Lessons learned in WASH Response during Rural Flood Emergencies

The Global WASH Learning Project
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The Global WASH Cluster, led by UNICEF, was established as part of international humanitarian reform, and provides an open, formal platform for all emergency WASH actors to work together.

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1. Preamble

This lessons-learned paper is an initiative of the Global WASH Cluster Technical Learning Project, led by ACF\(^1\)-UK. The Project has identified water, sanitation and hygiene (WASH) response to floods as a priority for technical learning in the sector. Flood emergencies are predicted to increase significantly because of climate change. A number of agencies have experience in responding to rural floods and this provides an opportunity to capture and harness good practices and lessons learned to inform future WASH responses.

This paper is intended for WASH technical advisors and personnel involved in planning and delivery of WASH programmes in rural flood emergency situations. Material in the paper is based both on a rapid review of literature, and on outputs from a WASH learning event held in Bihar, India in November 2008. The learning event was organised by ACF-UK, UNICEF and REDR India and was attended by international inter-agency WASH advisors and practitioners. It consisted of a workshop and field visits to selected areas affected by floods. The event allowed for sharing of experiences from Asia, including Myanmar (cyclone Nargis, 2008), Bangladesh (cyclone Sidr, 2008), Nepal (Kosi floods, 2008), India (Bihar/Kosi floods, 2008) and Indonesia. The learning event also provided experiences from Pakistan, Democratic Republic of Congo (Central Katanga) and Uganda. Additionally, desk research yielded valuable lessons from Ghana, Madagascar, Afghanistan, Ecuador, El Salvador, Bolivia and Haiti.

This paper identifies various lessons that can be learned from the experiences of relief agencies when responding to rural flooding emergencies. The lessons identified are meant to be practical and actionable in the short term, as opposed to actions that require time to implement. The paper does not claim to be comprehensive but can serve as a helpful document, which captures some important lessons to help improve future responses to floods in rural areas, and which can be added to in the future. In addition, these lessons have provided a framework for the development of technical guidance materials to support technical learning in the sector. A series of technical briefs have been developed on issues identified in this paper and are available via the WASH Cluster website [www.humanitarianreform.org/Default.aspx?tabid=770](http://www.humanitarianreform.org/Default.aspx?tabid=770).

An introduction section provides background information on flood emergencies, followed by a section on challenges of WASH response to rural floods, which presents the findings from the Bihar learning exchange and sets the stage for discussion of WASH issues. The resultant lessons are presented under four headings; Water, Sanitation, Hygiene and Cross Cutting Issues. A summary of the lessons learned contained in this paper is presented at Appendix 1.

We would like to thank the participants at the learning exchange and workshop in Bihar (24\(^{th}\) – 27\(^{th}\) November 2008), WEDC and members of the project Steering Group (including representatives from Care, CRS, Oxfam, REDR, UNICEF and ACF) for their contribution to this paper.

2. Introduction

Floods\(^2\) are seasonal and complex events caused by a range of human vulnerabilities, inappropriate development planning and climate variability. Of all natural hazards, they occur most often and are the most widespread in scope and severity. The pattern of floods across all continents has been changing. Floods have become more frequent, intense and unpredictable for local communities, particularly as the number of people living in areas vulnerable to flooding increase due to poverty and development issues. Floods often have a greater impact in rural areas than urban areas.

The recurrence of major rainfall and floods can be calculated, but specific floods are harder to predict. Harvey (2007) identifies three principal types of flood:

- Rapid-onset floods – these include flash floods, tidal surges, floods provoked by cyclones or accompanied by strong winds, high runoff from heavy rainfall, dam bursts and overtopping, canals and rivers bursting their banks; typically water rises to dangerous levels within 48 hours.
- Slow-onset floods – prolonged rainfall causing low-lying areas to gradually become flooded over a period of days or weeks.

\(^1\) Action Contre la Faim (Action Against Hunger)

\(^2\) Floods discussed in this section are limited to events causing damage to life, livelihoods and the environment and qualifying as disaster or emergency situations. They exclude normal floods that have no negative impact on the environment and human settlements.
Annual seasonal flooding – many communities around the world are flooded annually and may be under water for some considerable time each year.

Flooding is an expected and regular occurrence in many places, and in rural areas it may be welcomed as the floodwaters carry sediments that improve the fertility of the soil. Residents may use different terms to distinguish between beneficial and harmful floods.

Table 1: Types of Floods

<table>
<thead>
<tr>
<th>Type</th>
<th>Duration</th>
<th>Characteristic Impacts</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predictable, regular Flooding</td>
<td>Up to 3 months</td>
<td>Blocks access. Damage and displacement of population often relatively low depending on levels of protection.</td>
<td>Seasonal flooding in Kenya is caused by “long” rains (March to May). Eg. Kano plains, Kenya.</td>
</tr>
<tr>
<td>Increased size of regular flooding</td>
<td>Up to 6 months</td>
<td>Blocks access to many areas. Greater potential for infrastructure damage, livelihoods impacts, and large displacement of population.</td>
<td>River floods affecting low lying areas, with increased frequency and intensity as a result of increased climate phenomena such as El Nino. Eg. floods in Tana River Delta, Kenya.</td>
</tr>
<tr>
<td>Coastal flooding</td>
<td>A few days</td>
<td>Often combined with wind damage from storms. Damage and displacement along coastline with extent depending on storm size.</td>
<td>Maldives, 15 May 2007. Southern atolls affected by waves surging as far inland as 600 metres.</td>
</tr>
<tr>
<td>Slow-onset from sustained rainfalls</td>
<td>3-6 months</td>
<td>Blocks access. Depending on season, damage to crops may be significant. Population displacement limited and may be dependent on food security.</td>
<td>River floods that seasonally affect areas along major rivers eg. western part of Kenya.</td>
</tr>
</tbody>
</table>

Sources: ALNAP 2008, Flood Disasters, Learning from previous relief and recovery operations (Adapted from McCluskey, 2001); ReliefWeb; WASH emergency capacity mapping, Kenya (Mwaniki, 2008)

Health risks of most large scale flooding emergencies are both immediate and delayed. Among them, the disruption of public water supplies and waste disposal systems and the contamination of public water supplies can be a major threat to public health; diseases such as cholera, typhoid fever, diarrhoeal diseases, hepatitis and gastroenteritis may increase as a result. The most significant diseases are infectious diseases transmitted by the faecal-oral route (such as diarrhoea). Other water and sanitation-related diseases include those carried by vectors associated with solid waste and water.

