Saline wells in Aceh

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The drinking wells in the areas of Aceh affected by the *tsunami* were polluted with debris and salt water. How has their rehabilitation progressed in the months since?

An earthquake followed by a *tsunami* hit the north-west coast of Sumatra, Indonesia, on 26 December 2004. The Province of Aceh was one of the worst-hit areas. Complete villages were swept away and many people lost their lives. For up to 5 kilometres inland the *tsunami* had an impact on people's settlements and changed their lives forever.

Medecins Sans Frontières (MSF) supported the emergency aid efforts along the west coast of Aceh facing the earthquake epicentre (off the south-west coast) and in the areas affected along the north coast facing the Strait of Malaka. All water systems were affected, from traditional wells to piped water systems; the water was saline and inadequate for drinking or other domestic purposes (e.g. washing, pour-flush toilets etc.).

Despite the determination of the displaced people, their return to the villages two months after the disaster was questionable from a water and sanitation perspective. This article describes the difficulties of rehabilitating the shallow wells in the villages. The data presented in this article were collected by the MSF fieldworkers in the post-emergency period from February till July 2005 in the Kebupaten Aceh Utara (Northern Aceh District).

During and after the emergency

In the initial stages of the emergency, an estimated 1–2 litres clean water per person per day was provided. In the following two months, this rose to 15 litres per person per day, matching the recommended Sphere standards for water supply in emergency situations.[1] At the same time, the number of latrines available rose to a target of at least one latrine per 50 persons.

By the end of February 2005, displaced people started to move frequently to and from their former villages. Key criteria were used to define the levels of damage in the *tsunami*-affected villages:

- loss of life, shelter and livelihood
- loss of shelter and livelihood
- loss of livelihood.

In general terms, the first category of damage occurred nearest to the seashore, whilst the third was nearest to the main road. A second set of criteria characterized the structure of the villages affected.

Settlements on the coastline. Fisherman engaged in small-scale net fishing lived under the first row of palm trees next to the beach. Sources for domestic water pre-*tsunami* were a mixture of brackish and fresh water shallow wells (2–4 m depth).

Settlements inland from the fish and shrimp ponds. These were inhabited by fish/shrimp or rice farmers. Sources of domestic water pre-*tsunami* were: shallow wells (3–5 m), river estuaries and irrigation channels. Some existing wells (e.g. near shrimp ponds) were saline. Some communities had small water distribution systems, or alternatively they bought drinking water distributed by truck.

Settlements near the main road. These are inhabited by rice farmers, as well as traders and others. The sources of domestic water pre-*tsunami* were: shallow wells (3–7 m), boreholes, irrigation channels, small water distribution systems and the sale of drinking water distributed by truck.

In general, the *tsunami* swept away all belongings and infrastructure nearest to the shoreline. Inland from the fish and shrimp ponds major damage to

The team cleans a well using a surface pump

A specially designed tool is used to flush the side walls of a well

houses, land and infrastructure occurred, whilst those along the main road suffered some damage to property and mainly livelihood (salt water on the paddy fields).

The team concluded that all *tsunami*-affected settlements faced the problems of pollution and salt intrusion into fresh water sources (predominantly shallow wells). It was assumed that those nearest to the shore would have most difficulty resettling. Priority was therefore given to the second most hard-hit category, those living near the fish-shrimp ponds.

Salt intrusion in the wells was a serious problem for which no handbook provided a ready solution. Trial and error was the best available strategy.

Affected traditional water resources

Whilst continuing the distribution of clean water to the temporary camps, the distribution to the affected villages was implemented as a joint effort, co-ordinated by the local authorities and supported by NGOs and the military. The WatSan activities included:

- The installation of 39 3000-litre water tanks, each equipped with a distribution ramp to supplement the existing district distribution network of the water authority, PDAM.
- A fleet of seven 5000-litre water trucks added to the already existing transport capacity of PDAM, bringing to the affected area outside Lhokseumawe town 200 000–250 000 litres of clean water per day for a period of almost five months.
- Water treatment plants in the district were improved and new ones were set up.
- Existing boreholes were rehabilitated, new ones drilled and small water distribution networks were reconstructed.
- Irrigation channels were reconstructed and electrical infrastructure repaired.
- Shallow wells for drinking water as well as those for other domestic purposes (bathing, washing, flushing toilets etc.) were repaired.

Well cleaning, repair and protection was seen as a priority, in order to create sustainable water provision in the villages. The water from the cleaned shallow wells would also supplement the limited available clean water supplied by trucks, and meet the total need for water for domestic purposes.

Assessing the shallow wells

The wells to be rehabilitated were selected in villages near the main road up to the shrimp and fish farms, according to the following criteria:

- Those producing the best-quality water before the *tsunami*, as reported by the people who had used them for drinking water.
- Near to locations where people had started to rebuild their homes.
- If the well was private, the owner had to guarantee to allow other villagers to use it.

