

# **Possible Environmental Damage and Need Assessment in Tsunami Struck Areas in Southern Sri Lanka**

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## **1 Purpose**

This crude report was written on a volunteer basis after my visit to the tsunami struck area between Colombo and Matara. It only focuses on environmental and water resources engineering aspects of the problem. I see the problem from the point of view of an engineer in a US state agency, and someone who worked for the government of Sri Lanka for about 5 years in a similar capacity. The intent is to let professionals in similar fields to identify areas in which collaborative work could be undertaken between US, Sri Lankan and expatriate Sri Lankan professionals.

It is not easy to create a document like this because general policies or guidelines on environmental, energy and water sectors are not available in Sri Lanka. These sectors are always in conflict, and which issue gets the priority in a given situation depends on unwritten idiosyncracies. In this particular instance of the tsunami, only a few in the country believe, for example, that there is going to be a future shortage of fresh water in Sri Lanka. I however believe so, and therefore feel that issues related to the tsunami cannot be addressed in isolation, but should consider in conjunction with non-existent policies in some critical sectors.

## **2 Visited areas and physical damage intensity**

The casual survey of the affected area was carried out traveling from Colombo to Matara on the Colombo-Galle-Matara road in a mini van. Only a few interesting places were investigated in the 2 days spent on the road. The damage to property itself was seen as extremely variable, and depend on the distance from shore, elevation above sea level, and the level of energy dissipation provided by

trees, houses, walls, and under sea topography including corals. It seems like most of the damage occurred during the 10-20 minutes during which the water poured onto the land and returned to sea at a number of selected low points at the beach. The scour marks around buildings and trees indicated prolonged scouring effects due to the high velocity in the water that flooded the land.

### **3 Environmental damages**

The environmental damage to the affected area is obvious. Some of the damages are explained below.

1. The most obvious damage is the scour damage which affected the roots of trees, foundations of buildings and road embankments. This is not of significant interest to water resources engineers. However there is a need to point out that a better criterion is needed to mitigate the tsunami risk than using a simple 100 ft easement.
2. Change of the salinity of the fresh water and salt water marsh environments is also significant. This was visible particularly between Beruwala and Ginthota where there are a number of lagoon like areas. The true extent of this can be quite large. This effect is partly because of the water that flooded the marshes and became trapped.
3. Change of salinity of the agricultural lands. A vast amount of cultivated areas have been adversely affected in the aftermath of the tsunami. Some of the areas may not be usable for agriculture for some time. The resulting browning and drying of the vegetation can be seen over vast areas of the landscape.

4. The groundwater in many of the tsunami affected areas has an elevated amount of salinity. Many residents rely on groundwater for their drinking water supply. A remediation program is needed to recover the groundwater quality in these areas because of the lack of alternative supplies of fresh water. I saw areas in Koggala that have been affected in this manner. It is obvious that the groundwater cannot be used for drinking or washing. See Figure 1 for a sketch showing the possible situation before and after the tsunami. Figure 2 shows one of the proposals towards reduction of the salt water content. The idea behind the proposal is to provide source protection, and develop fresh water collection areas such as wetlands so that fresh water can be collected and protected. The trapped salt water can be pushed out of the system using the increased head.
5. The tsunami waves themselves were claimed to contain a thick tarry substance that has not yet been identified. This needs to be investigated for possible toxicity.
6. Heavy metal pollution is also suspected in the affected areas. There were some factories in the areas that spilled chemicals during the tsunami. It is necessary to investigate the extent of the damage in these areas.
7. There is a severe problem with solid waste management that can potentially ruin the water quality in the area. In clearing debris, solid waste is dumped in random areas including potential sources of fresh water. Immediate action has to be taken to identify fresh water sources in the area and steps have to be taken to prevent trash being dumped on lands that have drinking water sources. A short term solid waste disposal policy and a program is also needed.

Before any remedial plan is discussed, it is important to understand the spatial extent of the damage, and quantify the severity. The remedial action depend on these parameters. Most of the remedial actions may involve better water resources management as a key component.

