



# Water supply, health and vulnerability in floods

By Jean McCluskey

**Of all natural hazards, floods occur most often and are most widespread in scope and severity. The year 2000 has seen the greatest number of humanitarian responses to floods for Oxfam in any one year. In some regions, floods have outnumbered any other type of relief response for Oxfam GB.**

## Flood characteristics and effects on health

The public health consequences of any one flood event will vary depending upon the nature of the flood and the effects upon a given population. What constitutes a disaster for one community might be considered differently by others. In countries such as Bangladesh and India, floods form an important and regular part of people's lives, bringing important fertile deposits to agricultural lands situated in low lying floodplains; for others not used to such huge floods, it can bring destruction of homes, livelihoods and increased mortality.

Research has tried to identify key determinants of flood characteristics which suggest why some flood events lead to epidemic disease outbreak and others not. Although the potential for disease outbreaks is always present after a disaster, there are certain conditions that must be present for this potential to manifest in the form of epidemics. It is important for humanitarian agencies to have a better understanding of these factors when trying to determine where and when epidemics may occur and accordingly, how to allocate scarce resources.

Displacement, it seems, is of particular significance, specifically where overcrowding results. The risks of increasing disease seems to be greatest where there is overcrowding and standards of water and sanitation have declined<sup>1</sup>. Where this also results in longer-term displacement, this has the potential for huge risk increases, as there is a greater exposure to communicable diseases.

Research in the Dominican Republic has shown a relationship between hurricanes/flooding and displacement with the result of overcrowding for several weeks, inadequate sanitary conditions and massive increases in communicable public health diseases such as gastroenteritis, hepatitis A and typhoid<sup>2</sup>. Often research into the public health effects of floods last only a few weeks. Some diseases, such as hepatitis A can have incubation period of up to 50 days. An absence of any serious outbreak of water, sanitation or hygiene-related diseases in the 2 months that the flood displaced populations from Chokwe, Mozambique spent in displaced camps, was positively affected by the provision of adequate water, sanitation and hygiene promotion carried by Oxfam and other agencies.

1. PAHO, (1981) A Guide to Emergency Health Management after Natural Disasters, Scientific Publication 407

2. Bissell, (1983) Delayed Impact of Infectious Diseases after Natural Disasters, Journal of Emergency Medicine, 59-66.

## Effect of floods on water supply

### Urban environment

- Where a system provides water through a distribution network, it is likely to be most disrupted where flash or high velocity floods destroys important infrastructure, key to the operation of the system – treatment stations and pumping installations. The distribution system in this case is likely to experience localized damage where the force of the water has been strongest and will usually be repairable relatively quickly.
- Where fast rising floods occur

(less horizontal velocity), systems will be less affected. Often older style electrical installations, for example motors and circuit boards, have parts which can be salvaged post flood. Parts of the town system in Chokwe, Mozambique, once dismantled, cleaned, dried and reassembled functioned well in the short-term until replacements could be funded, purchased and fitted at a later date.

### Rural environments

The type of system and the flood experienced will determine the dis-

ruption caused. Where little infrastructure exists, there is obviously little damage to be done.

- In fast rising floods, infrastructure such as handpumps and gravity systems will experience little disruption other than system contamination.
- Violent flash floods can rip up and destroy any installation in its path. In Masengena, Northern Gaza, Mozambique, an Afridev handpump installed in reinforced concrete was ripped out of the ground and tossed aside like a small stone.

