Sm}/\text{cm}$ in some locations. It can be observed on the spot that plants are dying very fast now.

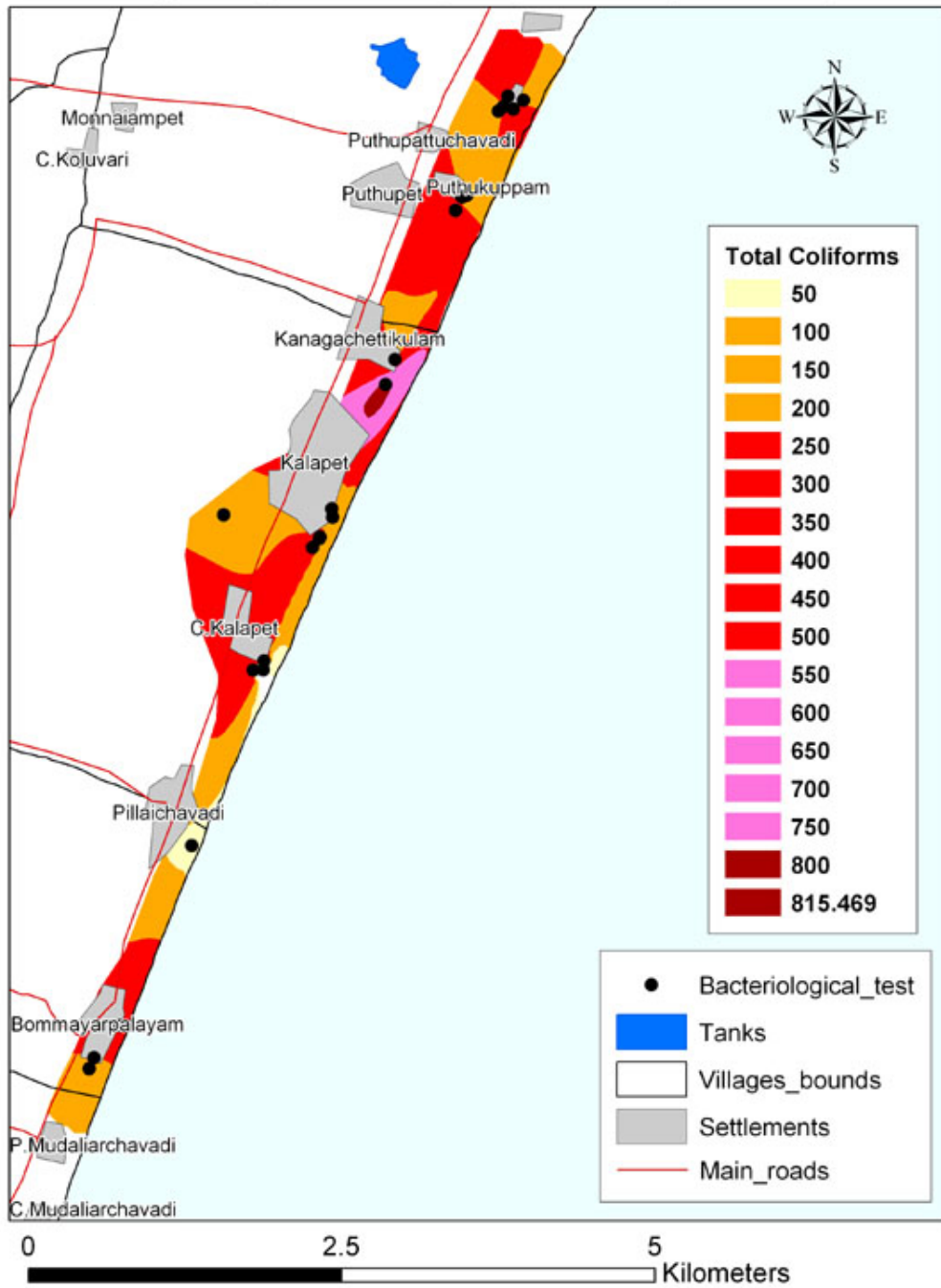
It is very clear that the entire Dune formation is now turned heavily saline and cannot be used anymore as a drinking water resource. Further west, the groundwater seems so far not too much affected at a part of some specific location, but it is necessary to maintain the monitoring in order to substantiate propagation of salt contamination through time, if any.

About the bacterial contamination, the same can be observed, as nearly all the samples show high level of e-coli and total coliform, absolutely unfitting for drinking purpose.

Water quality in coastal area, Survey from January 4th to 19th , 2005



Bacteriological test, Total Coliform, Survey from January 10th to 19th , 2005



Recommendations

It is clear that the beach population face now a very critical situation as an important part of their water requirement, the one coming from the wells along the beach so far, cannot be secured anymore. The constant (and even more important today) problem of bacterial contamination, with the lot of illnesses it is generating, cannot be disregarded as it is a constant and growing threat to public health.

We hence recommend to develop a plan of action following the points below:

- Proper measures have to be taken to secure and consolidate water supply of appropriate quality and quantity in the villages: new wells at appropriate location and new distribution systems must be developed.
- Treatment facilities must be developed to supply standardized drinking water as per quality of resources available (bacterial contamination, salinity).
- To try to rectify the saline water percolation in the shallow fresh water aquifer. This may be possible in some spot where the water does not get too heavily contaminated by pumping for a long period and check how the salinity level evolve.
- Conduct required investigations to evaluate the potential impact on the deeper aquifers
- Conduct researches on risk of short/middle/ long term intrusion of seawater in the system of aquifers.
- To take proper preventive measures against the intrusion of seawater in the deeper aquifers who is the source of drinking and irrigation water for the larger area. This can be done by developing a real groundwater management plan for the area.
- Regular monitoring of the quality of ground water.
- Mass awareness campaign about the ill effects of open defecation and other inappropriate sanitation and waste disposal.
- Construction of sanitation facilities, sewage, drains and solid waste compound.
- Recharge devices (check dams) in the upper part of the canyons
- Protection of the canyons outlet from pollution risk (fast and direct groundwater recharge areas).
- Development of alternative income generating enterprises for the women in the coastal villages.
- Development of settlement at suitable and safe locations (flood, high tidal, Tsunami, storm risks).
- To construct stone boulder protection walls in specific location for preventive measure of Tsunami effect, storm, but also erosion problem wherever needed.