reinforce local management structures by offering training on maintenance, and by incorporating community management systems into the new programme.

In these situations, it is very important to be sensitive to the local population's needs. It seems only reasonable that, if systems can be provided that offer them something in the long term, those options should be chosen.

Box 14

In North Kivu Province in Zaire, the region currently hosting 1 million Rwandan refugees, the displacement of 200,000+ people in May 1993 caused particularly difficult problems. Most of the displaced people moved into villages of the same ethnic background where they felt safe. Consequently there were large numbers of small clusters of people in villages which themselves had serious water supply problems. Apart from a few large piped water schemes, the Province had attracted very little in the way of water supply development programmes. At a village level, water was typically collected from unprotected spring sources or streams. To exacerbate the problem, many of the villages to which people had fled were on volcanic rock where water retention is poor, and unprotected spring sources posed a major health hazard since very little sub- surface filtering takes place.

A number of agencies saw a spring protection programme as offering the fastest response to the large number of settlements. One agency also decided to integrate the spring protection with a hygiene awareness programme which included community mobilisation to construct and use improved latrines, the promotion of basic hygiene practice, and the use of community health workers – all very important in an area where cholera is endemic. This is an example of a response to an emergency situation where an attempt was also made to address longer-term community needs as part of the same programme.

Sanitation Characteristics. When displaced people move into existing settlements, they will frequently occupy public buildings such as schools. These will usually have some sort of basic or improved latrine provided, but the large number of additional users will almost certainly result in overfull pits or septic tanks. In these circumstances, it is not uncommon to see effluent from the latrines washing over areas around the buildings. This is totally unacceptable. Measures need to be taken to clean this up and prevent it happening in future. One option may be to undertake a regular programme of desludging, as was done in Mazar-i-Sharif in northern Afghanistan in 1993 when people displaced from Kabul occupied schools and university buildings in the city. If a piped sewage system exists in the area it may be possible to connect the latrines from the public building to this, as is currently being explored in Bujumbura in Burundi where people displaced by fighting in October 1993 have occupied schools which were not connected to the city's sewage system.

7.6 Resident population affected by drought

Droughts result in a reduced yield and the possible drying-up of traditional surface and sub-surface water sources. Households (usually the female members) have to travel longer and longer distances to obtain water from reliable sources. As yields are reduced and the remaining sources are overused, so the quality of the available water tends to deteriorate. Ultimately, households and communities are obliged to migrate to better quality and more reliable sources. The use of poor quality sources, the stress of the move to better quality sources and the concentration around them often result in increased morbidity. National and international responses to drought invariably focus on the provision of food and it is often difficult to mobilise resources for water sector activities.

Water Characteristics. A broad range of interventions is available when responding to drought in rural areas. In considering the most appropriate intervention, it is important to bear in mind its likely time-lag and the chances of its relieving water stress in the affected communities before the start of the next rains which will herald the end of the drought. Some interventions are

unlikely to have an impact during the drought but may, if managed properly, improve the reliability of water sources during subsequent droughts.

In situations where water is normally head-carried and the drought necessitates the use of more distant sources an appropriate intervention may be to *assist communities with the transport of water.* This might involve the provision of animal-drawn water carts and, if necessary, the animals to pull them. This action would enable one individual to collect water for several families and thus save the time and effort of the women who would normally head-carry the water. In more difficult terrain, wheeled carts may be inappropriate and the provision of animals and water containers which can be strapped to their backs may be more appropriate. Such interventions need not entail the free provision of animals and equipment but could be managed on a loan basis or credit should be provided to water traders to enable them to expand their activities. Care would need to be taken in selecting those to receive the loans and in ensuring that they did not unduly exploit their position by overcharging for the water transported.

Where institutional capacity permits and the affected communities are many miles from reliable sources, it may be more appropriate to *tanker water to them* either by lorry or by tractor-drawn water-bowsers. Such interventions were undertaken by District Councils in Botswana during the extended drought of the 1980s for those villages where boreholes had dried up. The advantage of bowsers is that they can be left standing in a central location for use by the affected community whilst the tractor or lorry goes off to pull other bowsers to other affected communities, returning to the first community with a full replacement bowser a few days later. It would be uneconomic to leave tanker lorries standing for several days, and for communities serviced by tankers a centrally located reservoir will need to be constructed serving adjacent standpipes which can be regularly replenished by the tankers. Butyl rubber water bags (known as bladder tanks) on raised platforms or earth banks are well suited to this arrangement. Such a system was used in Lesotho during the response to the 1991/92 drought. (Section 5.2 provides additional information on tankering problems)

The yield of wells which are drying up as a result of the drought may be increased by *well deepening*. This may involve the provision of tools to villagers or the employment of local well-construction companies/artisans. (see Section 5.2).

