



Disaster Management Community



Environment

Water Community



Solution Exchange for the Disaster Management Community

Solution Exchange for the Water Community Consolidated Reply

Management of Water and Sanitation during Disasters - Experiences

Compiled by G. Padmanabhan and Pankaj Kumar S., Resource Persons and Nupur Arora and Ramya Gopalan, Research Associates
13 June 2007

From V.R. Raghavan, Oxfam GB, Kolkata
Posted 15 May 2007

Dear Members,

While working in the disaster hit areas of Eastern and Southern Indian states for last three years, I have observed that in the immediate aftermath of a disaster (mostly floods and cyclones), there is severe shortage of clean water, and inadequate sanitation facilities. Although drinking water is provided by the relief agencies, its only for a few days, and not adequate to cater to the demand across all the affected areas.

Most of the flood prone villages have inadequate water facilities, and the better conditioned water sources are accessible only to some privileged class/communities. The marginalised communities have to drink floodwater during the water logged days after the floods. In some areas, women avoid eating during floods due to lack of privacy and adequate space for defecation. In spite of several rehab agencies responding to immediate requirements to restore the situation, there is need to explore some sustainable solution to address the issue of WATSAN, Hygiene and Waste management.

In this context, I would like to learn from members:

- How to sustain suitable water sources and maintain community preparedness to manage these water and sanitation facilities both in villages, slums or small towns prone to water logging during and post disaster times.
- What are the mechanisms for appropriate excreta disposal facilities and instituting appropriate waste disposal systems during disasters?

- What are the measures taken by Total Sanitation Programme and other International Agencies working in the area of WATSAN, in designing and disseminating appropriate public health education and awareness campaigns for disaster situations and otherwise?

I would also request members to provide examples of:

- Permanent solutions for challenging environments (flood prone, high water table level, etc) in the area of WATSAN and public health and hygiene.

Looking forward from the community for learning and experiences as well as suggestions for improving the conditions of the people in flood prone and water logging areas.

Responses were received, with thanks, from

1. [Ranjan Kumar Mallick](#), Orissa State Water and Sanitation Mission, Bhubaneswar
2. [P. C. Joshi](#), Department of Anthropology, Delhi University, Delhi
3. [Arunabha Majumder](#), All India Institute of Hygiene of Public Health, Kolkata
4. [K. Y. Babu](#), Consultant- WES, UNICEF, Tamil Nadu
5. Ramesha C., Karnataka State Pollution Control Board, Bangalore ([Response 1](#); [Response 2](#))
6. [Arjun Khajuria](#), Sphere-India URS, New Delhi
7. [C. Vijayakumar](#), AFPRO, Bangalore
8. [Satheesh Kumar](#), United Nations Development Programme, Vijayawada
9. [A. K. Sengupta](#), WHO India Country Office, New Delhi
10. [Enamul Hoque](#), Oxfam GB, Islamabad

Further contributions are welcome!

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Summary of Responses

Management of water and sanitation (watsan) during disasters is a very valid and pertinent issue to address, members felt, and responded to the query by providing technological solutions and citing experiences dealing with watsan in disasters. Respondents agreed sustainable water supplies and sanitation are the most crucial services during disasters and stressed that existing water and sanitation projects, while generally meeting needs during normal times, may not be appropriate during disasters.

Discussants stressed the importance of ensuring the availability of safe water and maintaining minimum **standards of water quality, sanitation and hygiene** during emergencies. The majority of health problems during disasters stem from poor hygiene practices due to the lack of sufficient potable water. Members identified desirable [minimum standards](#) to ensure sufficient quantities of water are available during disasters; highlighting standards would increase sustainability and cost effectiveness of water use and wastewater disposal.

In addition, respondents cited **experiences** addressing water and sanitation in disaster situations, from different contexts with corresponding solutions. In [Orissa](#) as part of relief efforts volunteers provided

“hygiene kits” and drinking water to affected communities, successfully tackling the health and hygiene issues related to the 2006 floods. Members felt agencies and governments could easily replicate this type of intervention and also use it as an entry point to address broader sanitation and development issues. In **Gujarat**, a huge distilling facility provided safe water after the 2001 earthquake, and in **Tamil Nadu**, an NGO supplied bottled water to affected families.

Discussants further mentioned **different technologies** that communities and organizations could adopt during disasters. One suggestion was using Halogen tablets and disinfectants to purify dug wells, which worked well during the floods in Malda district, [West Bengal](#). Halogen tablets mixture (consisting of alum/bleaching powder-chlorine) was used by [UNICEF](#) and Public Health Engineering Department (PHED) in East India particularly during the 2001 and 2004 Bihar and Assam floods.