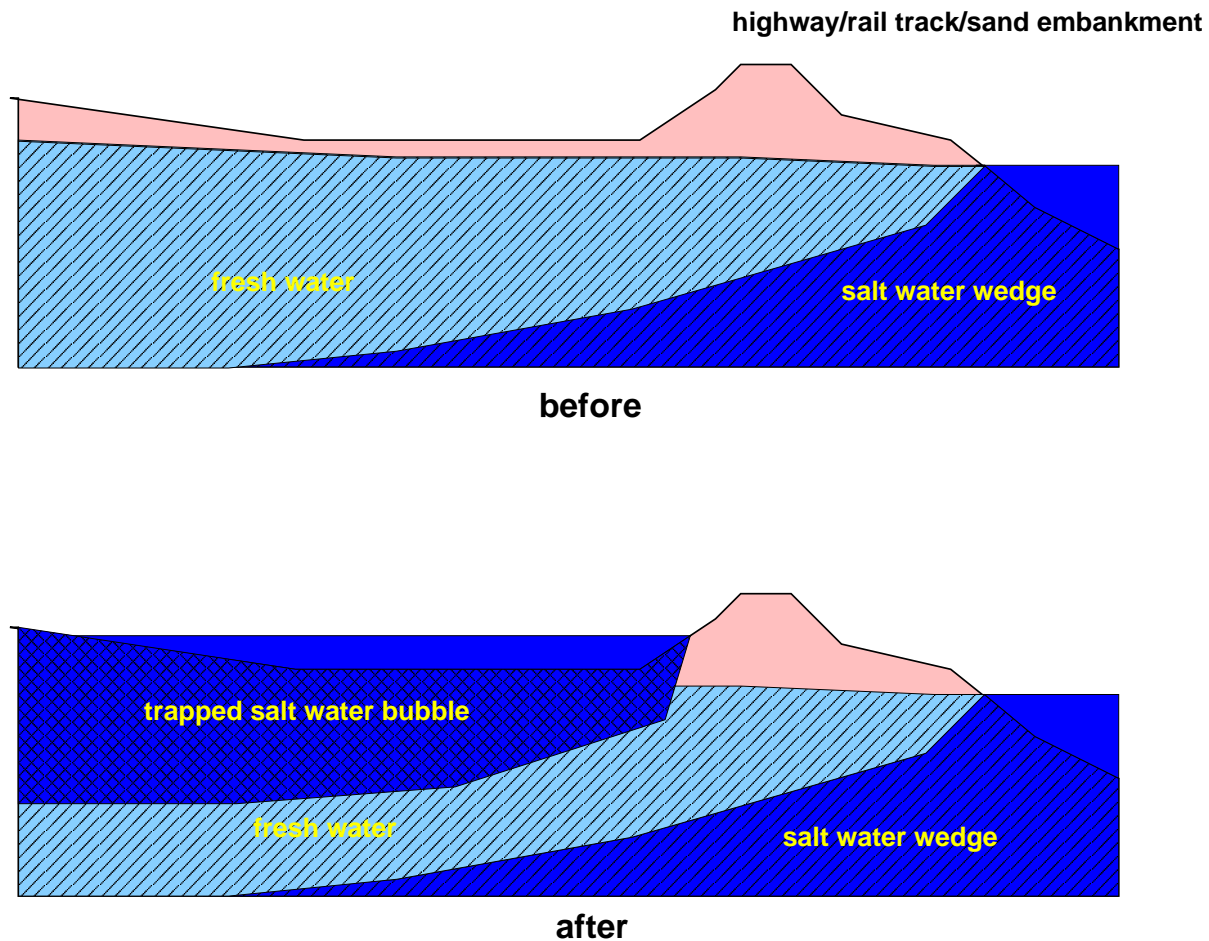


Figure 1: Entrapment of saline water in freshwater zones

### 3.1 Post tsunami environmental damages

There is a significant amount of environmental damage to the area resulting from the unplanned post-tsunami cleanup. Prior to cleanup of road debris, a cursory