In countries where government agencies are responsible for the maintenance of water supplies and where capacity has been in decline as a result of broken pumps and lack of spare parts, the *rehabilitation of faulty equipment on existing sources* would be more appropriate than embarking on the drilling of new boreholes. Supporting the responsible government agency by the provision of the required spare parts, transport for technicians to visit and repair the faulty equipment and perhaps technical assistance would be appropriate. In some instances it may not be possible to work with the government agency and the relief agency may have to undertake the rehabilitation work itself.

Finally, there is the option of drilling and equipping boreholes. This represents a high tech approach which might be attractive to donors. Borehole drilling programmes as a response to drought related emergencies have been of limited success but continue to be a commonly employed response to water problems in drought affected areas. Relief agencies need to be aware of the technical and institutional reasons why this may be the case and to ensure that all other options have been considered before resorting to a borehole drilling programme.

New drilling rigs are unavailable in most developing countries and therefore need to be imported. This may take months, with the result that the drought will have ended by the time the rigs begin operation, and it will be even longer before successful boreholes are equipped and functioning. The rigs are usually enormously over-specified and consequently very expensive. Rigs capable of drilling to depths in excess of 200m may be ordered for situations where it is only necessary to drill to less than 100m. (See Section 5.2 for more information on borehole drilling and equipping.)

Over the last few years a number of small, portable rigs have become available. Lightweight rigs manufactured in Thailand are currently working successfully

in Cambodia. Similar rigs available in the UK cost from (approximately) $15,000. Their small size means that they are transportable by air. As with all drilling rigs, spare parts, consumables such as drill bits, casing and technical support need to be readily available to ensure sustained drilling.

Low success rates should be expected in emergency drought relief programmes because of the difficulty of finding sufficiently productive boreholes in terrain that is probably hydrogeologically difficult and often problematic for drilling. For instance, in a programme in the Lebowa area of South Africa during the 1991/92 drought 73 boreholes were drilled over a 6 month period but only 25 were successful – a success rate of only 34%. The drilling of new boreholes may also be inappropriate because the pressure of the emergency reduces the quality of the work, resulting in sources which are poorly sited and equipped. In the Lebowa example engineers had to grapple with problems inherited from water systems constructed during a previous drought. At that time the government had imposed time limits on the use of emergency funds, the work was rushed and the systems were poorly designed and constructed and required remedial maintenance and repair[8].

Box 15

An evaluation conducted by a bilateral donor of its response to the Southern African Drought of 1991/92 found that most of the expenditures in the water sector in three of the affected countries had no impact on the water stress being experienced before the start of the next rains. The only activities to have had an impact before the rains were tankering operations. None of the well-deepening and borehole-drilling activities which had accounted for the bulk of expenditures had any impact before the next rains.

From the above it would appear that the use of *temporary, stop-gap measures* such as transportation and *pre-drought mitigation measures* aimed at improving the reliability of water sources during drought periods are to be preferred to 'quick-fix' solutions. A planned programme of infrastructural improvements in

[8] J. Davis - personal communication.

a drought-prone area is more likely to produce better supply systems at a lower cost than quick-fix emergency remedies.

Sanitation Characteristics. The reduction in water quality and availability associated with a drought means that people's consumption of water will decline, and this reinforces the need for good hygiene practices. People need to understand the relationship between personal and communal hygiene and the incidence of diarrhoea if they are to take measures to protect themselves. Agencies responding to the drought should complement their efforts to relieve water stress by running community-based educational programmes emphasising the importance of good hygiene practices. Such programmes may have as much, or greater, impact on the morbidity and mortality associated with the drought than more costly efforts to increase the volumes of water available.