3. Challenges of WASH response to Rural Floods

Rural flood events present exceptional challenges to WASH response. These include restricted excreta and waste disposal options on account of limitations in land availability and a high ground water table; poor quality of existing water sources due to turbidity, organic or saline contamination; increased concentration of vectors such as rats and mosquitoes; dispersed population (diverse settlements of displaced people and those unable or unwilling to leave their homes); inaccessibility due to flooded roads and broken bridges.

The main objective of any WASH programme in a rural flood setting is to reduce the transmission of faecal-oral and vector borne diseases, and reduce environmental health risks by promoting good hygiene practices, providing water and sanitation services and ensuring the optimal use of facilities provided.

A good understanding of water and sanitation conditions, hygiene promotion methods and approaches, disease surveillance, speedy response to warning and above all, preparedness of responding agencies are the preconditions to reduce the spread of diseases and maintain environmental integrity during and after flooding.

The table below provides an overview of findings from the WASH learning event in Bihar, November 2008. Some of the main challenges and gaps in the WASH response included:

• Limited options for excreta disposal in high water tables
• Integration and co-ordination between hardware and software delivery e.g. ensuring optimal use and operation and maintenance of facilities and supplies
• Supply chain problems e.g. due to access and management issues
• Support for those who remained at home
• Emergency preparedness
• Capacity building and technical support for field staff

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**Case Study: Bihar floods – India**

**Overview of situation**

On 18th August 2008, a breach in the embankment of Kosi Dam, Nepal, failed causing extensive flooding that affected 1.4 million people, mostly poor farmers, in India and Nepal. Many villages were washed away with an unknown number of people and livestock killed. Displaced people settled in camps set up by the government and UNICEF and in informal camps on canal embankments. A third group of people remained in flooded homes in order to protect their property. Informal camps were assisted by a range of national and international NGO’s with some government support. Initial WASH action was to install water supply mainly through shallow tubewells. Construction of latrines was a challenge because of high groundwater levels and lack of space. In addition, the affected communities practised open defecation and many had never seen a latrine. Hygiene promotion focused mainly around proper use of water treatment chemicals with some child-to-parent hygiene promotion initiated by UNICEF.

**Key findings**

- **Sanitation**
  - Options were very limited because of the high water table. Trench latrines and shallow pits were the main choices but were poorly designed
  - No consideration of operation and maintenance (O&M) for latrines and no advice on proper use of latrines
  - No separate provisions for men and women

- **Water supply**
  - Gaps in the management of the entirety of the safe water chain from source to consumer
  - Quantity and accessibility was good
  - Quality was poor because of no sanitary protection
  - No operation and maintenance (O&M) considerations
  - Point of use treatment systems (chemicals) varied depending on the supplier; users were confused and not sure how to use the chemicals
  - Lack of containers for collecting water

- **Hygiene promotion (methods and approaches)**
  - Child to parent education worked well but messages were too simplistic
  - Very little other promotion conducted with no consideration of women’s issues

- **Hygiene and Non food items (soap, containers, towels etc)**
  - Most people in camps received something
  - Big difference between the contents of different agencies
  - No subsequent distribution of consumables such as soap
  - No post distribution monitoring

- **Participation**
  - Very little consultation with or participation of affected population

- **Villages**
  - No support/advice for people who remained in their homes
  - Disasters provide a good opportunity to introduce new ideas and technologies
  - Poor support to people returning home – WASH facilities and livelihoods
  - Lack of resettlement plans for people from villages that have been washed away

- **Institutional**
  - Field staff have poor knowledge of emergency options and there were no arrangement for them to get help
  - Coordination between Government and NGO’s worked well and was effective
  - Coordination between hardware and software delivery was poor
4. Water

4.1 Water Treatment

4.1.1 Source Treatment: Well/Borehole cleaning and chlorination

Groundwater is an important source of water for many rural communities in developing countries. Groundwater sources often provide water of better quality than surface water sources. This is because the soil above an aquifer provides filtration that can remove pathogens, keeping groundwater protected.

During floods, groundwater may become contaminated as a result of inundation of unprotected/poorly protected wells and pumping facilities. The main concern during floods is contamination of drinking water with pathogens associated with human and animal excreta. In Asia, contamination of drinking water sources by human and animal corpses in flood situations is also a growing concern.

Once polluted, most groundwater has little capacity for self-purification and must be decontaminated.

However, disinfection is only effective if the area around the well or borehole is protected. Otherwise, recontamination will occur, interfering with the source's natural filtration process.

Despite borehole chlorination after the Bihar floods (2008), residents of Purab Jhatgaon village had resorted to unsafe water sources, as the water had a foul odour. Inspection of one of the boreholes during the Bihar field review revealed a new borehole outside the apron of the first borehole, which had broken down. Volunteers engaged by UNICEF to chlorinate the wells were unaware that recontamination was occurring, rendering the chlorination exercise futile. Construction of an apron around the new borehole would have solved the problem. Visits to other affected locations during the field review also revealed some handpumps without aprons, with many loose at the base, allowing waste water to flow directly from the surface to the aquifer.

In Ghana (2007 floods), a decontamination programme was launched to disinfect wells and boreholes in the affected regions. A later inspection of wells in the Upper East region revealed deficiencies in their construction, design and maintenance, absence of well aprons, cracked aprons, and well covers left open.

Experiences from other flood responses in South Asia outlined some viable water purification technologies for use in flood situations (see appendix 2).

Key Lessons

- Where groundwater is less than 1m from the surface, greater attention should be given to ensuring people do not use water from wells in the vicinity of excreta disposal facilities.

- Cleaning/disinfection of poorly protected sources does not improve water quality. Protecting the source from contamination is the most important safeguard for water quality, necessitating good design and construction of facilities, combined with hygiene promotion and community action to maintain good practice.

- Shallow wells are more prone to contamination from flooding than deep boreholes.

- In the event of deaths in a flood, human and animal corpses should be collected quickly and safely to minimise contamination of water sources and distress caused to survivors of the event.

- In emergency situations, water treatment should be minimised and always be simple, as it complicates the water delivery process. It is better to look for a water source supplying water of safe quality than to treat water, whenever possible.

- Consumers accept or reject drinking water mainly using aesthetic considerations. Issues such as turbidity, colour, taste and odour can make them turn to other water sources that may be more
contaminated and involve a higher health risk. There is a need for increased dialogue and better understanding of these motivations combined with hygiene promotion and community mobilisation.

4.1.2 Point of Use (POU) Treatment

Household level water quality interventions greatly contribute to immediate improvement of the health of the most vulnerable during emergencies. Recent evidence suggests that point-of-use\(^3\) water quality improvements alone result in a one-third or greater reduction in diarrhoeal disease morbidity (WHO, 2007).