# Water and sanitation in emergencies

Type of flood	Example	Area affected	Duration	Effect on health infrastructure	Effect on water supplies			Effect on sanitation		
					Water Utilities	Groundwater supply – protected	Groundwater supply – unprotected	Sewerage system	Simple pit latrines	Lined pit latrines
Predictable, regular flooding	Area of India/Bangladesh/Cambodia/Vietnam	Large (flood plain type)	Up to 3 months	Interruption of access	Medium system contamination	Low, but inaccessible	Medium (sources are already contaminated)	Low-medium some flooding; localized blockages where overuse/ lack water	Flooded pits; wall collapse; slab breakages	Low - flooding
Increased size of regular flooding	Area of India/Bangladesh/Cambodia/Vietnam	Larger than normal (flood plain type)	Up to 6 months	Infrastructure damage; loss of equipment, supplies; limited access over wide area	System contamination; damage to electrical equipment;	Low, but inaccessible	Medium (sources are already contaminated)	Low-medium some flooding; localized blockages where overuse/ lack water	Flooded pits; wall collapse; slab breakages	Low - flooding
Flash flood urban/ rural	Pernambuco Brazil (2000)	Small alongside rivers	Few days	Local devastation only	System contamination; damage to electrical equipment;	Low, but inaccessible	Medium (sources are already contaminated)	Low	Flooded pits; wall collapse; slab breakages	Low – flooding
Flash flood urban/ rural	Gaza, Mozambique (2000)	Large (floodplain type)	Weeks	Infrastructure damage; loss of equipment, supplies; limited access over wide area; displacement of medical staff	System contamination; damage to electrical equipment;	Low, but inaccessible	Medium (sources are already contaminated)	Medium some flooding; silt blockage	Flooded pits; wall collapse; slab breakages	Low – flooding; inaccessible
Slower onset, continuous, sustained rainfall (tends to be rural)	Peru (86)	Lowlying, can be large	3-6 months	Infrastructure damage; limited access over wide area; displacement of medical staff	System contamination; damage to electrical equipment;	Low, but inaccessible	Medium (sources are already contaminated)	Medium some flooding; silt blockage	Flooded pits; wall collapse; slab breakages	Low – flooding; inaccessible

Table 1 summarises some of the likely flood scenarios and potential effects on water, sanitation and health infrastructure.

## Water quality during floods

Where water supply is fully protected, the degree of contamination will be limited. In a study in Bangladesh<sup>3</sup>, a water quality survey revealed that of non-flooded tubewells, 87 percent were less than 10 coliforms/100ml and of flooded tubewells, 50 percent were less than 10 coliforms and 42 percent were between 10-99 coliforms/100 ml. Where a population is collecting its drinking water supply from a non-protected source, often there is little difference in the faecal coliform counts between a non-flooded unprotected source and a flooded unprotected source, with contamination ranging from 10<sup>4</sup>->10<sup>6</sup> coliforms/100ml.

In a further study<sup>4</sup>, it was also found that those who did not use tubewell water for drinking, were 8.5 times more likely to be hospitalized with non-cholera watery diarrhoea. So although the quality of water from flooded tubewells contained higher rates of contamination than the non-flooded tubewells, it was much lower than any other available source and therefore would still be recommended as a preferred source in the absence of any non-flooded protected water sources. The closing of a town water supply after recommissioning of the groundwater system after floods including disinfection, (because of the lack of a formal Ministry of Health approval) forced a large proportion of the population to collect water from the gutters, putting the population at greater risk of disease than utilizing water from a protected borehole<sup>5</sup>.

It is important to note however, that the presence of high quality water supply will not alone prevent diarrhoeal disease outbreaks where parallel routes of transmission exist<sup>6</sup>. An integrated approach to reducing public health risks in floods, which combine the efforts of adequate quantity and reasonable quality water supply, sanitation and hygiene promotion, is imperative to success in eliminating excess morbidity and mortality

## Water supply choices in flooding

The way in which floods affect any given population will affect the approach taken to water supply in floods. Where an effect is massive population displacement to out of the flooded area, water supply will usually be approached as any other large population displacement i.e. refugee camps. However, many floods are in areas which regularly experience such events, and as such, the populations, national authorities and relief agencies have had to develop mechanisms and technologies in order to sustain populations living in flooded environments. Table 2 describes some of the main methods currently employed in providing potable water to affected populations.

Oxfam is about to undertake a small research project to examine further alternatives for the provision of household based water supplies and would be interested to hear from others who may be exploring similar lines of thought.

