FORUM

war and water

INTERNATIONAL COMMITTEE OF THE RED CROSS

MISSION

The International Committee of the Red Cross (ICRC) is an impartial, neutral and independent organization whose exclusively humanitarian mission is to protect the lives and dignity of victims of war and internal violence and to provide them with assistance. It directs and coordinates the international relief activities conducted by the Movement in situations of conflict. It also endeavours to prevent suffering by promoting and strengthening humanitarian law and universal humanitarian principles. Established in 1863, the ICRC is at the origin of the International Red Cross and Red Crescent Movement.

"Water, thou hast no taste, no color, no odor; canst
not be defined, art relished while ever mysterious.
Not necessary to life, but rather life itself, thou fillest us with a
gratification that exceeds the delight of the senses."

Saint-Exupéry, *Wind, Sand, and Stars* (1939), tr. Lewis Galantière

R. Capa / Magnum

War

WATER IS THE SOURCE OF LIFE – and as such can also be a source of conflict. War is the ultimate outcome of tension between peoples, the causes of which are many and varied. Water is sometimes among these causes, but is very rarely the sole one.

Access to water, however, may well become problematic both during and after conflict. It may be that, in the heat of battle, water sources or people going to fetch water are deliberately targeted; it may be that people have had to leave their homes and must seek water in hostile environments; or it may be that the infrastructure that provided water is damaged in the fighting or becomes out of bounds for other reasons. Whatever the reason, as water is essential to survival, ensuring access to it is a priority for humanitarian organizations. Often their staff do this at their own risk and peril and, sadly, lives have been lost all too often in the call of duty.

Without claiming to be exhaustive, this *Forum* sets out to draw attention to some of the problems encountered by vulnerable populations with regard to water in times of conflict and describes or proposes solutions to deal with its lack, or its excess, or its contamination. As the ICRC acts above all in emergencies, it is in a unique position to witness the problems first-hand. Increasingly, nowadays, it stays on even after the fighting has ceased, conducting programmes – often in close cooperation with other organizations – that promote stability, and thus lower the risk of renewed hostilities. Its aim is to fill gaps in assistance provided, before organizations with mandates to carry out development projects are able to take over. Indeed, the shock waves often last way beyond the end of a conflict.

Water

Water does not just pose a problem in times of conflict: billions throughout the world do not enjoy access to clean drinking water or to decent sanitation, and will not do so for the foreseeable future.

Being aware that this is the case is already a step forward. However, awareness alone is not enough. It must be translated into action: action that can be taken much farther upstream before a crisis develops, action that foresees, and thus prevents, adverse occurrences. This can be done by improving conditions for rural populations, so that they do not overwhelm urban centres and create increased problems and tension, possibly leading to conflict, and by enhancing communities' economic well-being, as economic inequalities are most often the root causes of tension.

Forum will contribute to a debate that is beginning to go public. Successive conferences have identified the dangers, drawn attention to them and issued repeated warnings on the subject. In the final analysis, public opinion alone can make things move, as was overwhelmingly demonstrated recently by the campaign to ban landmines.

Forum is also a testimony to the fact that – even as predictions of doom and gloom abound – humankind has an extraordinary capacity to find solutions to its problems. This should be cause for optimism.

We hope that the following pages will help to fire the imagination and encourage us all to work towards improving the lives of the under-privileged both in war and peacetime. Water may be the key.

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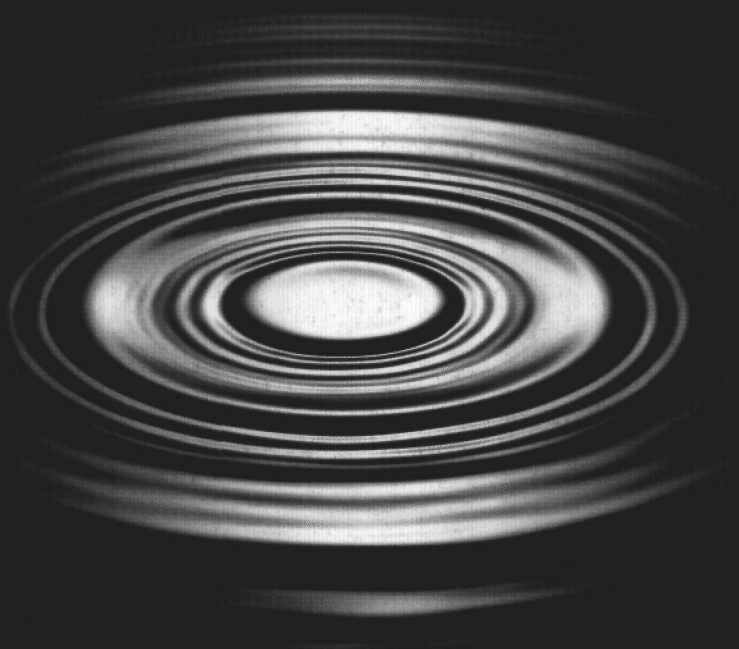
The contributions to *Forum* are arranged roughly in an order to reflect the periods before, during and after conflict. A series of articles looks at how wars may – or may not – arise over water, showing how vulnerability comes about as a result of water scarcity, and how this scarcity or an excess of water may affect food security and, ultimately, survival. Water-related diseases, too, may be the result of man's activities, and specific examples are given from the Middle East and East Africa. The protection afforded water by international humanitarian law during conflict is examined, as is the complexity of ensuring access to and the provision of water to sustain life, and man's ingenuity in doing so. Case studies of the ICRC's work in Somalia describe the difficulties of restoring irrigation systems and repairing damaged dams and dykes, and the dangers of uncontrolled privatization in a war-torn city. Ways of coping in the immediate aftermath of war and subsequently ensuring continuity of programmes are explored in the cases of Chechnya and Angola, as are the long-term effects of decaying infrastructure in Iraq and Tajikistan. Lastly, the specific problems faced by refugees and migrants are analysed, with a look at how much water they need and a case study from South Africa showing that solutions can indeed be found.