Based on [Red Cross's](#) intervention during Tsunami Operations and Floods in 2005, members also recommended deploying mobile treatment units to disinfect potable water. These mobile water purifications units can purify available potable water during a disaster situation, and consist of simple units of carbon filters, sand filters and a chlorination chamber. The units attached to inbuilt Diesel Motor pumps do not require electric power and can give 3,000 to 5,000 liters of purified water per day. In Rediarpet, Cuddalore district, **Tamil Nadu** an organization installed one such unit following the Tsunami and the local communities themselves operated the unit for four months providing people pure, clear, odorless and disinfected drinking water. Respondents opined that preparing mobile water purification units and keeping them ready for deployment during disasters would be a good approach to disaster preparedness.

In Tsunami affected Kanyakumari district, **Tamil Nadu** the organizations used a two-pronged approach. First, they disinfected bore wells, infiltration and open wells and then identified additional sources of water, such as farmer's wells from inland areas, to ensure a regular supply.

Another recommendation was using [ecosan toilets](#), which members felt are the most sustainable, cost-effective and technically viable option for sanitation during disasters and also can serve as a permanent sanitation solution in areas with high water tables and/or are flood prone. For example, in Tsunami affected villages of Nagapattinam district, [Tamil Nadu](#) and [Auroville](#), **Pondicherry** organizations involved in relief efforts successfully promoted the use of ecosan toilets. At the same time, drawing from the experience in Tsunami affected Cuddalore District discussants cited the experience of [BLESS](#) and highlighted that introduction of ecosan toilets during/post disaster scenarios is difficult in emergencies, because using ecosan toilets requires significant behaviour change, which needs considerable time.

Finally, respondents pointed out that while using raised tube wells and platforms in flood prone areas protects water supplies from contamination for the few days of floods, this approach is expensive and tends to increase the drudgery of women in fetching water for a larger duration in the year. As a progressive alternative to tackle this issue, members mentioned how [Oxfam](#) tackled this issue during the East India 1998 floods, by raising only the head and suction pipe of the hand pump, giving the community the flexibility to raise/descend or cap/protect the tube well when appropriate.

Along with mentioning various technologies, respondents listed several **quick short term measures** to ensure safe drinking water supplies, and quality sanitation and hygiene facilities during disasters.

Safe Drinking Water

- Mapping disaster prone areas
- Working out mitigation strategies need for disaster prone districts
- Creating water sources, storage structures and supply mechanisms as a standby in strategic locations
- Preventing man-made contamination of aquifers in certain zones
- Making low-cost water purifying technology and low-cost excreta disposing mechanisms (i.e. Sulabh) available

Sanitation and Hygiene Facilities

- Making the construction of full functioning toilets in schools, religious centres and community centres mandatory
- Selecting (carefully) locations in high water table areas (i.e. elevated points like sand dunes and exposed rocks) for backup sanitation facilities, which will not affect nearby water sources
- Adopting ecosan toilets in all high water table areas

Along with the above, members suggested several **technical interventions** towards ensuring safe water supplies:

- Disinfecting all tube wells and hand pumps immediately after floods by using Bleaching powder (200mg/l= Super Chlorination/Sodium Hypochlorite o/Calcium Hypochlorite Bleaching Powder) dose
- Distributing Halogen tablets before and during flooding along with packets with measured quantities of Alum + Lime + Bleaching Powder to each family as a disaster preparedness step
- Promoting earthen filters
- Practicing regular chlorination in water storage tanks in the relief camps
- Disinfecting dug wells by drip chlorination and ponds employing proper care and precaution
- Boiling drinking water during and after flooding

Finally, discussants emphasized that serious efforts are required between the end of relief operations and the start of health and sanitation campaigns, to guarantee sustainable water supplies and sanitation facilities and highlighted that community maintenance and preparedness must go hand in hand.

Comparative Experiences

Orissa

Sanitation and Hygiene Operations during Floods, Kendrapara District (from [Ranjan Kumar Mallick](#), Orissa State Water and Sanitation Mission, Bhubaneswar)

During the floods in 2006, five blocks of the district were most hit and 126,000 households were affected, and thousands more marooned. Several agencies, the government, donors, UNICEF and NGOs provided relief to over 179 villages and 33 Gram Panchayats in the blocks. UNICEF tied up with NSS volunteers, trained them to undertake relief operations in a campaign mode. As a result, the affected villages received drinking water pouches and hygiene and sanitation kits. Read [more](#)

West Bengal

Disinfection of Existing Water Sources and Other Preparatory Measures, Malda District (from [Arunabha Majumder](#), All India Institute of Hygiene of Public Health, Kolkata)

Immediately after the 1998 floods in the district all tube wells and hand pumps were disinfected using either Bleaching powder or Sodium Hypochlorite or Calcium Hypochlorite. Halogen tablets were also distributed before and during the floods. Additionally, packets with pre-measured quantities of Alum + Lime + Bleaching Powder were given to each family as a disaster preparedness measure. These efforts undertaken together with [UNICEF](#) gave good results during the disaster.