3. Bilqis et al, (1991) Environmental Health and the 1991 Bangladesh Cyclone, Disasters Vol.17, No.2.

4. Emch, Michael, (1999) Diarrheal disease risk in Matlab, Bangladesh, Social Science and Medicine 49, 519-530.

5. Author's own field experience

6. Briscoe, 1981

Table 2 describes the main methods currently employed in providing potable water to affected populations

Alternatives in Supplying Water During Floods	Where might be appropriate/used	Advantages	Disadvantages
<b>For those Living in the Flooded Area</b>			
<b>Boiling</b>	Often promoted, but not usually realistic	Can provide acceptable quality of drinking water	Requires fuel which may be unavailable or expensive; can be easily re-contaminated when stored
<b>Bleaching Powder</b>	On a household level; either distributed, or used with instructions for purchased chlorine; can be locally pre-positioned for predictable flooding events	Usually easily available in country; safer active % of chlorine	Difficulties for users in understanding instructions; different products of different active % available; often unreliable potency sustainability
<b>Water Purifying tablets</b>	Distribution for household level use;	Set amount of chlorine for a set amount of water; can be locally pre-positioned in predictable flooding	Varying strengths with same sizes of tablet can cause confusion; because has to be able to cope with the highest chlorine demands, can leave strong smell and taste
<b>Chloro-flocculants sachets</b>	Distribution for household use where waters are turbid and chlorination is either not completely effective or acceptable to the user;	Can produce clear water which has a residual chlorine level; ensures effective disinfection of turbid waters; can be locally pre-positioned in predictable flooding	More expensive; can suffer from same disadvantages as water purifying tablets
<b>Transport of chlorinated water in sealed plastic bags</b>	Transported and distributed to affected families; Half volume of water half air to ensure bags float	Gets some clean water to families where few options;	High logistics demand and cost; bags can be perforated; difficult to store in the house
<b>Raising level of tubewell above water level (pre/post flood)</b>	Where regular floods with predictable water levels;	Allows access all year round to existing protected water sources; can be very cost effective; can be a preparedness mechanism done at construction or pre-flood	Need to ensure access during floods (eg near building); can't cope with unpredictable bigger floods
<b>For those Displaced by Floods</b>			
<b>Access to free water from existing paid-for sources</b>	Where free or maintenance cost only sources are unavailable due to flooding (usually choice of the poor)	Gives access to clean water for all; can increase availability of water; can be useful in urban settings	Difficult to target the poor, requires blanket access; using existing suppliers of water (eg tanker suppliers) will not always increase the total availability of water
<b>Provision of protected water supplies at special shelters on high ground</b>	Sites or specially designated 'flood shelters' can serve large numbers of families for extended periods of time	Provides clean water for the displaced in the area in which they are sheltered. Water is nearby and boats are not needed for collecting water	Space is often limited in such shelters; sanitary seals are therefore important; shelters are often located in areas which will not be used at other times of the year - maintenance can therefore be a problem

7. Oxfam Public Health Assessment of Floods, Haiti, November 2000, unpublished.

## Recommissioning and rehabilitation of water supplies

Recommissioning of any water supply after potential or confirmed contamination obviously requires disinfection at super-chlorination rates before any water should be released for consumption.

- Chlorination of water supplies needs to be assured, as there are likely to be increased sources of potential contamination from leaks and breakages in a system, particularly as affected sewerage and drainage systems may be located nearby.

- Secondary contamination is also of particular importance during flooding since families are likely to be living in more unhygienic conditions. Water supplies collected externally and stored inside a house or collective centres (for the displaced) may be more vulnerable to contamination. In such instances, Oxfam have provided a specially designed drinking water container that has a sealable lid and a tap for extraction.

- Partially protected or damaged water supplies (for example hand dug wells), often require physical cleaning before the super-chlorination process. Oxfam has specially designed dewatering/desludging kits, which can be easily used by non-skilled personnel in the field. This ensures that any contaminants/sediments will be removed to both improve the chlorination process and return the previous yield of the well.