Liesl Graz is a writer and journalist based in Lausanne, Switzerland. She was Geneva correspondent for *The Economist* for many years, with a particular interest in international affairs and their humanitarian implications. Her long-standing interest in the Middle East has found expression in three books of socio-political analysis of countries and peoples in the region.

water source of life

For the last thousand years, every Thursday at noon seven men in solemn black have taken their places on high thrones before one of the side doors of the Cathedral of Valencia, Spain. They are the elected judges of the *Tribunal de las Aguas*, the Water Tribunal, said to be the oldest judicial institution functioning unchanged in Europe, if not the world. Within their jurisdiction they are omnipotent: the water channels they rule over bring life to the city and ensure riches on what would otherwise be a barren plain. The mountain villages of Oman have an arrangement that is not very different: the *qadi*, the religious judge, is also the guardian of the stone-hewn water channels that turn the rocky terraces into miniature gardens of Eden.

Such juxtapositions of water and the sacred are not fortuitous. In almost every known civilization, both are at the source of life. Creation stories vary in detail, but from the water serpents of China and the dragons of Borneo to Genesis and the liquid umbilicus of the Aztlan of Mexico, very few do not include the element of water.

An adult can live for several weeks without food, but even under otherwise favourable conditions, more than two or three days without water is a sentence of death. The international rule of thumb today is that the minimum water requirement is 10 litres per person per day,[1] but there is a good deal of leeway in how much constitutes "enough". Desert Bedouin would consider 10 litres as plenty, while North Americans feel seriously deprived if they are restricted to 10 times that.

Water for drinking is physiologically more important than water for cleanliness, but the two cannot be entirely separated. One of the major advances in public health came when drinking water in cities like London or New York could be provided without contamination by the dejections of cholera or typhoid victims, and when people – at least in the higher strata of society – began to wash themselves and their clothes with reasonable frequency. That came only around the middle of the 19th century. As late as 1930, in many parts of Europe, at least half the population had only two real baths during their earthly existence: as new-born infants and after death.

The physiological imperative of water is mirrored in its symbolic importance: Hindus achieve purification by bathing in the Holy Ganges, which also receives the ashes of the dead; the Christian is reborn in baptism; Muslims perform sacred ablutions before prayer; ritual baths form a significant element of Jewish observance. For the ancient Greeks, to whom springs were sanctified by the presence of gods and nymphs, the ferry passage across the River Styx was an essential prelude to the Elysian Fields; along the upper reaches of the Amazon, the souls of the dead can only find repose once their bodies are committed to the river.

If water is life, its possession confers power. Elaborate treaties govern the distribution of water along every river that touches several countries and breaching them is considered a legitimate *casus belli*. Even now, for instance, tensions between Turkey and its neighbours downstream of the Euphrates are in large part attributable to disputes over water. One of the major stumbling blocks in any real progress towards peace between Israel and its Arab neighbours is how to apportion use and distribution of the water from the River Jordan. From its spring-fed beginnings on the Golan to its outlet on the Dead Sea, it has, since before recorded history, both supported physical life and haunted the collective memories of all three Abrahamic religions.

The sanctification of water carries, as a corollary, a widespread taboo against deliberately depriving even one's enemies of it. Water has so rarely been evoked in war that John Keegan's masterly *A History of Warfare* (London, 1993) does not even include it as an index entry. And although poisoning the wells of an enemy has been considered perfidy – and so, theoretically, off limits – for millennia, the status of water has not been closely codified in modern humanitarian law.

The Geneva Conventions do mention the protection of civilian water installations,[2] though not quite on the same exalted level as hospitals or historic cathedrals and mosques. In Iraq in 1991, the water installations were indeed spared; the coalition bombed power stations which, as legitimate military targets, are not protected by the Conventions. Modern water distribution, of course, breaks down in the absence of electrical pumps.

Few modern warriors have used water as a deliberate weapon. One of them, and his weapon was not thirst, was the Chinese general who in 1938 ordered the sluices of the Yellow River opened to delay the advance of the Japanese, drowning several hundred thousand of his own people in the process.

On the other hand, thirst was very much a factor in the short but nasty Yemeni civil war of 1994. One reason the siege of Aden – and with it the war – lasted no longer than it did was that the North Yemeni commanders who controlled the city's access to water wanted neither to kill nor to permanently antagonize its inhabitants. Their eventual goal was not punishment but integration.

In July, survival in Aden requires every drop of the famous 10 litres per person per day, and more. Once the main pumping stations north of the city had been overrun in the fighting, the hastily revived shallow wells could no longer cope. Nevertheless, that war was unusual among recent conflicts: the armies were commanded by generals who listened when they were reminded of the principles of humanitarian law.

No one listened, or perhaps no one was thinking, during the great Rwandan exodus of 1994, in the wake of the massacres that year. More people probably died simply from lack of water than from cholera and other diseases. Much of that tragedy could have been avoided if, as refugees poured out of Rwanda in those first dramatic days of July, a policeman at the crossroads had been instructed to direct the stream towards Lake Kivu, to the south-west, rather than northwards towards waterless Goma, built on volcanic rock.