Tamil Nadu

Ecological Sanitation, Nagapattinam District (from [K. Y. Babu](#), Consultant- WES, UNICEF, Tamil Nadu)

After 2004 Tsunami, affected villages in the district, [SCOPE](#) promoted the use of ecosan toilets as a permanent sanitation solution for the area, since it had a high water table, was flood prone and also had

water scarcity issues. This effort has proved to be the most cost effective and best technical option for sanitation in the district, and was also welcomed by the agricultural community. Kameswaram, first tsunami-hit village, now has 100 household centered Environmental Sanitation Toilets.

From [Enamul Hoque](#), Oxfam GB, Islamabad

Assam

Mobile Toilet Solutions for Displaced People

In the 2004 floods, digging a pit in the embankment or road was not allowed for fear of the embankment collapsing. Therefore, to provide mobile toilet solutions targeting displaced people along embankments or in urban centres Oxfam's partner [Morigaon Women's Samiti](#) distributed mats and plastic sheets to families on embankment to especially create a privacy screen for women's toilets. The PHED later replicated this effort. Read more

International

Bangladesh

Distributing Treated Water in Plastic Bags

During the 1998 mega floods, hundreds of [Oxfam](#) volunteers distributed treated water by filling plastic bags half with water and half with air and then throwing this towards people stranded on the roof. The water bags float in water, so people can collect these. This also helped in keeping motorised relief boats at a safe distance from the fragile submerging house and enabled access to water where difficult especially for those marooned.

Sanitation Options for Women and Girls

During the 1998 floods, clogged and overflowing latrines left women and girls with no alternate options. Oxfam distributed polythene bags for disposing human waste to women taking shelter in crowded buildings. They used these bags, creating a private space with bedsheets and threw them into the water, which later drifted to neighbouring kitchens. Later Oxfam introduced bamboo containers to be collected by municipal sweepers, and the subsequent cleaning of urban public drains proved to be expensive.

Sustainable Sanitation Systems, Aceh Province (from [Salathiel R Nalli](#), CARE International, Banda Aceh, Indonesia)*

Initiated by [CARE](#) as part of the [Tsunami Recovery Program](#); 40% of people living independently have flush toilets with septic tanks acting as soak pits, resulting in direct contamination of ground water. The contamination of high water tables and nearby shallow wells poses health hazards to 60% of dependent households. CARE thus installed sanitation systems, which require treatment, watertight septic tanks, and does not allow release of untreated wastewater into public drains.

* *Offline Contribution*

Sri Lanka

Mobile Water Purification Plant, Pottuvil (from [Ramya Gopalan](#), Research Associate)

Introduced by German Red Cross to provide clean drinking water in refugee camps and homes with salt water contaminated wells post-tsunami. The system pumps muddy water from a stream into pools and after chlorination and distillation the clear water drawn off the top is filtered and pumped in waterbeds called bladders. This feeds tanker trucks, which then fill tanks at refugee camps and other sites providing 150,000 litres of clean water every 10 hours with no disease outbreaks recorded. Read [more](#).

Related Resources

Recommended Documentation

Kameswaram Tsunami-Hit Village Becomes a Model village for Eco-Sanitation (from [K. Y. Babu](#), Consultant- WES, UNICEF, Tamil Nadu)

By K.Y. Babu; WESNET Newsletter; February 2007

http://www.wesnetindia.org/fileadmin/newsletter_pdf/Feb07/Kameswaram-ECOSAN.pdf (Size: 137 KB)

Outlines the concept and importance of Ecological Sanitation (ECOSAN) technology, implemented by SCOPE in Tamil Nadu particularly in Tsunami hit coastal villages having high water tables

Tsunami Response Program Update (from [Salathiel R Nalli](#), CARE International, Banda Aceh, Indonesia)*

CARE International Indonesia, July, 2006

<http://www.tsunamispecialenvoy.org/progressreports/care2.asp>

Highlights watsan activities in the Tsunami affected region i.e. water quality testing, waste management, reconstruction/rehabilitation of wash stations, and septic systems

* Offline Contribution

From [Ramya Gopalan](#), Research Associate

The Challenge in Disaster Reduction for the Water and Sanitation Sector: Improving Quality of Life by Reducing Vulnerabilities

Pan American Health Organization (PAHO/WHO), United Nations Children's Fund (UNICEF), International Strategy for Disaster Reduction (ISDR), International Federation of Red Cross and Red Crescent Societies (IFRC), 2006

<http://www.paho.org/English/DD/PED/DesafiodelAgua.htm>

Draws attention to ensuring that water and sanitation systems remain fully operational in the aftermath of natural disasters, highlights importance of the risk management tool

ADB Bringing Clean Water and Sanitation to Rural Indonesia and Tsunami-Affected Areas

Asian Development Bank (ADB), Manila, Philippines, 7 April 2005

http://www.adb.org/Media/Articles/2005/7293_Indonesia_water/ (Size: 439 KB)

Details the Community Water Services and Health Project targeting 1,000 communities-1.2 million people in 20 districts to provide safe drinking water and improved sanitation.