Chlorination, solar disinfection (SODIS), ceramic filtration, and flocculation/disinfection are among Point Of Use (POU) options widely implemented in developing countries. Chlorination in its various forms is most commonly applied during emergencies.

A growing body of research suggests household water treatment and safe storage (HWTS):

- Dramatically improves microbial water quality
- Significantly reduces diarrhoea
- Is among the most effective of water, sanitation and health interventions
- Is highly cost-effective
- Can be rapidly deployed and taken up by vulnerable populations.

However, appropriate options for use in different situations should be determined before implementation. Different guidelines should also be established depending on the use of the water e.g. for drinking, washing or domestic use etc.

One of the challenges the Nepali government had during the Kosi floods in August 2008, was identifying alternatives to water purification tablets for POU treatment. In some cases observed in Bihar, the possibility that chlorination was not effective was indicated by high pH levels of 9.1 (WASH learning event, Bihar, India, November 2008).

During floods in Ghana (2007), ceramic filters distributed to affected communities were not used. Some were also damaged during transport from the capital. A field review concluded the filters were not appropriate, unless distributed in health centres and schools, accompanied by an effective information campaign. The conclusion was that a more effective, suitable and less costly solution should have been explored for better coverage and purification of drinking water (UNICEF-WCARO, 2007). Experiences from other countries on the use of ceramic filters in flood emergencies are presented in the box below.

Experiences on the Use of Ceramic Filters in Flood Emergencies

Evidence from other countries also suggests that use of ceramic filters is preferable during the resettlement phase of the emergency rather than in the initial stabilization and recovery phases (Household-Based Ceramic Water Filters for the Treatment of Drinking Water in Disaster Response: An Assessment of a Pilot Programme in the Dominican Republic. T. Clasen and S. Boisson; Community acceptability of ceramic filters distribution in Sri Lanka. J. Palmer. Deployment of filters requires programmatic and logistical support, which might be difficult to access in the immediate phase of the emergency. An example is the supply of replacement parts that periodically need replacement.

However, ceramic water filters can be an effective intervention for providing flood-affected populations with safe drinking water where recipients are living in transitional and permanent shelters, as demonstrated by cases from the Dominican Republic, Haiti and Sri Lanka. They may also be a potentially sustainable long-term solution, provided householders are properly trained on their use and have access to affordable replacement filter elements.

Storage and post-contamination of water at POU is often underestimated. Provision of wide-necked storage containers (buckets with covers) during floods in Central Katanga in 2007, contributed to re-contamination of

\(^3\) Household-level approaches to drinking water treatment and safe storage are also referred to as managing water at the “point-of-use”. This term or its abbreviation “POU” typically describe the same procedures as other abbreviations derived from household water treatment, like “HWWT” or “HWT” or “HWTS”. (The “S” in “HWTS” refers to safe storage.) “Household water management” is also commonly used, and can encompass both treatment and storage.
water. The containers were rarely covered. Water quality was also compromised during drawing of water from the buckets (MSF, WASH learning event, Bihar, India, November 2008).

A forum to discuss viable water purification technologies for floods (WESNET-South Asia), pointed out some challenges of Point of Use technologies. Technologies often do not work for various reasons, such as being poorly made or inappropriate products, difficult or inconvenient to use, or not cost effective. Participants felt emphasis must be on community mobilisation, social marketing and behaviour change, not products and technologies.

Key lessons

- POU technologies need to be accompanied by effective hygiene promotion campaigns that are based on a clear understanding of motivations and barriers to change and which aim to ensure that people know how to use and maintain the technology and safely store their drinking water.

- Guidelines for POU treatment should consider the different uses of water, including drinking, bathing and domestic use.

- Point of Use technologies often do not work for various reasons such as: being poorly made; being inappropriate products; inconvenient to use; not cost ineffective; culturally unacceptable; water quality (including aesthetic conditions such as taste, odour and colour) and other local conditions.

- Water treatment should be accompanied by appropriate storage containers to protect collected water against re-contamination.

- Positive attitudes and ideas, such as taste, good health, clarity and affordability are better predictors of whether people will consistently treat water, rather than negative campaigns.

- Standardisation is a valuable aid to effective, sustainable interventions and familiar techniques lower the skills needed. It would therefore be highly desirable if major humanitarian organisations could agree on common water treatment specifications for household treatment.

4.2 Water Sources

Factors affecting the choice of drinking water during emergency situations usually differ from those influencing choices for "normal" water supply. The most important decisive factors for drinking water supplies during floods include:

- Quality / contamination of available water supplies
- Access to the area in terms of roads and topography
- Characteristics of the affected population e.g. number of people displaced or remaining in their homes
- Socio-political, legal and cultural constraints

4.2.1 Rainwater Harvesting

Rainwater harvesting involves collection of rain or rainwater runoff, and taking measures to store that water. It can be collected using unconventional surfaces such as tents or plastic sheeting, which can be laid on the ground to catch the water.

It is useful as a supplementary source of safe water in certain situations. For example, during coastal flooding, wells in low lying areas may become saturated with saltwater, rendering them unusable especially if salinisation is irreversible. Rainwater was a key source of water in Myanmar’s Ayeryaddy Delta region during cyclone Nargis and in Bangladesh after cyclone Sidr, when shallow wells were affected by saline intrusion.

However, a major challenge is availability of rainwater during required periods. In addition to having the necessary resources for harnessing, sufficient storage capacity is a prerequisite. Disinfection is also usually needed to ensure good quality of drinking water.

De Veer T. (2002). Water supply in disasters and emergencies
Key Lessons

- In an emergency, rainwater should be treated in the same way as surface water because of the likelihood of contamination during harvesting.
- Although a relatively inexpensive source of water, rainwater storage that is sufficient for people’s needs may require considerable capital investment.

4.2.2 Role of Bottled Water

There has been a lot of discussion generated on the appropriateness of bottled water during emergencies. Recent flood emergencies, particularly in South Asia, have seen significant amounts of bottled water distributed in the initial phase of the emergencies.

Despite bottled water being an extremely expensive source of water, it has featured severally in recent flood responses. One reason may be that it is seen as an immediate solution to drinking water for survival in the initial stage of an emergency. Another reason may be the fact that bottled water is often provided at no cost, to governments and other responding agencies, by the bottlers themselves.

When compared with other survival supply sources, bottled water appears advantageous. Water tankering for instance is only possible when certain requirements are fulfilled; adequate water source, water pumps, sufficient supply of chlorine for water treatment, professional skills and experience, to name a few. However, pertinent issues such as being appropriate for drinking water supply only, environmental concerns regarding disposal of empty bottles, sustainability of bottled water (even in the relief phase of an emergency) cannot be overlooked. The pros and cons of bottled water for emergency water supply are found in appendix 3.