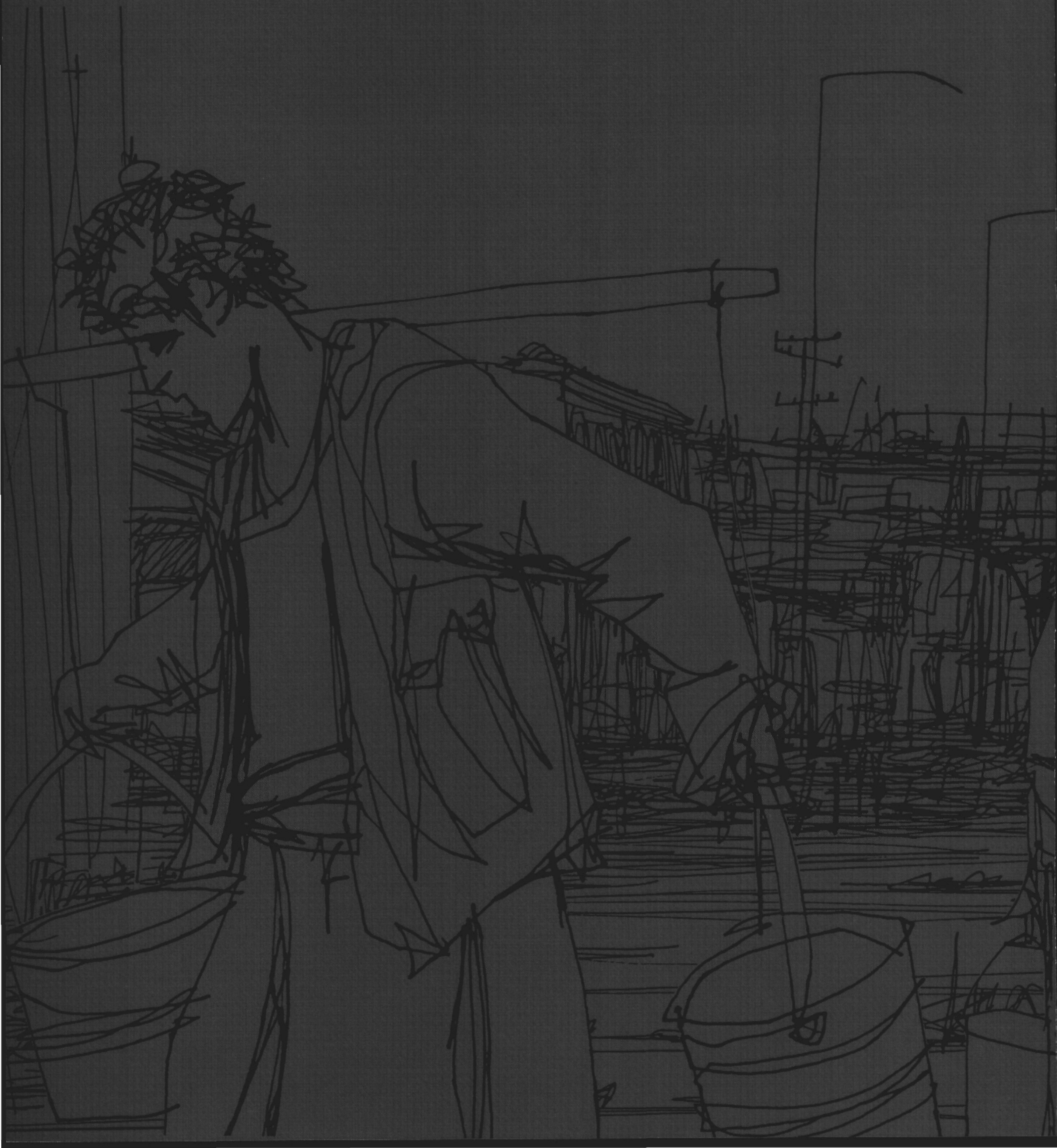
We will never know how many lives could have been saved there. But the sad reality should stand as a reminder that just as religious leaders, physiologists, politicians and, perhaps, generals all – in their own way – recognize the vital importance of water, so it must not, cannot, even in the heat of an emergency, be forgotten in the humanitarian equation.

I. Berry / Magnum

Purification is achieved by bathing in the Holy Ganges.

1 This amount varies widely, according to the period, source and context: see Les Roberts, p. 96.
2 See Ameur Zemmali, p. 30.