Water Modelling for the Tsunami Recovery Program

Geospatial Solutions, 4 December 2006

<http://lbsuc.geospatial-online.com/gsslbsuc/article/articleDetail.jsp?id=389782>

Details the collaboration between Bentley water modelling experts with the American Red Cross team to design water and sanitation infrastructure in Indonesia's Aceh region.

Fighting Epidemics with Clean Water

Denise Grady, The New York Times, 18 January 2005

Click [here](#) to view link

Details the mobile purification plant in Sri Lanka to provide clean drinking water for about 20,000 people of refugee camps and Tsunami affected homes in the Pottuvil region

Recommended Organizations

United Nations Children's Fund (UNICEF), New Delhi (from [Ranjan Kumar Mallick](#), Orissa State Water and Sanitation Mission, Bhubaneswar and [Arunabha Majumder](#), All India Institute of Hygiene of Public Health, Kolkata)

73, Lodi Estate, New Delhi 110003; Tel.: 91-11-24690401/24691410; Fax: 91-11-24627521/24691410; newdelhi@unicef.org; http://www.unicef.org/wes/index_emergency.html

Provided immediate assistance to ensure continued and effective functioning of water and sanitation systems during the Tsunami, followed by rehabilitation and reconstruction programmes

National Social Service (NSS) Unit, Orissa (from [Ranjan Kumar Mallick](#), Orissa State Water and Sanitation Mission, Bhubaneswar)

Kendrapara Evening College, Kendrapara, District Kendrapara, Orissa

NSS volunteers of the Kendrapara College jointly worked with UNICEF in the District undertaking relief operations catering to water and sanitation needs during the floods in 2006

Society for Community Organization and Peoples Education (SCOPE), Trichy (from [K.Y. Babu](#), Consultant- WES, UNICEF, New Delhi)

P/17,6th Cross, Ahamed Colony, Ramalinganagar, Trichy 620003 Tamil Nadu; Tel.: 91-0431-2774144;

Mobile: 91-9443167190; scopeagency@rediffmail.com, scopeagency86@rediffmail.com;

www.scopetrichy.org

Pioneer in ECOSAN technology, working towards ECOSAN compost toilets design and construction, preventing water contamination and ensuring reduced water use especially in Tsunami affected areas

BLESS, Tamil Nadu (from [Arjun Khajuria](#), Sphere-India URS, New Delhi)

Market Committee Campus, Salakkarai, Cuddalore Port 607003, Tamil Nadu; Tel.: 91-4142-227254; Fax:

91-4142-227016; admin@bless.org.in; <http://www.bless.org.in>

Aims at making Cuddalore as a model total sanitation district taking into account that it is a coastal district with a need to conserve the upper water layer resources particularly during disasters

From [Enamul Hoque](#), Oxfam GB, Islamabad

Oxfam, United Kingdom

Oxfam House, John Smith Drive, Cowley, Oxford OX4 2JY United Kingdom; Tel.: 44-0-1865-473727;

http://www.oxfam.org.uk/what_we_do/emergencies/index.htm

Undertakes relief operations during emergencies; recommended in particular for its experience in providing water supply and sanitation services during the Bangladesh and East India floods in 1998

Morigaon Mahila Mehfil, Assam

Civil Hospital Road, H.O. Morigaon, Police Station and District Morigaon, Assam

Works towards women empowerment and was actively involved as Oxfam's partner in providing mobile toilet solutions for displaced people particularly women during the Assam floods in 2004

Indian Federation for Red Cross and Crescent Societies (IFRC), India ([Satheesh Kumar](#), United Nations Development Programme (UNDP), Vijayawada)

Red Cross Building, 1 Red Cross Road, New Delhi 110001; Tel: 91-112- 371 64 24; indcross@vsnl.com

<http://www.ifrc.org/what/disasters/response/tsunamis/index.asp>

Indian Red Cross in involved in disaster preparedness and healthcare work; recommended for deploying mobile water treatment units in affected villages during the Indian Ocean Tsunami.

CARE International, UK (from [Salathiel R Nalli](#), CARE International, Banda Aceh, Indonesia)*

10-13 Rushworth Street, London, SE1 ORB, United Kingdom; Tel.: +44 (0)207 934 9334; Fax: +44 (0)207 934 9335

<http://www.careinternational.org.uk/Water+and+sanitation+95.twl>

Involved in the Tsunami Recovery Program of Aceh Province, Indonesia with water and sanitation as a priority, working on suitable sewage disposal and safe sanitation systems

* *Offline Contribution*

Water and Sanitation Program (from [Ramya Gopalan](#), Research Associate)