Key lessons

- Empty water bottles can facilitate SODIS for poor people in developing countries.
- Use of plastic bottles as storage and drinking vessels from which water is directly consumed can reduce the risk of disease transmission through saliva, especially where outbreaks of disease have occurred.
- Bottled water is too expensive to permit supply for all water needs of users. It also entails huge logistical inputs and organisation for effective distribution. A more sustainable and longer-term solution is preferable.

4.2.3 Rapid Water Supply Technologies

The primary aim of interventions in the initial phase will be to achieve a survival supply of drinking water quickly.

Major humanitarian organizations such as IFRC\(^5\), Oxfam and Médecins Sans Frontières (MSF) have developed their own technologies for rapid water supply in the crucial phase of an emergency. For instance, IFRC’s Water and Sanitation Emergency Response Unit has an elaborate treatment, supply, distribution and trucking module, complete with trained personnel and a manual. Oxfam GB has a series of modular water kits for use in emergencies that are robust and easy to assemble.

There are a range of other technologies that could be applied rapidly in an emergency. One of these is well jetting. Jetting is a well-known but little used method of well construction, in which the well is bored through the erosive action of a stream of water.

Compared with driven wells, jetting of wells is much faster as mechanical force is not needed. Jetting is best suited for areas with unconsolidated, sandy aquifers.

After cyclone Gafilo in March 2004, heavy rainfall caused massive flooding in Madagascar. Most water sources became heavily contaminated with faecal matter. Several (household level) emergency actions were immediately undertaken in Maroansetra. More than 200 wells were rapidly constructed using the well jetting technique. These wells would not only provide safe drinking water in the aftermath of the floods but in the long-term as well. The low cost of jetting ensured a high density of pumps per head of population were achieved, a well for 5-10 neighbouring households \((Mol \text{ et al}, 2005)\).

\(^5\) International Federation of the Red Cross and Red Crescent Societies
Key lessons

- An inventory of rapid water supply technologies and conditions for implementation is necessary, as part of the process to select short-term water supply options. Including water equipment guides/lists for the various techniques would enhance rapid assembly of items.

- Jetting will provide safe water faster and more affordably than other techniques, if the underlying soil conditions are right.

- Progress of work on permanent/longer term sources should be linked to temporary water supply operations, so that the latter can be reduced and stopped as appropriate.

Figure 1: A raised borehole in Cambodia

5. Sanitation

5.1 Excreta Disposal in High Water Tables

There are a number of techniques and latrine options that can be used in flood situations. However, it must be mentioned that technical solutions for excreta disposal in flood situations are limited.

Technology options for immediate or short-term intervention include packet latrine, storage tank latrine, bucket/container latrine, chemical toilet overhung latrine and clean up campaigns. These techniques are used when time is of the essence and there are no other viable options. They are not sustainable and their use must be linked to construction of more appropriate and sustainable interventions.

More sustainable excreta disposal options are usually characterised by raised latrine pits – where containment pits are built upwards above ground level. However, these are more costly and take more time to construct. Some of these options include raised pit latrines, sand-enveloped pit latrines, sealed pits or
tanks, septic-tanks or aqua-privies and raised urine diversion (UD) latrines. Simple composting toilets can also be effective on a small scale.

A pit dug below the water table may collapse, hence pits should be lined with appropriate, locally available materials such as fired clay bricks, block work, wicker baskets, large stones/rocks, or pre-cast concrete rings.

Ecosan⁶ can be useful to increase the life of the latrine by taking the urine and anal cleansing water off to a soak away and just storing the excreta, as well as providing sustainable, low-contamination sanitation in flood situations. An analysis of three emergency case studies from El Salvador, Afghanistan and Pakistan⁷ has shown that ecosan can be successfully implemented in the long-term phase of an emergency. It also demonstrates that people are willing to accept something unfamiliar during an emergency, as long as an appropriate consultation process with users is followed.

Simple composting latrines ‘arborloos’ were used in Haiti as part of the flood response. The latrines used a concrete slab manufactured by a local contractor and the community were involved in digging pits and completing the superstructure. Locally available materials were used, with many people choosing mud walls (similar to local houses). Woven palm tree leaves were also used. Trained community volunteers supervised the work. When completed, the contractor installed the metallic roofing and finalised technical aspects of the work.

Key lessons

- The priority in any flood situation is the speed of response. It is essential that any 1st phase technology can be installed quickly and that it is effective in containing excreta.
- Attention to operation and maintenance (O & M) including awareness raising in relation to good hygiene practices is essential to the effectiveness of excreta disposal solutions.
- Conventional pit latrines – that use traditional infiltration techniques – are never floodproof; other technology options (eg. those that involve raising latrine pits) should be explored and used in flood prone areas.
- The choice of option should depend on the situation, in particular whether the flood has displaced communities or whether they have decided to sit the flood out.
- Pits below the water table should be lined with appropriate, locally available materials.
- Use of UD toilets requires additional disposal and management of wastes, as well as awareness raising with users.
- Simple composting toilets can be effective on a small scale.

5.2 Drainage, Solid and Wastewater Management, and Vector Control

Over-saturation of land surface with water during flooding often leads to stagnation of floodwaters. An increase of vectors, such as mosquitoes, often follows, as breeding ground is facilitated by stagnant pools of water. Other factors that favour presence of vectors include poor solid waste and waste-water disposal. Solid waste heaps will attract vermin and flies. They also provide breeding ground for mosquitoes, which can transmit malaria, filariasis, dengue and yellow fever.

In addition to eliminating physical conditions that favour proliferation of vectors and their hosts, hygiene behaviour and hygiene promotion that help affected populations protect themselves from vectors and their associated diseases are most important.

⁶ Ecological sanitation: an alternative to a raised pit pour flush toilet is known as ecological sanitation. There are two types of ecosan toilet; a desiccating toilet, which manages urine and faeces separately and an aerobic composting toilet, which manages urine, faeces and limited quantities of water together (Guidelines for Implementing WATSAN components in Flood Affected Areas, WES-Net India).

Key lessons

- Effective vector control is impossible in the absence of proper drainage and waste management; drainage, solid and waste-water management and vector control are intertwined activities in flood situations.
- An initial priority is to assess the risk of vector-borne disease transmission in the immediate post-flood phase.
- It is important to include people with expertise in vector-control in your rural floods response teams, especially in the assessment and implementation.
- Provision of storage and disposal facilities for solid waste should be a priority after a rural flood emergency.
- Provision of appropriate household waste storage disposal containers should be an integral part of WASH NFIs in rural flood situations, especially where populations are displaced.