Well cleaning

A well-cleaning team of three people was trained and equipped, with specially developed well-cleaning tools. The team started by cleaning an average of five wells per day. When the well cleaning first started (February 2005), in the absence of proper equipment, the turbidity was assessed from samples collected in transparent bottles, before and after the cleaning. Taste tests were conducted over several days, and interviews with users yielded qualitative information on improvements in the salinity of the well water. This primitive but effective monitoring was replaced in March by a more objective approach using conductivity and turbidity meters.

After a trial on some wells, over 90 per cent yielded 'clear water' within two days of the cleaning taking place ('clear water' is used to mean suitable for domestic uses other than drinking). The returning villagers used this clear water intensively for domestic purposes, even though the taste was too salty for drinking. It was hoped that once well water was drawn regularly freshwater would come from the aquifer. But even where users noticed a decrease in salinity, even after several weeks this was not sufficient to produce clean fresh water with an acceptable taste. Salinity remained a

Mud and debris are extracted from a well serious problem even after several months of drawing water, hampering the reconstruction of the communities.

The first wave of well-cleaning activities had created the basic availability of water for domestic use in all targeted settlements. With the hope of a possible improvement of water quality, repair and protection of the most promising wells for drinking water was implemented.

From March until June 2005 more than 350 wells were cleaned in more than 20 settlements, of which 10 per cent were repaired and improved with a concrete apron, drainage channel and soakaway pit.

Monitoring salinity by measuring conductivity

Conductivity monitoring using a meter confirmed the limited progress in salinity reduction. In most cases, cleaning the wells alone did not result in an acceptable drinking water of less than 900 microS (microSiemens, see also Table 1).

After a second trial, which linked the conductivity data to the location of the well, some clues emerged for identifying wells with the potential for fresh water yield. They should be:

- more than 300 m away from the sea
- less than 400 m away from a river bed or estuary
- more than 500 m away from fish/shrimp ponds
- as close as possible to rice fields or irrigation channels.

With the conductivity readings in the Aceh Utara villages the team concluded that wells with conductivity greater than 2500 microS were unlikely to improve significantly after cleaning, and that wells with less than 900 microS could be acceptable for drinking. Table 1 presents conductivity data collected in the period April to the end of June 2005.

In total 289 wells were monitored in 15 villages; 41 wells were found to have a conductivity of less than 2500 microS and only 5 of those were less than 900 microS (i.e. fit for drinking).

The results of the conductivity readings indicate that the improvement in water quality for drinking water purposes has been very limited. After a significant reduction in the turbidity of the well water the quality did not improve any further, yielding water suitable for domestic purposes like washing, bathing, toilet flushing etc. but not for drinking.

Very little has been achieved in reducing the salinity of the well water by drawing the clear water from the wells over a period of more than five months. Only five affected wells recovered to less than 900 microS to produce clean water for drinking. The quality of the water in the 41 wells in the promising range of less than 2500 microS could not be developed any further. In fact the conductivity readings only went down following periods of heavy rainfall.

Table 1. Monitoring results of the well cleaning in *tsunami*-affected desa in Aceh Utara

Villages	Number of wells cleaned	Number of wells <2500 microS conductivity	Number of wells <900 microS conductivity	Max. reduction – Conduct. Before/After
Muara Batu				
Dakuta	21	7	2	11700/9600
Mns Lhok	20	5	0	10000/9100
Mns Baro	22	5	0	3300/1320
Kuede Mane	20	0	0	7440/4360
Mns Drang	21	3	3	5400/4640
Samudera				
Kuta Krueng	15	5	0	4770/3680
Kuta Glumpang	18	0	0	6540/4570
Puúk	19	0	0	6020/4490
Sawang	20	4	0	7710/4540
Blang Nibong	20	8	0	2450/1760
Meucat	12	0	0	8320/5380
Tanah Pasir				
Matang Tunong	19	0	0	5850/5030
Matang Baroh	19	0	0	4540/3950
Kuala Cangkoi	35	4	0	26200/3000
Kuala Keureto Timor	8	0	0	10500/5970
TOTAL	289	41	5	

Future developments

With the wet season approaching, local people hope the heavy rains will replenish the ground water, and hence the wells, with fresh water. Modelling scenarios have been constructed to predict drinking water quality in future, and although these confirm the positive effect of rainwater falling in the hinterland, the benefits will be felt in the long- rather than short-term:

> 'It can be stated that shallow groundwater in some coastal areas may remain unsuitable for drinking water for about one to two years. This may be concluded from density-dependent groundwater flow simulations of the effect on a freshwater lens of the flooding by sea water (. . .) during and after the 26–12–04 *tsunami*. (. . .)'[2]

It is therefore expected that trucking drinking water to the *tsunami*-affected villages may be needed beyond the monsoon season. The conductivity in the 41 wells with less than 2500 microS will be an indicator for the potential availability of suitable drinking water in the villages.