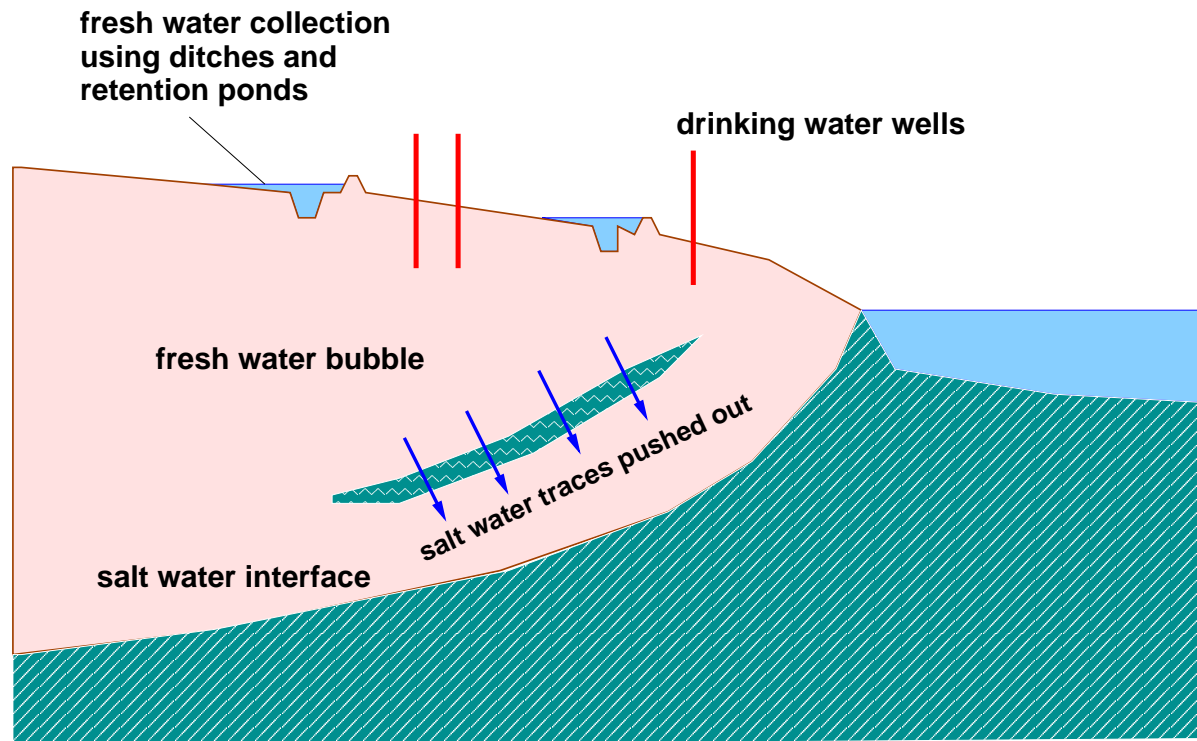


Figure 2: A proposal to recover saline land

survey could have revealed the sources of fresh water, materials, and solid waste dumps etc. In the effort to clean the roads in a rush, there has been dumping of all kinds of waste in even the most sensitive areas, making the entire area polluted with waste materials of unknown origin.

It is doubtful if the previously used drinking wells can be re-used for some time to come because of salinity, waste and toxic substances. The assumption that the Water Supply and Drainage Board can pump water from far away rivers to all the newly settled areas is an exaggeration. Any action plan undertaken now has to seriously consider the implications of post-tsunami solid waste dumping.

## **4 Damage to agriculture**

The damage to agriculture in the Matara area and other areas in the deep south have been recorded by the Dept of Agriculture, Matara campus. The damage to rice, aquaculture, and other farm crops have been extensive according to senior professionals. The views of the agriculture professionals have to be considered seriously in any of the future planning.

## **5 Engineering review of the reconstruction plan**

It is the responsibility of planners to seriously consider the following during the reconstruction effort.

1. Protection against tsunamis and large wave action: the hydraulics of wave actions and damage to property around a 1 km zone has to be studied to delineate a safe margin for human settlement. The 100 ft zone is too simplistic, and has to be reviewed with more parameters. Consideration should be given to the probability and the intensity because tsunamis are not common in Sri Lanka.
2. Protection against flooding: every effort has to be taken to preserve the integrity of the freshwater lagoons and groundwater aquifers, possibly integrating with wetland type treatment
3. Freshwater source protection: areas with freshwater resources have to be delineated for protection and agricultural/domestic use.
4. Policy for solid waste management: A solid waste management policy has to

be established and enforced vigorously. Otherwise, the tsunami struck areas will look like slums with sick people.