![Figure 2: A raised public latrine in Cambodia](image)

6. **Hygiene Promotion in Rural Floods**

A crucial aspect of WASH response, hygiene promotion is the “software” facet of WASH activities without which proper use and maintenance of hardware - water supply and environmental sanitation – facilities is impossible. Proper use and maintenance is necessary to curb and/or prevent disease transmission. A WASH response that is not supported by a strong and well-implemented hygiene promotion strategy is bound to rank poorly or fail altogether. Key components/target areas for public Hygiene promotion after a rural flood situation must include:

- Proper use and maintenance of water supply facilities and latrines
- Handwashing with soap at critical periods
- Vector control and disease transmission
Hygiene promotion is extremely critical during rural flooding. An altered physical environment not only presents new challenges to the affected population; it also creates conditions that greatly increase their vulnerability to diseases previously not afflicting them.

### 6.1 Methods and Approaches

Repeating messages about hygiene practices does not usually change behaviour and nor does the dissemination of information on disease transmission. There are, however, some factors that are important for behaviour change.

A well-known model of behavioural change by J. Hubley (1993) suggests that an adult will develop new health practices:

1. When he or she believes that the practice has net benefits, for health or other reasons, and considers these benefits important.
2. When the significant people in his environment are positive about and support the new practice.
3. When the enabling factors for that behaviour are present. This means that the skills needed to do the practice, the time, materials and resources are sufficiently available. The costs, in terms of money and effort, should seem to be less than the benefits.

Enabling factors are often easier to provide in an emergency situation e.g. toilets, water, handwashing facilities and soap but there will still be costs and benefits associated with their effective use. Health may not always be the main perceived benefit or motivator for change. It is therefore important to identify other reasons (such as privacy, convenience, an increase in status or nice smelling hands) that might also motivate people better.

Hygiene promotion programmes, need to have an understanding of both current and past hygiene practices, in order to ensure that the practices that are promoted are both feasible and, where possible, sustainable. Consultations with local people will define what the affected population are used to doing and what constraints they currently face. For example, people may be used to using ash for handwashing. This can be promoted along with soap where this is distributed, ensuring that people are still able to protect their health even when soap is not so readily available.

Regular access to those affected by floods may be particularly difficult. It is important to use a variety of methods so that those affected are provided with key information about the response and key environmental risks. Mass media and interpersonal communication through outreach networks, where these exist or can be rapidly trained, are key options.

**Key lessons**

- Hygiene promotion is often seen as an optional extra in a water and sanitation response but should be integrated with all the components of the hardware response. Only the effective use and maintenance of facilities will ensure an impact on public health.

- Hygiene promotion should not be seen as the dissemination of hygiene messages. It should be based on dialogue and interaction with the affected population in order to identify feasible actions that can be taken during the emergency.

- Information campaigns should be based on an understanding of the key public health risks and the priority target groups. They should ensure optimal use of facilities and so will need to understand and target different groups such as men, women, children and those with disabilities.

- Enabling factors such as toilets or soap may only be available from agencies during the emergency response. Hygiene programmes that also factor in local conditions increase the likelihood of sustained hygiene practices.
A variety of methods, media and approaches can be employed to promote hygiene and provide information to affected populations. However, interactive methods may be more successful in mobilizing communities to make the best use of the WASH facilities and to protect their health.

The celebration of global WASH or handwashing days in camp situations provides an opportunity for effective hygiene promotion activities.

### 6.2 Family Hygiene Kits

Many organisations distribute packs – family hygiene kits – with key WASH items such as WPTs (water purification tablets), containers, soap and sanitary napkins. Sometimes, these are incorporated into general NFI (Non-Food Items) packs.

Hygiene kits are intended to complement hygiene promotion activities that aim to prevent or mitigate water and sanitation related diseases. Ensuring that appropriate items are included in family hygiene kits, therefore, becomes crucial.

During cyclone Sidr in Bangladesh, sanitary napkins included in hygiene kits were not used. Interviews with women revealed they were not familiar with what was distributed. They were accustomed to sanitary cloths that they washed and reused. The agencies distributed unfamiliar sanitary towels of a colour culturally unacceptable to them.

Effectiveness of family hygiene kits is dependent on their correct use. Information on how to use the kits is, therefore, indispensable. In the Bihar floods, a large “pause” between provision of family hygiene kits and initiation of hygiene promotion activities meant kits were not properly used. The importance of the items in the kit was largely lost on the users. In addition, there was little consultation with affected people, especially women who are usually responsible for family hygiene.

**Key lessons**

- Hygiene kits present an opportunity to promote the use of safe water for drinking, the use of toilets, personal hygiene and hand washing with soap at critical times.

- Whilst incorporating WASH items into general NFI kits makes it difficult to monitor which items have been distributed, where and how they are used this may be the most efficient way to ensure people have access to the items they need.

- There is often little consideration of women’s menstrual needs and the provision of female sanitary protection. Consultation with local people on the constitution of hygiene kits is an essential activity.

- Hygiene items such as water purification tablets should never be distributed without information on how to use them and the benefits of their use.

- Where possible, hygiene promotion activities should accompany the distribution of hygiene items and post distribution monitoring of the use of items should be carried out.

- Having standard kits across agencies will reduce confusion among users and negate the need for diverse information campaigns.
6.3 Distribution of Non Food Items (NFIs)

The preferred mode of distribution of NFIs is largely determined by responding agencies. Both external (eg. physical conditions) and internal factors – such as staff numbers – predispose agencies to different ways of distributing NFIs. For instance, some agencies set up distribution centres where people go to collect items. Others engage community volunteers in house to house distribution.

Experiences from different flood affected areas have helped identify some common challenges to draw lessons from:

- **Regular replenishment of distributed items**: In most IDP camps set up during the Bihar floods, there was only one-time distribution of soaps with hygiene kits. Soaps were used for bathing much more than for handwashing, leading to rapid consumption of supplied soap.

- **Linking distribution activities with awareness raising and information activities**: There is often a disconnect between distribution of hygiene kits and related hygiene promotion activities.

- **Prioritisation of those in greatest need**: Distribution mechanisms have not always prioritized those in urgent need. People living in temporary conditions along road sides require urgent attention as these locations have poor sanitary conditions. In the Bihar floods case, people that remained in their flooded homes for fear of losing their property did not receive aid.

- **Centralised distribution hubs**: can reduce pressure on available human resources. They can also enhance the likelihood of systematic monitoring and information activities.

**Key lessons**

- Distribution of NFI kits – with sufficient items to cover needs – for a longer period, to a limited number of priority beneficiaries, provides greater potential for increasing coverage, compared to distribution to more beneficiaries for a shorter period of time.