## Other factors that can exacerbate effects produced by floods

There are also other significant factors that may contribute to the severity of any potential outbreak including:-

- Vulnerability of populations
- Lack of preparedness
- Previous experience of affected community to cope with similar disaster
- Lack of co-ordination/collaboration
- Lack of resources at a local or national level

Although there are countries that experience floods on a regular basis, and the population, local and national authorities have developed coping mechanisms to

deal with some of the problems the floods present such as building houses on stilts from bamboo, there are still major losses of life, increases in morbidity and devastation of livelihoods.

- People live in dangerous areas because either gains can offset the risks, through caste or occupation.
- Families live in high-risk areas mainly because poor people have no choice – disaster occurs when hazard and vulnerability meet. Research in south India<sup>8</sup>, which has resonance in many other countries' reports that successive government policies to reduce vulnerability and poverty in its coastal areas have succeeded in reducing the loss of life, but failed to reduce poverty.

8. Winchester, P. (2000) Cyclone Mitigation, Resource Allocation and Post Disaster Reconstruction in Southern India: Lessons From Two Decades of Research, Disasters, 24:1, 18-37.

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9. Blaikie, P. M. (1981) Class, Land Use and Soil Erosion.  
10. Loretto and Tegegn, (1996) Disasters in Africa (Old and New hazards and growing vulnerability), World Health Statistics Quarterly, 49.

11. Dai Zhi-Chang, (1992) No Epidemic Despite Devastating Floods, Chinese Medical Journal 105:91, 531-34.  
12. Winchester, P. (2000) Cyclone Mitigation, Resource Allocation and Post Disaster Reconstruction in Southern India: Lessons Form Two Decades of Research, Disasters, 24:1, 18-37.

## about the author

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Children find a drinking water source at the centre of a flooded village



Shehzad Noorani/Still Pictures

There are increasing numbers of people vulnerable to floods. In many respects, the physical risks are of secondary importance to the economic risks presented to a population. It is suggested that established incomes and credit worthiness are two key attributes to reducing vulnerability<sup>9</sup>. This given, NGOs potentially have an important role to play in alleviating some of the major causes of poverty and in turn, vulnerability. It is therefore key that an approach to relief, disaster preparedness and mitigation, starts with programmes with a developmental focus on the vulnerability of such populations

Structures and capacity for disaster reduction and emergency management in many countries are often very poor. The UN Economic Commission for Africa reports that 50 percent of African countries have plans for disaster mitigation, but very few have laws and budgets to support them and inter-country collaboration and support systems are weak<sup>10</sup>. A Ministry of Public Health report in China<sup>11</sup> suggested that it was only through enormous planning, preparedness, surveillance and the participation of everyone

(co-ordination at ministerial to community level), which ensured that there were no epidemic outbreaks despite the most devastating floods of the century.

A number of technical solutions to water supply problems in flood events have been presented and further research needs to be done in order to pro-

vide more effective, appropriate safe water supply to affected families and communities. Improved preparedness, capacity building and pre-positioning of procedures and materials, which give greater community involvement in the choices of water supply, could significantly improve the effectiveness of present options. In particular, there is a need to understand better the coping mechanisms of the affected populations, particularly those who are not (or chose not to be) displaced, how they adapt at the household level to diminish risk and how important underlying levels of awareness are, such as risks and what influences this (literacy, level of education, previous exposure to health promotion).

However, the greatest single factor that describes vulnerability, is socio-economic status – being the greatest cause of direct and indirect cause of public health risks in floods. It is suggested that poverty is at the root cause of many of the direct variables such as lack of access to clean water. The speed of recovery from the effects of floods is also relative to the size of the asset base<sup>12</sup>.

NGOs therefore have an important role to play in reducing this vulnerability through programmes aimed specifically at livelihoods and income protection. It is unfortunate however, that in many cases, there is significantly greater amounts of funding available to respond to a disaster which has already occurred, rather than in the prevention or mitigation of its effects. NGOs and donors must work together to improve preparedness and mitigation strategies for the millions of people who are often predictably and regularly affected.



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