United Nations Team for Recovery Support (UNTRS), Apex Towers (opposite Kaliappah Hospital), 54, 2nd Main Road, R.A.Puram, Chennai 600 028; Tel.: 91-44-42303551; Fax: 91-44-42303556; info.untrs@undp.org; http://www.un.org.in/untrs/content_01.asp?ref=pa_06

The program in the Tsunami relief and recovery aims at a safe environment and reducing the risk of waterborne diseases due to contaminated water and unsanitary conditions

Recommended Contacts and Experts

Dr. Lucas, Solid Waste Management Unit, Auroville (from [Arjun Khajuria](#), Sphere-India URS, New Delhi)

Auroville's Future, Center for Urban Research, Administrative area, Auroville 605101 Tamil Nadu; Tel: 0091-413-2622-170; aurofuture@auroville.org.in

Involved in design and construction of ECOSAN toilets, like dry toilets, which can be used to reduce water usage and prevent contamination of high water tables particularly during disasters

Recommended Portals and Information Bases

WELL (from [Enamul Hogue](#), Oxfam GB, Islamabad)

<http://www.lboro.ac.uk/well/links/links.htm>

Web resource capturing technologies and experiences from around the world on simple water treatment, which can be used during disasters

Water and Sanitation for Emergencies (from [Ramya Gopalan](#), Research Associate)

Water, Engineering and Development Centre, Loughborough University, UK

http://wedc.lboro.ac.uk/projects/mdg_target_country.php?area=1

Accounts experiences of members of WEDC staff, provides publications, projects and technical notes aimed at appropriate, affordable and sustainable watsan facilities

Responses in Full

[Ranjan Kumar Mallick](#), Orissa State Water and Sanitation Mission, Bhubaneswar

You have raised very valid and pertinent question. I give below my experience on how we tackled the health and hygiene issues in Kendrapara district during the recent floods from 31st August to 5th September 2006.

In these floods, the entire coastal Orissa, and especially Kendrapara district were affected. Five blocks of the district, namely Marshaghai, Kendrapara, Mahakalapada, Garadpur and Derabisi were the most hit and a population of one lakh and 26 thousand households were affected, and thousands marooned. Several agencies including Govt. departments, International Donor Agencies, UN bodies like UNICEF and local NGOs geared up to provide much needed relief to the affected people. The relief operation spread over 179 villages and over 33 Gram Panchayats in the above five blocks.

Interventions by UNICEF

UNICEF also tried to contribute its bit in providing emergency relief to the affected people. The relief operation by UNICEF started in right earnest on 4th August upon request by Rural Water Supply and Sanitation (RWSS) Department. The RWSS office requested UNICEF to provide drinking water pouches and bottles to affected people as an emergency measure. Later, when the floodwaters subsided, UNICEF felt that it was imperative to provide clean drinking water and other hygienic kits to arrest the spread of epidemics.

In order to streamline the operations, UNICEF tied up with National Social Service (NSS) unit of Kendrapara Evening College. A request was made to the NSS Programme officer to choose a band of dedicated volunteers to undertake the operations. Hundred volunteers were engaged and were divided into eleven groups led by a teacher. Six boys groups with a 54 members and five girls group with a membership of 45 were formed. After the team and groups were formed, they were trained on the objectives of the campaign and their roles and responsibilities. The operation was undertaken on a campaign mode.

Distribution of hygiene and sanitation kits

The villages and households that were targeted were identified clearly before hand to alleviate any duplication and confusion. In beginning it was decided to distribute 20,000 kits. At the end of the campaign 16,375 health kits and 5,000 bottles of drinking water were distributed. The Health kit included five ORS packets, 10 water purifier packets (PUR), five soaps and one leaflet containing health and hygiene messages. The NSS volunteers tried to cover the most vulnerable villages. 52 villages were covered in five blocks spanning over 17 Gram Panchayats. The entire campaign was undertaken for 7 days spanning from 10th to 17th September 2006.

Monitoring and Evaluation

In order to make a quick impact assessment of the campaign, an extensive monitoring format was developed and filled up by the volunteers during door-to-door visit. Village people accepted the local students and volunteers did not face any problem during distribution. A re-assessment was done three weeks to look for the reoccurrence of any hygiene-related problems like diarrhea and de-hydration. An attempt was also made to know the reaction of the people regarding this intervention.

Lessons Learnt

Though this intervention was a small one, it was quite significant in terms of impact. First, though many people were providing relief material, nobody gave serious thought to the hygienic aspects and to providing clean drinking water. Through this intervention the importance of hygiene during the calamity was underscored. The people also responded positively by using the distributed health kits, which provided clean and hygienic environment to the villages. Moreover, people became aware of the importance of sanitation.

This small intervention on sanitation can be replicated in future calamity situations and is a very good entry point activity not only on sanitation front but also on social development. As a result of this small intervention, people will take the sanitation message more seriously, which they would have taken in a lighter vein earlier. Thus a serious effort needs to be made from the point where relief operation stops and a new campaign on health and sanitation starts. Each volunteer who participated needs to get a certificate by UNICEF.