6.4 Operation and Maintenance (O & M)

The need for proper maintenance and management of WASH facilities is generally recognized. However, in practice, actual maintenance work is frequently neglected. Promoting the optimal use of facilities should be seen as a key aspect of hygiene promotion.

The unique challenges presented by flood situations in the provision of water supply and sanitation facilities further complicate O & M issues. In Bihar, where open defecation is widely practiced, flooded ground saw locals forced to use latrines, some for the first time. Many women had previously not seen a latrine. Many users had little knowledge of how to use and maintain latrines. As a result, latrines were generally in poor condition. Consultation with users during a field visit discovered that few agencies had provided clear guidelines on O & M.

**Key lesson**

- There is often very little consideration given to hygiene promotion and operation and maintenance by agencies.
- Flood situations involve challenges often not experienced in other disaster situations, such as high groundwater levels. These will have an impact on O & M activities.
7. Cross Cutting Issues

7.1 Phasing of WASH Interventions for Rural Floods Response

The Disaster Management Cycle provides insight into the phases of a disaster or emergency. Response to any emergency is built around these phases.

![Figure 3: The Disaster Management Cycle](image)

Flood responses usually follow an easily identifiable pattern; in the immediate phase of the emergency, interventions used are short-term and often unsustainable in the long run. These change with time, becoming more sustainable and of a different nature. An example from recent South Asia rural flood responses (Bangladesh, Myanmar) shows the distribution of bottled water a couple of days after the emergency, followed by deployment of water trucking and treatment units. These interventions were followed by cleaning of water ponds and rehabilitation of existing boreholes – increasingly sustainable activities.

It is clear that certain WASH interventions are only suitable for certain phases of an emergency, making it imperative to recognise the phasing of WASH interventions as integral to effective rural floods response.

Key lessons

- Phasing rural flood response interventions is of great significance as it can support quick decision making and provide technical guidance for faster and effective WASH response.

7.2 Role of Technical Expertise in the Initial Phase

The relief phase of a disaster is the most crucial in terms of saving lives. Availability of technical expertise for the various WASH components during this phase means specific aspects of relief operations can be implemented more speedily and effectively. Immediately after a disaster, there is an initial surge in demand for relief needs. This demand also corresponds to a greater capacity demand to meet these needs, especially after a rapid onset disaster, as demonstrated by Figure 1 below.

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*Bangladesh WASH Cluster (2007). Bangladesh Cyclone SIDR: WASH related NFI supply and distributions, sitrep 02/12/07; Presentation by Ben Harvey, IRC, WASH learning event, Bihar, India, 24 - 27 November 2008*
In trying to meet demands, agencies often try to stretch available resources by using inexperienced or inappropriate staff. However, this can reduce effectiveness of relief interventions and therefore overall impact of the response.

Babahoyo, a town located along Babahoyo River in Ecuador, was hit hard by floods. The town’s water sources were contaminated by flood waters containing sewage. Several countries shipped emergency water treatment units to Ecuador as relief assistance. One country sent an engineer and technicians along with the units to assist with initial set-up and train local staff. The initial unit was in operation within several hours. In another instance, problems requiring previously unanticipated changes arose once the units were in operation. On-site technical experts were able to rectify them speedily. Where technical personnel were absent, the impact of initial water supply interventions was greatly reduced or totally absent. One country sent a water treatment unit without a technician. It was never set up, and remained in storage throughout the emergency (adapted from Reiff, 1982).

Key lessons

- No matter how simple or effective emergency equipment may be, the likelihood of use – hence effectiveness of the intervention - is greatly decreased if a technician familiar with the equipment does not accompany it.

- Emergency situations naturally contain many unknowns. The presence of experienced personnel to oversee and modify technical operations is a requisite.

7.3 The Gender Factor in Hygiene and Sanitation in Rural Floods

Although provision of separate sanitation – toilets and bathing areas – facilities for women and men is a recognised standard for emergency WASH response, it is often not properly addressed.

Failure to take cognisance of the different facets that make up the “dignity” of especially women, results in poor planning for their needs during a rural flood situation. A flood disaster presents unique hygiene behaviour challenges for rural women that men might not face. Women will need to bathe on a daily basis; many women and girls clean themselves with water, not only after defecating but also after urinating; menstruating girls and women need menstrual absorption materials as well as water for associated needs; in
addition, all these activities must be carried out in absolute privacy while guaranteeing security for women and girls.

Lessons from past WASH responses during rural flood emergencies show that the different aspects of women and girls’ dignity have been consistently neglected.

In the 1998 Bangladesh floods, adolescent girls reported perineal rashes and urinary tract infections because they could not properly wash themselves, and launder and dry menstrual rags in private. The girls also said they wore the still damp clothes because they did not have a place to dry them. They also lacked access to clean water for their various ablutions. During floods caused by Cyclone Sidr in Bangladesh (2008), women and girls cited washing themselves and laundering of menstrual cloths, in private as some of their challenges.

**Key lessons**

- Women and girls of reproductive age must have access to appropriate materials for absorption and disposal of menstrual blood.
- Hygiene promoters should advocate for providing private facilities for girls and women to wash themselves, wash and dry underwear and sanitary clothes, and properly dispose of women’s sanitary napkins (Behaviour Change Communication in Emergencies: A Toolkit UNICEF ROSA 2006).

### 7.4 Risk Reduction: Flood proofing handpumps and latrines

Activities to provide or improve water supplies during “normal” times should take cognizance of the specific hazards to which water sources might be subject. This should be as much a part of the planning of water supply systems as other factors, such as distance to users, water quality and taste.

Floodproofing latrines is a measure that can be implemented during both pre and post-flood periods. As in the case of water supply, floodproofing existing latrines should be an integral factor in hazard mapping and mitigation activities during pre-disaster situations. Examples of options for floodproofing latrines include lining pits, raising both pits and squatting slabs. *Sealing the drop-holes of flood prone latrines will improve excreta containment during flooding.*

**Key Lessons**

- Raising handpumps above floodwater level is an inexpensive long-term solution. Emergency water supplies are expensive to deploy, operate and maintain. Preference should be given to prevention through flood protection.
- Floodproofing latrines is an exercise that should be carried out hand in hand with floodproofing water sources, as improvement of excreta disposal is often a prerequisite for protection of water sources.
- Consider that it may be more cost-effective to develop alternative water sources than to provide alternative excreta disposal facilities.

### 7.5 Exit Strategies

Experiences from different flood situations indicate that few agencies have clear exit strategies. The absence of clear exit strategies was observed during the Bihar floods learning event. Transition was not adequately supported from a WASH perspective. There was no systematic identification of WASH needs of returnees or provision for post-flood needs in agency planning.