Unfortunately the "national water policy document" to be passed or has been passed in the parliament does not have any guidelines to this end.

## **6 Proposal of an emergency response system**

Even if tsunami is the issue under focus, many other catastrophies and emergencies have to be considered before responding to tsunamis. An emergency response center with following components can be responsible for a range of emergencies. Some of the programs needed on a national basis include:

- Extreme weather response program
- Hurricane monitoring program
- Earthquake monitoring program
- Landslide risk assessment and monitoring program
- Dam safety risk assessment and monitoring program.
- Tsunami risk assessment and monitoring program
- Toxic spill response team. Immediately after a hurricane, it is necessary for this team to go to a site and prevent any further spillage of toxic substances. This service is needed after major accidents, fires, and other disasters as well.

Establishment of a microwave network for data communication to a central location, creation of an emergency response team and creation of operational pro-

cedures during various emergency conditions can be accomplished with the assistance of US or other countries. Sri Lankan Army is probably one of the organized entity capable of taking some of the emergency response tasks, considering that it can be less exposed to one of the biggest problems- political manipulation.

## **7 A sample of the critical short term needs**

The general tone of this document has been to point out long term infrastructural needs in the water resources and environmental disciplines. However, some of the short term needs that may temporarily alleviate difficult situations should not be forgotten. I skipped them because I have seen the media picking them up. Some of the ideas listed were pointed out by some of my close friends.

One of the fixes to the drinking water problem is to extend the available pipe lines of the NWSDB to cover areas previously not covered. This involves the use of 400 mm-755 mm ductile iron (DI) pipes and smaller diameter HDPE pipes for primary and secondary transmission from existing major sources. Since there has not been a general water policy clarifying the long distance/trans-basin piping of water, this solution is legally valid.

In the water quality field, the need for equipment and training could also be identified and resolved without much infrastructure planning. Certain equipment used for detecting nitrates, heavy metals etc are not available in SL. Training of existing Shimadzu and Kjeldal brand named equipments in areas such as gas chromatography is critical.

## **8 Becoming aware of problems**

During any effort to rebuild the areas, a number of problem areas have to be cleared out. Anyone planning to work on the rebuilding effort will experience political problems first. To avoid this, and to make sure that some progress can be made, a number of bold actions have to be taken to separate real work from politics. Good politicians and professionals respect and listen to each other, and want to keep it that way for the benefit of both. Good administrators promote this and make sure that there is a healthy atmosphere for this to take place. The first step towards this (at a legislative level) is the creation of a number of public/state agencies that can house and safeguard professionals in the field. This I hope will ultimately benefit the situation. The agencies have to be responsible to the public and their representatives through their inherent transparency. They should not not be micromanaged by the politicians except at the policy level. Without this, none of the proposed solutions may bear fruit, particularly if they are to attract honest expatriates and foreign companies.

It is imperative that local professionals of the correct field get involved before any real work is carried out. Any work where a foreign company or a professional is involved has to happen as part of training or subordination of the local professionals. Blind programs where the local professional cannot explain the project has to be avoided. In any program that has a collaboration between both local and a foreign professionals, the local professional should define the needs and the foreign professional should generally guide and help the local team. The final product and the responsibility should belong to the local professionals.

There should be conditions imposed to have free flow of data and information

between scientific communities. Interim and final results have to be published and posted on the internet or some other place for public reviews and comments. Without these conditions, there is a tendency for resources to be wasted, and efforts be duplicated. The product quality will also suffer, and the potential for misinterpretation of results will become very high.

The issues in hand are not isolated single purpose issues. A single professional group representing agriculture, water supply, building construction, sociological, etc should never take the overall lead on the overall reconstruction project. Instead, people with general planning experience should coordinate the effort with contributions from these and other groups, supervised by representatives of the public (politicians). These conditions are necessary to make sure that the participation of the expatriates in reconstruction can be worthwhile.