[P. C. Joshi](#), Department of Anthropology, Delhi University, New Delhi

I think that water becomes the most important necessity in all kinds of disasters. In the Indian context, provision of clean water as part of emergency relief was made during the Gujarat earthquake and Tsunami. In Bhuj, Gujarat, there was a huge distilling facility to provide water during emergency, while

in Nagapattinam and other areas in Tamil Nadu, bottled water was made available to the affected families. In both areas, there was no epidemic due to safe water practices. In fact, due to saline water logging, there was a marked drop in the malaria incidence that year in Tsunami affected areas.

However, such measures are costly and can be implemented only for a short time. The need for a sustainable water and sanitation intervention is indeed very crucial. Low cost water purifying technology and Sulabh type of low cost excreta disposing mechanisms need to be developed. Water and sanitation projects have made a very effective contribution in this regard, but whether their efforts will be applicable to the disaster situation needs to be seen and experimented with.

Arunabha Majumder, All India Institute of Hygiene of Public Health, Kolkata

I would like to recommend that:

- Immediately after floods all tube wells and hand pumps must be disinfected by using Bleaching powder or Sodium Hypochlorite or Calcium Hypochlorite. Bleaching Powder dose may be 200mg/l, that is, Super Chlorination.
- Halogen tablets should be distributed before as well as during the floods.
- Packets with measured quantities of Alum + Lime + Bleaching Powder could be distributed in each family as a step towards disaster preparedness. Earthen filters could also be promoted.
- Regular chlorination needs to be practiced in water storage tanks in the relief camps.
- If Dug Wells exist, these must be disinfected by drip chlorination.
- All ponds should also to be disinfected with proper precaution and care.
- Boiling of drinking water during and after the floods can be encouraged.

We got very good results using the above measures during floods in Malda district of West Bengal while working with UNICEF.

K. Y. Babu, Consultant- WES, UNICEF, Tamil Nadu

The permanent solution for high water table area and flood prone area the best technical option for sanitation is Ecological sanitation (ECOSAN) toilets. It is cost effective and welcomed by the Agricultural community. We have succeeded in this tsunami affected villages of Nagapattinam district, Tamil Nadu.

ECOSAN toilet is the most appropriate technology for water scarcity areas (because we need water only for our body wash) it is also suitable for high water table areas(since we are constructing above the ground level).

For more information about ECOSAN please read my article in WESNET newsletter - Feb-07.

http://www.wesnetindia.org/fileadmin/newsletter_pdf/Feb07/Kameswaram-ECOSAN.pdf

For further details about this technology please contact SCOPE, a Tamil Nadu based NGO which is a pioneer in ECOSAN. Contact person: Mr. Suburaman. Director, SCOPE; scopeagency@rediffmail.com

Ramesha C., Karnataka State Pollution Control Board, Bangalore (response 1)

I could not understand your first point. Dosage of 200mg/l of active chlorine is fine for stored water. How do we calculate the required dosage for tube wells and hand pumps in a disaster-affected area? Would you please explain further, how you did the exercise in Malda?

Arjun Khajuria, Sphere-India URS, New Delhi

What you say about ECOSAN (toilets) is indeed true! It is a method that has a great promise for many parts of our country, not only in the coastal belt (with high water tables) but also in high altitude area and, I think, even in our cities!. It is especially useful for "sustainability and cost effectiveness" - both in water use and in wastewater disposal. Advance models of ECOSAN or dry toilets can be found in Auroville (Pondicherry) , where people have been using these type of toilets since a long time (I guess over two decades), apart from the great waste water management system done for every building at Auroville. Dr Lucas has been working on these issues for a while now. (http://www.auroville.info/ACUR/urban_research/about.htm/).

Additionally, ECOSAN is a globally talked-about model, and its entry into India has been quite late.

However, in the post-disaster scenario, there is a flip side to ecosan. In my experience of working in Cuddalore in Tamil Nadu with an NGO called BLESS (www.bless.org.in), we found that adoption of Ecosan is dependent more on behaviour change than on technology. Since it is about changing "mind sets", it requires a lot of persuasion and a lot of time.

In a post- disaster situation, time is on a premium (as relief agencies have a very short term intervention span, typically something like 12-15 months). In such a condition, beginning introduction of ecosan toilets in a post-disaster scenario may be a bit difficult.

Hope this adds value to our discussion.

C. Vijayakumar, AFPRO, Bangalore

I would like to share our experience in Tsunami affected Kanyakumari district.

Step 1: First, we disinfected the bore wells, infiltration wells and open wells in the coastal areas. Then we undertook continuous dewatering of wells and application of disinfectants. During this time, we were monitoring the water quality in all the sources along with other agencies. We tried to ensure restoration of water supply at least for domestic usage in camps, if not for drinking.