7.7 Resident population affected by sudden-onset disasters

There are a wide range of natural hazard types in the 'sudden-onset' category and thus considerable variations in impacts in terms of water and sanitation. The principal sudden-impact hazards, in terms of mortality and numbers affected, are floods, cyclones and earthquakes. These are dealt with briefly here as the wide variation in context and impacts serves to discourage the development of notions of good practice, and it is likely that relief agencies and communities in known hazard-prone areas have experience of previous hazard events and are aware of most of the appropriate interventions.

The principles of providing people with safe drinking water and a safe means of disposing of their excreta apply equally to these situations. The population affected by such disasters will want to stay as close as possible to their homes; it is unlikely that camp situations will spontaneously occur and so the need for concentrated services will be less pressing. This will impose a different kind of burden on the agencies providing the service as they will have to start up a number of separate programmes in a number of discrete locations aimed at

meeting the needs of disparate groups of people. This will obviously have staffing and resource implications.

Floods

Flash floods can cause intense damage on hill sides in hilly areas but the impact is usually localised. Floods are generally confined to valley bottoms and low-lying areas, where they prevent access to existing water sources and pollute them. People are forced to seek temporary shelter on raised ground where they will be obliged to use the polluted flood water for drinking and where the observance of minimum sanitation standards will be difficult. When the flood waters retreat the priority needs are to clean and rehabilitate the traditional water sources.

Water and sanitation. Providing all the groups on the raised ground with good quality drinking water for the period of the inundation will be extremely difficult unless the affected area is small, reliable water sources are available within or near to the affected area, and the relief agencies possess the means of transport (fast small boats, helicopters) for moving quickly between the concentrations of population. Where these conditions do not apply, it will not be possible to reach large sections of the population before the floodwaters retreat. In areas which are highly flood-prone, it would be desirable to protect traditional sub-surface water sources from the floods. In Bangladesh, for instance, many tubewells have been equipped with sealed raised plinths on which the handpumps are placed in order to raise the pump above the expected flood level and prevent the ingress of polluted flood water into the borehole. A complementary preparedness measure would be to equip the population for such events by providing them with the knowledge and means of treating drinking water drawn from polluted floodwaters. Fast-dissolving chlorine tablets are often distributed but their impact upon morbidity statistics is unclear, illustrating the difficulties faced when trying to educate people about water treatment methods employing chemicals.

The populations on the raised ground should be encouraged to observe basic sanitation standards and to adhere to the principle of burying their faeces. Even if defecation areas are sited above the floodwater levels, rain storms will wash faeces into surface water sources and inundated groundwater sources such as wells and boreholes. If sufficient land is not available for managed defecation, then defecation should be strongly encouraged at the furthest downstream point on the raised land.

Once the floodwaters retreat and people are able to return to their homes it will be necessary to rehabilitate the traditional water sources by cleaning polluted sources and repairing any damaged pumping equipment. Boreholes may be cleaned by flushing out the polluted water with water from a clean source or by repeatedly disinfecting the borehole and pumping it out. The quality of water in ponds used for household activities other than drinking can be improved by emptying the polluted water and allowing recharge from rain and through the restoration of the watertable.

Cyclones

Cyclones affect water sources in several ways. Surface instillations such as pumps may be damaged by the high winds and flying debris and electrical pumps will be rendered ineffective by the disruption of power supplies. In low lying coastal areas cyclones frequently cause flooding and saline incursion.

Water and sanitation. It is likely that survivors will want to stay as close as possible to their homes and villages; large concentrations of displaced people are therefore unlikely. The priority is to rehabilitate the damaged and polluted water sources, by repairing/replacing the pumping equipment and cleaning out the polluted/saline boreholes. Whilst this is being done, efforts should be made to ensure that the water being consumed is as clean as possible. Options include the distribution of fast-dissolving chlorine tablets; setting up filtration systems; transporting drinking water to the affected communities by tankers or tractor-bowsers; and ensuring that the risk of additional pollution to the water sources

being used is minimised through the use of upstream and protected sources. If the area is highly cyclone-prone, preparation measures may have included training people in the correct use and application of treatment methods, the simplest of all being to boil water. Dead bodies and animal carcases should be buried and where populations have congregated pit latrines should be constructed.

Earthquakes

Earthquakes make large numbers of people homeless on a temporary or longer-term basis, rupture piped water supply and sewage systems, and damage reservoirs, pumping equipment and boreholes.