Lessons learned

Little was known about the short-, medium- and long-term effects of large-scale intrusion of seawater in shallow wells as a result of a *tsunami*. The following lessons have been developed by the MSF WatSan team, in combination with other international research organizations:

- Pumping out turbid water, scrubbing the walls, and cleaning the floor up to the sandy soil improved the turbidity of the water to a pre-*tsunami* standard. This resulted in an initial reduction in conductivity by sometimes up to 50 per cent, but this was generally not enough to produce water fit for drinking.
- The pumping rate must be slow to match the well yield and to avoid wells collapsing or shallow aquifers being disturbed.
- Repeating the cleaning procedures gave no further improvement to water quality.
- The intrusion of seawater in the aquifer near shrimp/fish farms

causes salinity but this is probably unrelated to the *tsunami*.

- *Tsunami*-affected wells near freshwater sources like rivers, estuaries and irrigation channels tend to recover more quickly and become less saline after cleaning. These shallow wells can often be successfully rehabilitated.
- Wells with a conductivity reading of >10 000 microS near sources permitting salt intrusion (e.g. shrimp ponds) can be improved for turbidity only with the well-cleaning method. Often these wells were already problematic before the *tsunami*. Wells with a conductivity reading greater than 2500 microS are unlikely to return to their pre-*tsunami* function of supplying drinking water.
- A significant reduction in salinity is unlikely to occur before the end of the monsoon season.

About the authors

Jean François Fesselet is co-ordinator of the Water and Sanitation unit for Medecins Sans Frontières Holland. He participated in the first wave of relief workers; the Watsan unit then remained as a back office for technical support to the field. Ralph Mulders co-ordinated the fieldwork in Aceh Utara Indonesia from January until March 2005. He analysed the well-cleaning monitoring results based on the monthly field reports from the team in Aceh Utara, Indonesia.

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1. The Sphere Project (2004), www.sphere-project.org/handbook
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From our water correspondent

When the floods came to Bayanloco

October 2005

I am 53 years old and no member of my generation can ever remember the stream that flows through Bayanloco overflowing its banks. But in September this year it did so, three times, and the third time was a frightening experience. All the houses that were within 6 m of the banks were flooded. The rains were torrential and unexpected. The clouds did not look any different, and when the downpour started in the late afternoon, everyone took shelter and waited for the storm to spend itself. But this time, the skies would not stop emptying down the rain. The resulting toll stood at two children drowned and scores of homes flooded. Those houses whose walls were all already weakened by termites just dissolved into the surging stream.

We have heard of floods happening in the southern parts of Nigeria, in Lagos and Ibadan. The floods have been linked to inadequate housing layouts and blockage of drainages, especially by the ubiquitous plastic bags. These same reasons are applicable to the houses in BayanLoco. The health hazards that followed the floods are still with us, as pit latrines filled up and flowed into living quarters. The incidence of typhoid fever and water-borne diseases has also shot up, and there are more funerals now than celebrations. The population is bearing up as much as it can. So far, however, there has been no official response from the health or town-planning authorities.

After the numbness that attends such tragedy, the community is picking up the pieces and we are brainstorming on how to prepare and prevent future disasters. My role has been one of awareness raising on the need for individuals and families to observe basic hygiene rules in food preparation, and ensuring that water used for drinking is boiled or treated.

Kafanchan's Bayanloco community has no visible presence of the local government health department. The recurrent malaria and diarrhoea epidemic leads to regular illness outbreaks and death, especially among children.

Fantsuam Foundation has several of her microfinance clients resident in the Bayanloco community, and they have requested community-wide intervention regarding the lack of water, sanitation, waste removal and other basic infrastructure and services for the community. Sometimes Fantsuam clients have to divert their microfinance loans to meet hospital expenses, thus worsening their economic situation.

Fantsuam would like to use its experience of microfinance administration to engage with the community, to clarify what it wants, and to assess and influence their demand for an environmental health project. We expect that by using participative approaches, it will be possible to focus on behaviour change, move responsibility for community health closer to the users of the service, and make willingness to pay a criterion for prioritization of the services. The proposed activity will start with identification of our clients' environmental health priorities, and empowering them to invest their own resources and enter into dialogue and negotiation with statutory authorities to stimulate a productive working relationship. This will be a learning process for the community, and will generate a list of environmental health investments and services, reflecting the community's perceived needs, and available resources.

The data gathering will improve self-awareness of the relationship between beliefs and behaviours, and level of correlation between knowledge and actions. It will facilitate on-site sanitation and provision of water-supply facilities, water storage tanks, washbasins, showers, VIP latrines, drainage, introduction of solid-waste disposal charges, and the selection of village environmental sanitation committees.

If there are readers of *Waterlines* who have worked on how rural community participation in environmental health can be integrated into job and income generation, suggestions will be most appreciated.

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