Step 2: There were many agencies involved in supply of drinking water both as bottled water and by tankers getting water from inland sources. We needed to identify other sources of water as well, such as farmers' wells from inland area to increase the frequency of supply where water supply is not regular.

Based on my experience, I have the following suggestions to make:

Drinking water

- Mapping of disaster prone areas and mitigation strategies need to be worked out for the entire district.
- Preparedness has to be created by creating water sources, storage structures and supply mechanisms as a standby in strategic locations.
- Prevention of man-made contamination to aquifers in the certain zone.

Sanitation

- It should be made mandatory that all toilets in schools, religious centres and community centres be fully functional.
- Even in high water table areas, there are a few elevated points like sand dunes and exposed rocks. Such places can be selected carefully without affecting nearby water sources for creating backup sanitation facilities. Also, I agree with other members - ECOSAN is the best option in all high water table area.

[Ramesha C.](#), Karnataka State Pollution Control Board, Bangalore (response 2)

Our open well in Yeshwanthpur of Bangalore city, which was functioning fine for a few decades, is now contaminated with sewage from neighboring houses through infiltration.

If we are saying that all toilets should be fully functional, how will we address the issue of contamination in case of earthquake and other disasters?

For example, in case of an earthquake in Bangalore, how will we control contamination, when even in normal conditions, ground water is being contaminated at an alarming rate.

[Satheesh Kumar](#), United Nations Development Programme (UNDP), Vijayawada

It is quite interesting to read the issues regarding water and sanitation here.

I was working with Red Cross during Tsunami operations and the floods of 2005, and we deployed some mobile water treatment units for the affected villages. These water purifications units can purify available potable water during a disaster situation, and consist of simple units of carbon filters, sand filters and a chlorination chamber. The unit is portable and can be used anywhere and without electric power since has an inbuilt Diesel Motor pump attached to it. The unit can give 3,000 to 5,000 liters of purified water per day.

During the floods in 2005, one such unit was installed in Rediarpet in Cuddalore district and the communities themselves handled it for the period of about 4 months. The maintenance cost is also minimal compared to Reverse Osmosis systems. In flood situations, water gets contaminated and the colour changes due to the sediments which can be cleared and disinfected by chlorination. Thereby, people get pure clear, odorless and disinfected drinking water.

Preparing such mobile water purification units and keeping them ready for deployment during disasters will be the right approach, in my opinion.

[A. K. Sengupta](#), WHO India Country Office, New Delhi

Please find my views on issues of Handling Drinking Water facilities during Emergency and Treatment of drinking water as mentioned below:

Handling Drinking Water facilities during Emergency

Since people can survive much longer without food but not without water. During emergency the aim is to ensure the availability and distribution of enough safe water and maintain a minimum standard in water supply, sanitation and hygiene promotion. It has been observed that in majority of cases, the main health problems are caused due to poor hygiene practices because of lack of sufficient quantity of potable water. All affected people are supposed to get sufficient quantity of water for drinking, cooking and personnel and domestic hygiene. The desirable minimum standards suggested are:

- Drinking - 3-4 litres/ capita/day
- Food preparation, cleanup – 2-3 litres/ capita/day
- Personal hygiene – 6-7 litres/ capita/day
- Laundry – 4-6 litres/ capita/day
- Total individual – 15-20 litres/ capita/day
- Feeding Centres – 20-30 litres/ capita/day

- Health Centres – 40-60 litres/ capita/day for in patient. 5 litres per out patient.
- The maximum distance between household/shelter and the water source may be restricted within 500 meters.
- Queuing time at the water source should not be more than 15 minutes.
- There is at least one water point per 250 people.
- Flow rate at each of the collection should be at least 0.125 liters/ second.

Treatment of drinking water

The quick short term measures are to provide safe survival level of drinking water from unsafe polluted water sources. The treatment methods should ensure suitability for any source of water but, in general, will only remove physical and microbiological pollution. But special treatment may be needed for pollution by chemicals.

The treatment processes suggested are:

- Straining including aeration
- Storage and Settlement
- Filtration
- Disinfection

It is essential that drinking water be free of harmful organisms. Storage, sedimentation and filtration of water reduce the contents of harmful bacteria but none of them can guarantee the complete removal of germs. Disinfection is a treatment process that ensures drinking water is free from harmful organisms or pathogens.

Disinfection can be achieved in a number of ways but the most common is through the addition of chlorine. However, chlorine will work correctly, if water is clear and there is sufficient contact time of at least 30 minutes. Water requires 2.0mg/l of chlorine to destroy all organisms. But there should be residual chlorine left in water for future. Recommended residual chlorine is at least 0.5 mg/l. Regular residual chlorine test need to be done in the field to ensure safe drinking water is being provided to the community in the disaster areas.

Enamul Hoque, Oxfam GB, Islamabad

I give below responses to issues discussed so far, based on my experiences in Oxfam during floods in South Asia.