**Key lesson**

- Experience has shown that there is often poor support for displaced/affected people to re-establish their lives.
References

4. Centre for Diseases Control and USAID (2008). Household Water Treatment Options in developing Countries: Ceramic Filtration
5. Clasen, T. and Boisson, S. Household-Based Ceramic Water Filters for the Treatment of Drinking Water in Disaster Response: An Assessment of a Pilot Programme in the Dominican Republic.


28. Walden, V. M. *Challenges for Water, Sanitation and Hygiene Promotion interventions in the immediate aftermath of the Tsunami: an Achenese perspective.*


30. WES-Net India *Guidelines for Implementing WATSAN components in Flood Affected Areas*

**Websites**

31. Environmental health in emergencies and disasters: [www.humanitarianinfo.org](http://www.humanitarianinfo.org)

32. Sanitation for difficult situations: [www.unicef.org/eapro](http://www.unicef.org/eapro)

33. Emergency sanitation – family latrine options: [www.irc.org](http://www.irc.org)

34. Water purification technologies (experiences): [http://www.karmayog.org/biharfloods/biharfloods_18199.htm](http://www.karmayog.org/biharfloods/biharfloods_18199.htm) or [http://www.solutionexchange-un.net.in](http://www.solutionexchange-un.net.in)

35. Household water treatment options : [www.who.int/household_water](http://www.who.int/household_water)

**Workshop Presentations**

36. Learning exchange on WASH response to floods, Bihar, India (24 - 27 November 2008)
   - Floods in Central Katanga, DRC. Frederic Patigny, MSF Belgium
   - Floods in Sunsari District, Nepal. Rajesh Singh, Government of Nepal
   - IRC’s Experience with Floods: relief, recovery and risk reduction. Ben Harvey, IRC
   - Bihar Floods WASH Review. Abraham, RedR India

37. East Asia Ministerial Conference on Sanitation and Hygiene, Japan (December, 2007)
   - Options for challenging environments. Dr. Darren Saywell, International Water Association

38. Nairobi Workshop on WASH Sector Capacity Mapping for Emergencies (September 2008)
   - WASH Capacity Mapping and Assessment: Briefing for Nairobi workshop. John Cosgrave, UNICEF consultant
## Appendix 1: Summary of Lessons Learned

<table>
<thead>
<tr>
<th>Key issues</th>
<th>Lessons learned</th>
</tr>
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<tbody>
<tr>
<td><strong>Water</strong></td>
<td></td>
</tr>
<tr>
<td>1. Water Treatment:</td>
<td>Point of Use technologies often don’t work for various reasons such as: being poorly made; being inappropriate products; inconvenient to use; not cost ineffective; cultural acceptability; existing WATSAN conditions.</td>
</tr>
<tr>
<td>- Point of Use (POU) treatment</td>
<td>- POU technologies need to be accompanied by effective hygiene promotion campaigns that aim to ensure that people know how to use and maintain the technology and safely store their drinking water.</td>
</tr>
<tr>
<td>- Source treatment</td>
<td>- Water treatment must be accompanied by safe storage to protect against re-contamination.</td>
</tr>
<tr>
<td>- Standardisation of water treatment used by different agencies</td>
<td>- Treatment is ineffective without provision of adequate and appropriate containers for collection and storage.</td>
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<tr>
<td></td>
<td>- Consumers are likely to accept or reject water based on perceived quality.</td>
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<td></td>
<td>- Water treatment should be minimized and always be simple in emergency situations.</td>
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<tr>
<td></td>
<td>- Shallow wells are more prone to contamination from flooding than deep boreholes.</td>
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<td></td>
<td>- Cleaning and disinfection of poorly protected sources does not improve water quality, as they are immediately re-contaminated.</td>
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<td></td>
<td>- Source protection should go together with hygiene promotion and community action to maintain good practice.</td>
</tr>
<tr>
<td></td>
<td>- Use of different products by different agencies can cause confusion.</td>
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<tr>
<td>2. Water Sources</td>
<td>Water source protection supersedes treatment in safeguarding water quality.</td>
</tr>
<tr>
<td>- Rainwater Harvesting</td>
<td>- Rainwater should not be considered safe unless treated because of the likelihood of contamination during harvesting.</td>
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<tr>
<td>- Bottled Water</td>
<td>- Rainwater storage that’s sufficient for people’s needs may require considerable capital investment.</td>
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<tr>
<td>- Rapid Water Supply Technologies</td>
<td>- Use of plastic bottles as storage and drinking vessels from which water is directly consumed can reduce spread of disease through saliva, especially during outbreaks.</td>
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<tr>
<td></td>
<td>- Plastic bottles can facilitate SODIS for poor people in developing countries.</td>
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<tr>
<td></td>
<td>- Bottled water is too expensive to permit supply for all water needs of users. It also entails huge logistical inputs and organisation for effective distribution.</td>
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<tr>
<td></td>
<td>- An inventory of rapid water supply technologies and underlying conditions is desirable for quick identification of options.</td>
</tr>
<tr>
<td><strong>Sanitation</strong></td>
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</tr>
<tr>
<td>1. Latrine options for high water table areas</td>
<td>Conventional pit latrines are never floodproof; other technology options (eg. those that involve raising latrine pits) should be explored and used in flood prone areas.</td>
</tr>
<tr>
<td></td>
<td>Technical solutions for excreta disposal in flood situations are limited.</td>
</tr>
<tr>
<td>2. Drainage, Solid and Wastewater Management, and Vector control</td>
<td>Effective vector control is impossible in the absence of proper drainage and waste management.</td>
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<tr>
<td></td>
<td>It is important to include people with expertise in vector-control in your rural floods response teams, especially in the assessment and implementation.</td>
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<tr>
<td></td>
<td>Provision of storage and disposal facilities for solid waste should be a priority after a rural flood emergency.</td>
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<tr>
<td></td>
<td>Provision of appropriate household waste storage disposal containers should be an integral part of WASH NFIs in rural flood situations, especially where populations are displaced.</td>
</tr>
<tr>
<td><strong>Hygiene Promotion</strong></td>
<td></td>
</tr>
<tr>
<td>1. Methods and Approaches</td>
<td>Hygiene promotion is often seen as an optional extra in a water and sanitation response but should be integrated with all the components of the hardware response.</td>
</tr>
<tr>
<td></td>
<td>Hygiene promotion should not be seen as the dissemination of hygiene.</td>
</tr>
</tbody>
</table>
messages. It should be based on dialogue and interaction with the affected population in order to identify feasible actions that can be taken during the emergency.