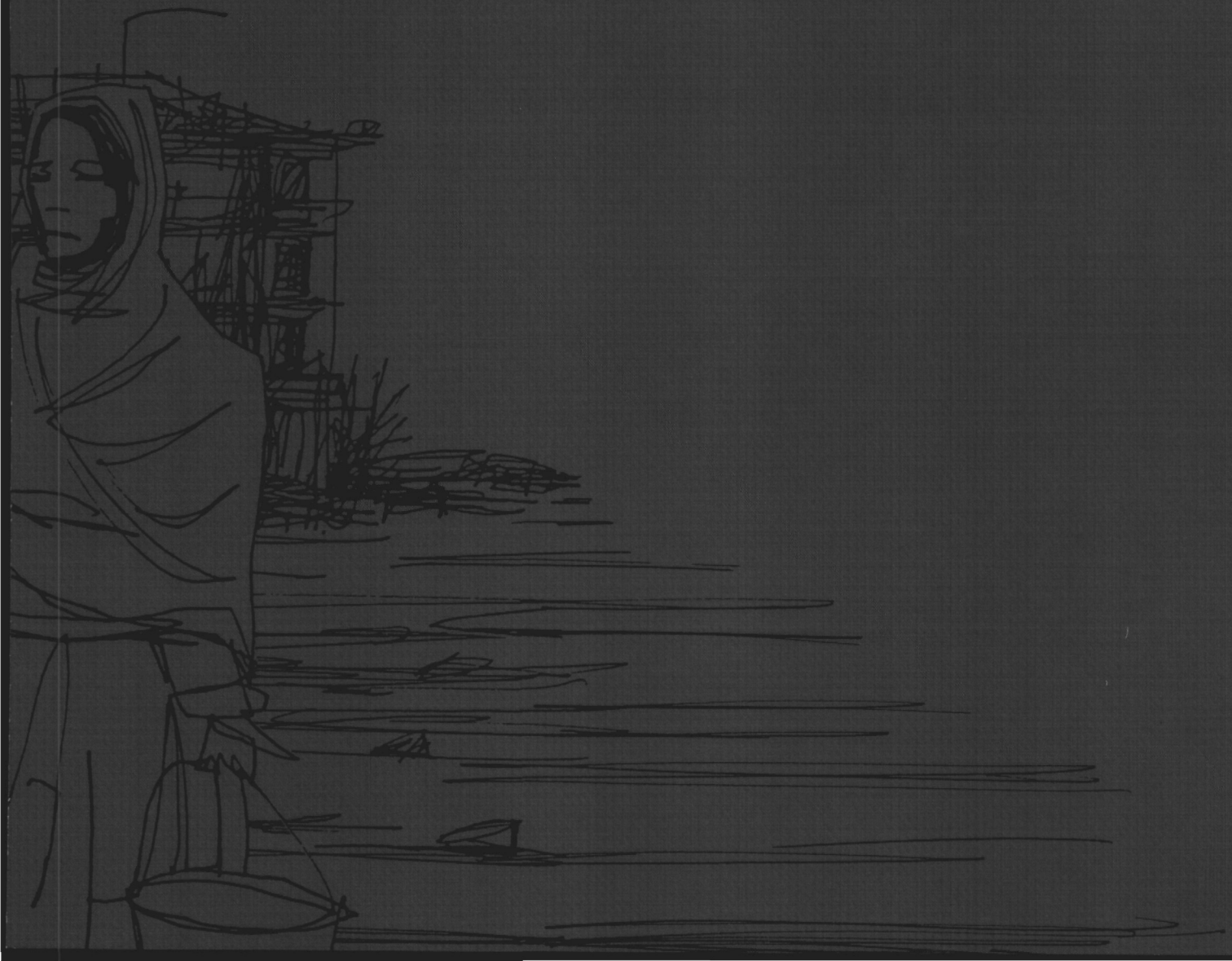
D. Tazzyman



Thomas Homer-Dixon received his doctorate in political science from MIT in 1989 and has written on a range of topics, including arms control, environmental policy and the philosophy of the social sciences. He is Director of the Peace and Conflict Studies Program and Assistant Professor in the Department of Political Science at the University of Toronto, Canada, and Associate Fellow of the Canadian Institute for Advanced Research.

the myth of global water wars

Despite fears that future wars may be over water, Thomas Homer-Dixon argues that it is hard to find clear historical or contemporary examples of major wars motivated mainly by scarcities of renewables such as cropland, forests, fish and fresh water.



D. Tazzyman

At a meeting in Stockholm in August 1995, Ismail Serageldin, the World Bank's vice-president for environmentally sustainable development, released a new report on global water issues. The report and his accompanying speech described an emerging "water crisis" in the Middle East, North Africa and many other countries, including India and China. "In the near future," Mr Serageldin said, "availability of water rather than land will be the main constraint to agricultural production in many areas."[1]

The World Bank is right to focus on the water crisis. Water scarcity and pollution are already hindering economic growth in many poor countries. With global water demand doubling every 21 years, these scarcities, and the social stresses they cause, are going to get much worse.

Unfortunately, though, Mr Serageldin strayed from this sensible proposition into sensationalism. He declared in a press release that the "wars of the next century will be over water," not oil. Although environmental activists, policy-makers and academics commonly make such claims, they are almost certainly wrong.

Among international-relations scholars, it has been conventional wisdom for some time that severe scarcities of natural resources can produce wars among States. During the 1970s, it was argued[2] that countries facing high resource demands and limited resource availability within their territories would seek the needed resources through trade or conquest beyond their boundaries. Although this "lateral pressure" theory helped explain some past wars, such as the First World War, more recent research by our team at the Peace and Conflict Studies Program at the University of Toronto highlights a number of the theory's errors. Most important, the theory makes no distinction between renewable and non-renewable resources.

There is no doubt that some major wars in this century have been motivated in part by one country's desire to seize another's non-renewable resources, such as fossil fuels and iron ore. For instance, during the Second World War Japan sought to secure oil and minerals in China and South-East Asia. But our research shows that the story is different for renewables like cropland, forests, fish and fresh water. It is hard to find clear historical or contemporary examples of major wars motivated mainly by scarcities of renewables.

There are two possible explanations. First, States cannot easily convert cropland and forests seized from a neighbour into increased State power, whereas they can immediately use non-renewables such as iron and oil to build and fuel the military machines of national aggression. Second, countries with economies highly dependent on renewables tend to be poor, and poor countries cannot easily buy large and sophisticated conventional armies to

attack their neighbours. For both these reasons, the incentives and the means to launch resource wars are likely to be lower for renewables than for non-renewables.

The exception, some might argue, is water. In particular river water. Adequate water supplies are needed for all aspects of national activity, including the production and use of military power, and rich countries are as dependent on water as poor countries (often, in fact, they are more dependent). Moreover, about 40% of the world's population lives in the 250 river basins shared by more than one country. Experts such as Mr Serageldin have therefore declared that the risk of water wars is rising sharply, especially in these basins.

But once again, the story is more complicated than it first appears. Wars over river water between upstream and downstream neighbours are likely only in a narrow set of circumstances: the downstream country must be highly dependent on the water for its national well-being; the upstream country must be able to restrict the river's flow; there must be a history of antagonism between the two countries; and, most important, the downstream country must be militarily much stronger than the upstream country.