Water and sanitation. The population rendered homeless will probably settle spontaneously on the outskirts of the village/town or in camps. The priority will be to provide them with clean water (either through tankering, the repair of the damaged supply system or treatment of polluted sources) plus the usual sanitation measures such as establishing managed defecation sites, latrine construction and hygiene awareness training.

Earthquakes can damage household latrines and, in towns, rupture sewage pipes resulting in sewage flowing into the streets. These areas should be cordoned off and steps taken to prevent or reduce the pollution of surviving water supply systems.

Water treatment activities may involve the construction of temporary water treatment stations and the distribution of quick-dissolving chlorine tablets. If the region is highly earthquake-prone, preparation measures may have trained people in the correct use and application of these tablets.

Once the immediate objective of providing people with good quantities of reasonable quality water has been met, the water programme must then facilitate the return of people to their normal supply source as soon as possible.

Immediate and medium-term needs are not necessarily mutually exclusive and work on both can be simultaneous if resources allow. If communities previously relied upon piped water supplies, a quick solution is unlikely and medium-term reconstruction programmes will be required. Earthquakes will cause major land upheaval and it is highly probable that groundwater sources will also have been affected. Spring-lines may have been altered, wells can be irreparably damaged and boreholes can collapse. In such circumstances a speedy return to normal supplies is unlikely and the emergency solutions may need to be continued for a period of months or even longer. The planning of emergency interventions should anticipate the period over which they are likely to be required.

7.8 Emergency water and sanitation programmes in urban areas

The question of emergency water and sanitation responses in urban areas is raised regularly. In recent years the problems in the former Yugoslavia, the former Soviet Union and Iraq have been very high-profile. This Section briefly reviews some of the issues which NGOs need to consider in deciding whether or not to become involved.

Probably the first thing to consider is the scale of the problem. Providing water and sanitation facilities to 200,000 people in a camp easily is more achievable than trying to provide them to 200,000 people spread across a town or city. The level of technology employed in any urban system is likely to be high. As discussed in Section 3.3, the technical knowledge of how urban water and sewage systems operate needs to be available to the agency. Large-scale funding will be required as specialist equipment will need to be replaced and, pipelines may have to be reinstated or rerouted. Previous experience in these situations has shown that technical problems which at first seem to be easily reconcilable and possibly the direct result of recent conflict, bombing, etc., are in fact long-standing problems due to poor maintenance and under-funding of local departments charged with managing the systems. OXFAM has learnt this the hard way in Iraq.

During the Gulf war, the approach adopted by the International Committee of the Red Cross and UNICEF in Iraq concentrated on serviceable installations. Both agencies made essential items available to the water boards which meant that most of the major treatment stations were able to continue to function[9].

When an agency embarks upon an urban rehabilitation programme, it must recognise the scale of the task it is taking on. The problems of a poorly maintained urban water or sewage system cannot be resolved by a small NGO as an emergency response. OXFAM was involved in the rehabilitation of the Phnom Penh water system, and spent 12 years working on it.

Involvement originally intended to be restricted to the water system may inevitably have to be extended to the sewage system also. Bombs do not discriminate between water or sewage pipes. Both will be broken. This will mean that as people continue to use their toilets, sewage will flow not only into the streets but also into the water mains.

It can be argued that the best emergency response in an urban situation is to provide water storage facilities around the town and bring clean water to them, probably by tanker. This will afford the opportunity to survey and take in the scale and complexity of the work which is needed.

In Monrovia, Liberia, the ICRC initiative decided that the city's piped supply system was too big for them to deal with. They have adopted the alternative approach of digging wells for people to use around the city, which has gone some way towards meeting the drinking water needs of the inhabitants. People also acknowledge the fact that they may have to boil or otherwise disinfect their water.

One aspect of providing water in urban areas that has not previously been mentioned is that of pollution. Unlike rural areas, surface water sources in urban areas are likely to be chemically polluted. If the use of such sources is

[9] G Nembrini, ICRC - personal communication.

being considered, simple treatment processes such as those outlined above will be effective only on microbiological and not on chemical pollution. Specialist advice will have to be taken for every situation encountered.

Most NGOs can only hope to provide temporary answers or to patch up the problems of urban rehabilitation. Alternative ways of addressing the emergency will probably have to be sought until large and better resourced agencies can resolve the large-scale needs of rehabilitation.