1. Use of raised tube well and raised latrines

Sustainability of water and sanitation facilities goes hand in hand with community maintenance and preparedness. In the post 1998 floods in East India, raised tube wells & platforms above the flood level were not used in a village in Bihar, as the community had deserted the inundated village to a nearby road/embankment. Similar situations were seen in raised villages which escaped inundation, but were barred from access to safe water as their hand pumps had gone under water.

Raised tube wells with a platform are also expensive. Before building such tube wells, we need to know how high it can be raised, what is the highest flood level at which people will evacuate, and site selection of such tube wells. Also, the flood normally lasts for 3 to 4 months, and in most cases, inundation or high flood level remains only for a few weeks. This means that people, especially women, have to climb up to a raised platform to fetch water for 9 months or more in a year to ensure access & protection from contamination during a few weeks or at the most a couple of months in flood.

Oxfam introduced a progressive provision to tackle this issue by raising only the head and suction pipe of the hand pump. For this, they provided the community with 1m length of pipe/nipple, socket and a cap (in case they need to abandon the arrangement temporarily) and simple tool/wrench or unscrew/re-fixing techniques. This gave the community the flexibility to raise/descend or cap/protect the tube well when appropriate.

2. Emergency water treatment and supplies

In Eastern India's diverse rural context, halogen tablets, UNICEF/Public Health Engineering Department mixture (consisting of alum/bleaching powder-chlorine) is widely used. During 2001 & 2004 Bihar and Assam floods, we found most of halogen tablets (4mg) in reduced strengths.

Normally you need 4 tabs in 1 litre, which means 80 tabs in a 20 L container. Zeoline was found to be more effective, which is similar to a 1% Chlorine solution. Oxfam refills the dispenser bottle with 1% Chlorine in Morigaon and Dhemaji at 1/4th the cost of Zeoline.

For camps or larger evacuation centres, modern technology is available in India. Ultra membrane or micro membrane filtration can be introduced with solar cells, battery, gravity or fuel pump operated systems. We are working with a few inventors in India to develop this to suit flood situations.

Pre-flood distribution of silver impregnated ceramic candle filters, low cost terracotta clay disks or clay pot filters are also useful at household level, where access to water is difficult, especially of people are marooned.

During the 1998 mega floods in Bangladesh, hundreds of Oxfam volunteers distributed treated water by filling plastic bags half with water and half with air and then throwing this towards people stranded on the roof. The water bags float in water, so people can collect these. This also helps in keeping motorised relief boats at a safe distance from the fragile submerging house.

On simple water treatment, there are a lot of resources available from around the world, of which the WELL web resource is a good one. (See <http://www.lboro.ac.uk/well/>).

3. Mechanisms for appropriate excreta and waste disposal systems during disasters

Latrines can also be raised in a progressive manner if they are traditional. The UNICEF/PHED ring slab model can be provided additional rings, so that when necessary, users can add rings to raise the latrines and remove the rings to put these back to original settings. Permanently raised latrines can be built if the village or homestead is at a raised level.

In the embankment/roadside, where people normally take shelter, sinking a temporary tubewell is easy but the site does not allow digging for a latrine. If the evacuation centre is a school or flood shelter, any additional latrines often become defunct if they are not maintained or used during normal time.

Another insight is that in South Asia, privacy is more of a priority for women than health concerns related to sanitation or latrine.

During the 1998 Bangladesh floods, Oxfam distributed millions of polythene bags for disposal of human waste to women who had taken shelter in overcrowded public buildings and schools in Dhaka/urban areas. Latrines had clogged and were overflowing, and women and adolescent girls had no place to go to for toilet. The women made a private space with bed sheets for privacy, and used the bags provided by Oxfam to collect the human waste and later threw these into the water, and these bags later drifted into kitchens of neighbouring houses. Later Oxfam introduced a container with bamboo matting so that the used bags were dumped into the container which was later collected by municipal sweepers when the flood water receded. The flip side of this was that the municipal bodies spent millions to collect and clean these packets from the urban drainage system.

In the 2004 floods in Assam, Oxfam's partner - Morigaon Women's Samiti - distributed mats and plastic sheets to families on embankment to create a privacy screen for women's toilets, as it is not allowed to dig a pit in the embankment/road for fear of the embankment collapsing. The PHED later replicate this intervention.

There is also a need to investigate mobile toilet solutions to target displaced people in urban centres or on embankments.

On other measures, members may refer to the earlier query on Water Community on "spreading hygiene awareness through children."

Many thanks to all who contributed to this query!

If you have further information to share on this topic, please send it to Solution Exchange for the Disaster Management Community in India at se-drm@solutionexchange-un.net.in or Solution Exchange for the Water Community in India at se-wes@solutionexchange-un.net.in with the subject heading "RE: [se-drm][se-watr] Query: Management of Water and Sanitation during Disasters - Experiences. Additional Reply."

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