There are, in fact, very few river basins around the world where all these conditions hold. The most obvious is the Nile: Egypt is wholly dependent on the river's water, has historically turbulent relations with its upstream neighbours Sudan and Ethiopia, and is vastly more powerful than either. And, sure enough, Egypt has several times threatened to go to war to ensure an adequate supply of Nile waters.

But more common is the situation along the Ganges, where India has constructed a huge dam – the Farakka Barrage – with devastating consequences for downstream cropland, fisheries and villages in Bangladesh. Bangladesh is so weak that the most it can do is plead with India to release more water. There is little chance of a water war here between upstream and downstream countries. The same holds true for other river basins where alarmists speak of impending wars, including the Mekong, Indus, Pirana and Euphrates.

This sensationalism distracts the public's attention from the real results of water scarcity. Shortages reduce food production, aggravate poverty and disease, spur large migrations and undermine a State's moral authority and capacity to govern. Over time, these stresses can tear apart a poor society's social fabric, causing chronic popular unrest and violence. Mr Serageldin and his World Bank colleagues should emphasize these outcomes rather than the chimera of water wars.

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1 This position has not changed fundamentlly in the meantime.
2 For example, N. Chourci, R. North, *Nations in conflict*, Freeman, San Francisco, 1975.

Tony Allan received his doctorate from the University of London in 1971. He specializes in the renewable natural resources of arid regions and especially water in the Middle East. He has written and edited a number of publications on the subject and advises governments and international agencies on water issues.

avoiding war over natural resources

"Water is a major livelihood issue for poor communities; it is a major strategic issue for poor political economies."[1]

It is a universally held belief that surface water that crosses boundaries is prone to dispute. In the arid Middle East and North Africa, where water symbolizes communal security, the tendency is for water to be perceived as a prime factor in determining the course of regional international relations. Since about 90% of the usable water in the region crosses one or more international borders, such an assumption is understandable. Tony Allan shows that, while water is important in international relations, its role in bilateral and multilateral international relations is complex and never determining, because water issues are always linked with other factors.

"When nations negotiate, often the toughest bargaining is not between nations but within them. The reason is simple: international agreements, no matter how much in the national "interest", inevitably have differential effects on the factional concerns... experienced negotiators almost invariably insist that the more difficult part of their job consists not in dealing with the adversary across the table but in handling interest groups, bureaucrats and politicians at home."[1]

Individuals and communities can pick a fight over any issue, including tangibles like territory and resources – water among them. Disputes can also arise over what can be described as transgressions of national honour. The seizure, or attempted seizure, of territory or resources by one State from another occurs when power relations enable an acquisitive initiative to be first considered, then judged feasible and subsequently attempted. In 1990 just such a cycle culminated in armed conflict when Iraq occupied Kuwait in pursuit not of water but of oil. Sovereignty over oil resources is only rarely ambiguous. Only a tiny proportion of crude oil reservoirs are located directly beneath international borders. Kuwait's excessive pumping of the oilfield beneath the Iraq-Kuwait border was in this case cited as the reason for the invasion. In fact, the pumping of oil from a particular oilfield was much less important than Kuwait's perceived irresponsibility in pumping and exporting oil at a rate that softened the international price for producers with substantially greater needs for oil revenues than Kuwait. Iraq's economic security was severely affected by global oil prices.

Nations will go to war over natural resources. Iraq's invasion of Kuwait, the reactions of its neighbours and especially the response of the United States and the other industrialized economies were historic in their confirmation of this contention. The response of the OECD[2] countries was swift, so threatened were their interests. They deployed their military might, or gave it their financial support, when there was a threat to the secure flow of cheap Middle East oil. The Iraqi invasion signalled either unacceptable regional instability or Iraq's equally unacceptable regional hegemony over the world's major oil reserves. The Allied intervention was effective in terms of ejecting Iraq from Kuwait and ending its attempt to control the Gulf crude oil trade.

Water as an issue

In the Middle East and North Africa, water is of obvious importance to the individual economies of the region. However, it is of

H. Gruyaert / Magnum

"Some waters are more prone to dispute than others."[1]

little significance on a global scale. It is not a surplus resource to be traded. It can be used in agriculture to produce commodities which can be exported, but the comparative agricultural advantage of the region is no greater than many others, not least those on the neighbouring northern shore of the Mediterranean. Using water in industrial- and service-sector activities is an option – and one shown by Israel to have immense potential – but, again, it is not one that gives the region any intrinsic economic advantage. Water certainly does not attract the interest of the global community – especially not of the Northern economies, along with their transnational corporations – in the way that oil does. For these global players, water in the Middle East and North Africa is only interesting strategically insofar as disputes over scarce water would be an additional source of political instability in a region already worryingly destabilized by Arab-Israeli, Arab-Iranian and religious-secular conflicts.

Transboundary water

Water and oil are significantly different in another important way. There is little transboundary oil, but transboundary water forms the majority of water in a region which has little soil water. Sovereignty over oil resources is easily established, albeit through the rather recent acceptance by the Middle Eastern leaderships of the operational but troublesome nation state system, if not universally by the peoples of the region. It is commonplace for very large volumes of water to cross international borders. Over 90% of the conventionally calculated water resources of the region cross international borders as surface flows. If soil water is taken into account, the figure is still very high – over 60% – and would be very much higher were Turkey to be left out of the regional calculation. For the Egyptian economy, transboundary water is over 95% of its water budget. Sovereignty over water is not determined by customary or formal international laws, notwithstanding the May 1997 United Nations Convention on transboundary watercourses of the International Law Commission.[3]