- Enabling factors such as toilets or soap may only be available from agencies during the emergency response. Hygiene programmes that also factor in local conditions increase the likelihood of sustained hygiene practices.
- Information campaigns should be based on an understanding of the key public health risks and should ensure optimal use of facilities. They will need to understand and target different groups such as men, women, children and those with disabilities.
- Interactive methods may be more successful in mobilizing communities to make the best use of the WASH facilities and to protect their health.
- The celebration of global WASH or handwashing days in camp situations provides an opportunity for effective hygiene promotion activities.

2. **Family Hygiene Kits**

- Hygiene kits present an opportunity to promote the use of safe water for drinking, the use of toilets, personal hygiene and hand washing with soap at critical times. Whilst Incorporating WASH items into general NFI kits makes it difficult to monitor which items have been distributed, where and how they are used this may be the most efficient way to ensure people have access to the items they need. There is often little consideration of women’s menstrual needs and the provision of female sanitary protection. Consultation with local people on the constitution of hygiene kits is an essential activity.
- Having standard kits across agencies will reduce confusion among users and negate the need for diverse information campaigns.

3. **Distribution of Non Food Items (NFIs)**

- Inconsistent distribution of WASH NFIs results in people returning to unsafe practices once consumables are depleted.

4. **Operation and Maintenance**

- There is often very little consideration given to operation and maintenance by agencies.
- Flood situations involve challenges often not experienced in other disaster situations, such as high groundwater levels. These will have an impact on O & M activities.

### Cross Cutting Issues

1. **Phasing of WASH interventions for Rural Floods Response**

- Phasing rural flood response interventions is of great significance as it can support quick decision making and provide technical guidance for faster and effective WASH response.

2. **Role of Technical Expertise in the Initial Phase**

- Technical equipment is only likely to be used if technical expertise is also provided.
- Emergency situations contain many unknowns. The presence of experienced personnel to oversee and modify technical operations is necessary.
- Agencies often use inexperienced and inappropriate staff in the field.
- Experience has shown that there is often poor support for displaced/affected people to re-establish their lives.

3. **Gender factor in hygiene and sanitation**

- Women and girls of reproductive age must have access to appropriate materials for absorption and disposal of menstrual blood.
- Hygiene promoters should advocate for providing private facilities for girls and women to wash themselves, wash and dry underwear and sanitary clothes, and properly dispose of women’s sanitary napkins.

4. **Risk Reduction: Raising Handpumps and Latrines**

- Raising hand-pumps is more cost-effective than providing emergency supplies.
- Sealing drop-holes of latrines that will become flooded improves excreta containment during flooding.
- Floodproofing latrines and water sources should be done together; improving excreta disposal enhances water source protection.

5. **Exit Strategies**

- Experience has shown that there is often poor support for displaced/affected people to re-establish their lives.
Appendix 2: Water purification technologies used in South Asia

- During floods in Assam, the government used a mixture containing Ferric Alum, lime and bleaching powder to purify turbid water. In Gujarat, an NGO along with the People's Health and Development Trust (PHDT) developed a low-cost concept called “Matka Filter” to filter water after the floods.
- Several respondents mentioned that Sodium Hypochloride Solution-based technologies have worked well during previous floods in Bihar.
- After the Orissa Super Cyclone, organizations helped communities fit TERAFLIL red-clay filtration discs to household containers to filter high turbid water.
- During the Mumbai floods in 2007, the Bhawalkar Ecological Research Institute (BERI) used Biosanitizer technology to purify floodwater.
- After the Tsunami, WaterHealth installed water purification and filtration system, in conjunction with ultra violet light disinfection technology in Sri Lanka. In Andhra Pradesh, they installed more than 200 systems.
- In Barmer District, Rajasthan, NEERI provided Portable Instant Water Filter “NEERI-ZAR”, to convert turbid and contaminated rainwater into potable water during the 2007 floods.
- The Aga Khan Development (AKDN), working in Tsunami hit areas and geographically vulnerable villages in Andhra Pradesh have developed a “Hollow Fiber Ultra Filtration Membranes Technology” that can easily purify surface water.
- The West Bengal Public Health and Education Department has truck-mounted water treatment plants for treating floodwater, which it then distributes in plastic pouches in affected areas.
- The USAID-funded Point-of-Use Water Disinfection and Zinc Treatment project (POUZN) is establishing commercially viable and scalable models for sustainable penetration of low-cost, high quality treatment methods among low-income communities.
- They also noted that Pedal Gen, a Singapore based technology, reported success post Tsunami as it filtered water from ponds.
- Respondents stressed the need to increase usage of PUR(R) Purifier of Water and Solar Disinfection (SODIS).

Source: [http://www.solutionexchange-un.net.in](http://www.solutionexchange-un.net.in)

Appendix 3: The pros and cons of bottled for emergency water supply

<table>
<thead>
<tr>
<th>Advantages</th>
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<tbody>
<tr>
<td>Bottled water is a speedy and effective source of water, particularly in the life-saving phase of an emergency.</td>
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<tr>
<td>Comes ready to drink; does not require treatment at point of use</td>
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<tr>
<td>It is more convenient – and less tiring – to carry a bottle over long distances in comparison with water containers normally used/distributed during emergencies.</td>
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<tr>
<td>Can be air-dropped if road network is inaccessible.</td>
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<tr>
<td>Does not require technical expertise at point of distribution.</td>
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<tr>
<td>Bottles can be recycled for storage of water by users.</td>
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</tr>
<tr>
<td>An important low-cost component for solar disinfection of water (SODIS) for poor people in developing countries.</td>
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</table>

<table>
<thead>
<tr>
<th>Disadvantages</th>
<th></th>
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<tbody>
<tr>
<td>Exclusively a drinking water source.</td>
<td></td>
</tr>
<tr>
<td>Bottled water is incredibly expensive per unit of water delivered. It includes many inefficiencies such as the need to transport thousands of bottles to the point of need.</td>
<td></td>
</tr>
<tr>
<td>Too expensive to permit supply of sufficient quantities for all water needs of users</td>
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</tr>
<tr>
<td>Distribution can be labour intensive.</td>
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<tr>
<td>Plastic bottles used in water bottling are difficult to dispose of as they are non-biodegradable.</td>
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</tr>
<tr>
<td>The plastic in these containers may leach chemicals dangerous to the drinker’s health.</td>
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</tr>
<tr>
<td>Water quality may be compromised as bottlers are generally private entrepreneurs who are more concerned with profits than ensuring integrity of water supplies.</td>
<td></td>
</tr>
<tr>
<td>Inspection standards are generally more lax and tests less frequent for bottled water than for public supplies</td>
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</tr>
</tbody>
</table>

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