The nightmare of the downstream riparian is that a neighbour upstream will unilaterally exert sovereignty over the flow by increasing its own consumption. Egypt is very anxious in this regard, although it has not suffered any diminution of flow except that which it agreed with its immediate neighbour, the Sudan, in the 1959 Nile Waters Agreement. Syria and Iraq have actually endured a dramatic reduction of almost 50% in the average flow of the Euphrates since the 1970s. They are anticipating additional reductions in the flow of the Tigris. Israel, a downstream groundwater entity, signals an uncompromising stance on its continued supervision of the shared groundwater flows from the limestone massif of the West Bank, which it has been exploiting heavily since the 1950s.[4]

Difficulties of defining sovereignty over surface water flows make international relations over the region's water resources very difficult to analyse. The ownership of a water resource enables water markets to be developed. To date, such markets only exist for domestic use and particularly for drinking water. Such trade usually involves the lifting of water from a groundwater resource of recognized quality for human use for which the water rights are individual and recognized. An individual or company signifies its "ownership" of the resource by

1 F.W. Mayer, "Managing domestic differences in international negotiations: the strategic use of internal side-payments", *International Organization*, Vol. 46.4, 1992, pp. 793-818.
2 OECD: Organization for Economic Co-operation and Development
3 ILC 1997.
4 M. Haddad, E. Feitelson, *Joint management of shared aquifers*, Palestinian Consultancy Group and The Truman Institute for the Advancement of Peace of the Hebrew University, Jerusalem, 1995.

charging a price for the water. Sometimes the supply is a communal surface flow, a river, for which the water provider makes no payment. The identification of sovereignty over water would massively improve the chances for stable and secure international relations over transboundary waters.

Agreements over water are beginning to be made (see Jordan-Israel Agreement of 1994[5] and the PLO-Israel Interim Agreement of 1995[6]). These agreements, though not the same as defining sovereignty over water, and certainly not "principled agreements" based on legal principles, nevertheless provide a sufficiently precise arrangement for naturally fluctuating water resources to be allocated and managed within separate territories to satisfy national honour and to enable the secure and sustainable growth of the respective economies. Operational arrangements for allocating water during periods of fluctuating availability are particularly important in providing the stable political economic circumstances for sustainable socio-economic development.

Global demand for virtual water

Since it is impossible to define precisely sovereignty over water, untidy and occasionally stressful water politics in the Middle East and North Africa are inevitable. They will remain untidy until all the economies of the region have achieved advanced levels of socio-economic development. In such diverse economies water resources are one of many minor factors of production rather than the determining major economic input. When water is a major factor of production in the economy, such as in agriculture, its role in the livelihoods of a majority is palpable and the significance of such water in terms of international relations makes water scarcity an easy focus for national and communal anxiety. In this region water is insufficient to meet regional food production needs, although the region is well enough endowed to provide water for industrial and domestic needs. Such a resource deficit can be politically stressful if it is detected by users through an evident reduction in availability.

The international trade in water-intensive imported commodities is so effective that the impact of the substantial water deficit is not registered by the 300 million people living there. It is not a political issue at the domestic level or the international level, except where governments choose to make it one. With political stress over water being so easily managed at the level of the whole economy, it should not be surprising that there has been so little armed conflict over water. More importantly, there has been none since the early 1960s. The region has been free of armed conflict over water for more than three decades. There is no evidence that the next half-century will be any different. The only factors that could in future impede the economic solutions which would enable water deficits to be ameliorated are external to the region.

Understanding the factors affecting global demand for virtual water (see box) is the crucial issue for water-deficit economies. This global dimension of Middle Eastern and North African international relations is not given a high priority in policy-making agendas across the region.

A dangerous optimism

It is a paradox that the water pessimists are wrong but their pessimism is a very useful political tool which can help the innovator to shift the eternally interdependent belief systems of the public and their politicians. The water optimists are right but their optimism is dangerous because the notion enables politicians to treat water as a low political priority, delay innovation and thereby please those who perceive that they are prospering under the old order. Pessimists also bring more sensational stories to the media. Optimists bring a version of unsensational good news. The good news is complicated and indigestible as well as unsensational.

Virtual water

Virtual water is the very substantial volume of water embedded in water-intensive commodities such as grain. About 1,000 tonnes of water are required to produce a tonne of wheat. When an economy imports a tonne of wheat it is in effect importing 1,000 tonnes of water. The Middle East and North Africa region was importing annually about 40 million tonnes of grain and flour by the end of the 1990s. About 40 billion tonnes of water would be required to produce this volume of grain. Such a volume reflects about 20% of the region's annual water use and is equivalent to the water used each year by Egypt in its agricultural sector. Engineers could not contemplate moving so much water, but those involved in the international grain trade take the challenge in their stride. There is a very clear "nexus" involving "water, food and trade" which is of major strategic significance to grain-importing economies in arid and semi-arid regions. Virtual water has, since the early 1970s, ensured the economic stability of this major arid region in the world. Future economic stability here will depend on its capacity to sustain the trade in virtual water.

J. Vink / Magnum

5 J.A. Allan, "The Jordan-Israel Peace Agreement - September 1994", Appendices 1 and 2, in J.A. Allan, *Water, peace and the Middle East: negotiating resources in the Jordan Basin*, Tauris Academic Studies, London, 1996, pp. 207-221.

6 J.A. Allan, "The Israel-PLO Interim Agreement – September 1995", Appendices 3 and 4, in J.A. Allan, *Water, peace and the Middle East: negotiating resources in the Jordan Basin*, Tauris Academic Studies, London, 1996, pp. 223-240.

The nightmare of the downstream riparian: falling levels of water due to increasing consumption upstream.

Günther Baechler obtained his Ph.D. from the University of Bremen, Germany, on the topic of violence through environmental discrimination in Rwanda. He has directed several international research projects in the field of environmental conflict management and is currently director of the Swiss Peace Foundation and a lecturer at the Institute of Political Science at the University of Bern.

violence through environmental discrimination

As the 20th century draws to a close, the most serious problems confronting mankind include armed conflicts, poor human development and the degradation of the environment. Not surprisingly, many analysts suggest that these phenomena may be closely intertwined.

The Indian ecologist Vandana Shiva calls this threefold syndrome maldevelopment, or "the violation of the integrity of organic, interconnected and interdependent systems, that sets in motion a process of exploitation, inequality, injustice and violence".[1] Indeed, in the early 1990s both war and endemic violent conflicts were more widespread than during any other decade since World War II, almost all of them located either in the south or the east.

What is immediately striking is that today's regional conflicts take place against a background of widespread poverty and misery in politically stressed countries, in sometimes highly militarized but nevertheless weak, poorly performing States and in fragmented societies with endemic competition between ethnic or religious groups. Only recently was it recognized in the academic literature that the scarcity of natural resources and environmental degradation may also be reasons for inter-group violence and anti-regime struggles. Competition for resources is not only seen as related to development projects but increasingly to issues linked with poverty, such as overuse of scarce land resources, high population growth and lack of the technical competence or financial means to deal with resource degradation. In addition, societies throughout the developing world are confronted with natural disasters – drought, floods, earthquakes, etc. – that weak States can barely cope with. While natural catastrophes and environmental disruption, closely intertwined, may not trigger internal tensions, social competition, power struggles, quarrels to the death or civil war, they do at the very least aggravate them.

In comparison to the classic all-out wars between States, today's domestic armed conflicts seem to be of relatively low intensity; this does not, however, mean that their costs in terms of victims, economy and infrastructure are generally low. On the contrary, many small-scale wars are long, protracted conflicts. They have no clear boundaries, either in terms of time

concerning the beginning or the end of hostilities or in terms of dynamics concerning the level of violence or the number of parties involved. They are stop-and-go wars, erupting from time to time, viciously affecting one region or another. Clear-cut victories by one side over the other, with the latter admitting total capitulation, are seldom.

Resource conflicts – over land, water, energy and minerals – have historically lent themselves to military solutions. But what was once a zero-sum game – to the victor belong the spoils – has been transformed into a no-win situation as environmental threats have become more prominent and global in scope; not the common goods but the common bads are the *casus belli*, and increasingly so. Thus, States will never be able to restore ecologically lost territory with military means.

The supposed correlation between violence and poverty-driven environmental disruption is, however, only one side of the coin, whereas the reverse consists of complex causal relationships. Analysing them requires more detailed area studies. Recent conflict studies have rather laboriously been focusing on the question of "environment matters". Nonetheless, there is still a lack of straightforward explanations for questions such as: Why does the environment matter? If it does matter, what role does it play? How are the different factors of the man/nature problem/ syndrome related to one another? What is a major cause? What is only an effect? There is no easy answer to any of these questions. Neither short definitions of "eco-conflicts" nor thin explanations provide satisfying answers. The dilemma between definitional clarity and factual multi-dimensionality is especially challenging in this field of research, which is still largely unexplored despite an increase in academic contributions over the last few years.

In order to overcome both data constraints and methodological dilemmas, one has to deal with the syndrome of factors involved in environmentally caused violence in as encompassing a manner as necessary and as reductionisticly as possible. The notion "syndrome" is designed to cover the problem adequately; in medicine, according to the dictionary, it constitutes a number of symptoms occurring together and characterizing a specific disease. Syndrome means a running together of socio-ecological key factors in a particular politico-geographical arena. Such an arena encompasses different conflict parties or actors with contradictory interests and preferences "which mobilize their cultural, social and economic capital in view of playing an active role in policy design and receiving a significant part of the cake".[2,3] "Cake" in the context of research into environmental conflicts basically means the arena's natural capital or the arena's landscape with its available renewable resources.

In the past three centuries, science, technology and industry have opened up opportunities to replace scarcity by hitherto unknown abundance and wealth; in certain arenas the cake has grown enormously. The price for this exceptional growth is high. On the one hand, only relatively few people in the industrialized countries and newly developed countries can enjoy the privileges of the abundance of resources available. The high standard of living of a privileged group of people cannot be extended to all; nor is it possible to foresee whether and how the pattern and level of consumption can be maintained worldwide. On the other hand, in several arenas abundance and wealth coincide with environmental disruption, leading to new and severe forms of resource scarcity. It is one of the working hypotheses that fundamental change – or, better, transformation – of the relationships between society and nature in a given arena provokes a running together of several key factors, the constellation of which causes violent reactions in many ways. Land, wood, water and other scarce renewable resources have become objects of conflict among actors who, in order to survive, struggle either to preserve their endangered traditional forms of life or to raise their standard of living.

It is of fundamental importance now, and vital to survival on the threshold of the 21st century, that these conflicts be better understood from both their proximate and ultimate aspects in order to defuse them and resolve them peacefully, or at least to avoid violent excesses.[4]

1 V. Shiva, "Development, Ecology, and Women", in C. Merchant (ed.), *Ecology. Key Concepts and Critical Theory*, Humanities Press, New Jersey, 1994, pp. 272-280.
2 B. Sottas, "Conflict resolution in a setting of contradictory regulations and rationales: Approaches to resource management in the Ewaso Ng'iro Basin (Kenya)", in *Proceedings of the regional workshop in Asmara, Eritrea, 12-16 February 1996, Environmental conflict management and sustainable development*, Berne/Zurich, 1996, pp. 215-220.
3 H.D. Evers, T. Schiel, *Strategische Gruppen. Vergleichende Studien zu Staat, Bürokratie und Klassenbildung in der Dritten Welt*, Reimer, Berlin, 1988.
4 G. Baechler, *Violence through environmental discrimination*, Kluwer, London, The Hague, Boston,1998.

"The thirsty earth soaks up the rain
And drinks, and gapes for drink again.
The plants suck in the earth, and are
With constant drinking fresh and fair."
Abraham Cowley, 1618-1668, *Drinking*

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water in emergencies

A people without water is a people without a home. Malin Falkenmark and Johan Rockström link emergencies with pre-and post-emergency phases, as seen from a water perspective. The overall message is that emergency action and livelihood security are complementary, and that the main concern is to ensure access to both water and food.

An emergency arises when a population cannot cope by itself with a disaster, which can be either natural or man-made. Emergencies are complex. Water scarcity, leading to famine and health hazards, can be a higher-order effect of a progressive destruction of soil and water productivity in a particular landscape. This in turn can be caused by political, ethnic or military conflicts pushing people to marginal areas or to over-exploitation. The effects of this water scarcity might not precipitate a disaster unless it is triggered by a series of drought years. However, water, with its fundamental role in livelihood security, may be highly relevant to the task of facilitating migrants' return to their origins.

A threatened life-support base is often at the root of environmental crises and conflicts.[1] Two aspects are of crucial importance: human health and food security. Water's vital function in human livelihood security means that such resources are of particular interest to the International Red Cross and Red Crescent Movement. One of the first tasks for emergency personnel is to secure a safe water supply and sanitation facilities for settlements for displaced people or refugees. To do this they have to be knowledgeable about water resources in the natural landscape. However, such information may also be relevant in identifying possible future conflicts that may develop into new emergencies.

Water stress – the total number of individuals who depend on each flow unit of water in rivers and groundwater formations – has been used as one possible indicator of the likelihood of a dispute arising in the quest to identify areas at risk. When the relationship between a rapidly growing population and a finite, vital and non-substitutable natural resource such as water becomes stressed, problems may be foreseen with both water supply and food production. In cases where land is also scarce, sufficiently large agricultural yields will be critically dependent on whether there is enough water in the root zone. It is interesting to note that Malin Falkenmark suggested, in an article in the late 1980s, that Rwanda and Burundi were particularly vulnerable, on the basis of rapidly growing water stress.[2]

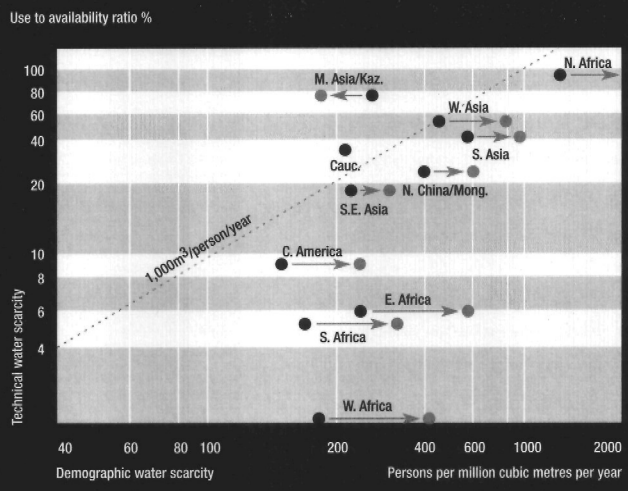
Water and human security

People's health may be put at risk by both a dearth of safe water and a lack of sanitation to take care of human excreta, which will otherwise act as vectors of infectious diseases. It is estimated that most of the illnesses in developing countries are spread in this manner. However, organizing and implementing sanitation is a tricky task. The international community made major efforts to this end during and after the International Drinking Water Supply and Sanitation Decade, 1981-90, but sanitation is much more difficult to effect than water supply, in view of the cultural complications involved. Sanitation development actually came to a halt during the 1990s.[3] The

number of people who will need help with safe sanitation during the next 30 years amounts to 5.4 billion, or nearly half a million individuals a day.

Food production is the other sector of crucial importance for livelihood security. The risks vary according to whether the agriculture is rain-fed or irrigated:

- rain-fed agriculture, which is prevalent in Africa, is highly vulnerable to unreliable rainfall in the dry tropical and subtropical regions. On the one hand, intermittent droughts are part of the predominating climate. Over the hunger crescent in Africa, the tendency is that there will be at least two successive severe drought years between five and seven times during a 50-year period.[4] In other words, droughts are part of the climate and averting their effects is a crucial component in any strategy to avoid emergencies. On the other hand, even during a year with average or high rainfall, the rainfall is very erratic. This easily upsets plant growth and results in extremely low yields: in the Sahel region yields may be as low as 0.3 tonnes per hectare as a combined result of water scarcity and lack of soil nutrients;[5]
- irrigated agriculture may involve a risk of "creeping" crises. Groundwater over-exploitation is a widespread phenomenon, and is unsustainable in the sense that, sooner or later, the source will cease to deliver any more water. In other situations, the water source may be a river such as the



Comparing water availability with water requirements to attain food self-sufficiency in semi-arid countries*

Water demands (as a percentage of total water availability, vertical axis) for various developing regions of the world and their population growth to 2025. The horizontal axis shows the demographic water scarcity (number of persons sharing 1 million cubic metres of annually renewable blue water).

One million cubic metres per year is defined as 1 flow unit, which is the amount of water annually available to the country from the global water circulation system. The water barrier is defined as 100% utilization of the available water.

In humid climates crop production is rain-fed; in arid climates all the water has to be provided by irrigation. In semi-arid climates 50% of the water needed to attain food self-sufficiency may be provided by irrigation and 1,000 m³/person/year (diagonal line) is needed to feed a certain population. But irrigation has to compete with households, industry and in-stream requirements to support valued aquatic ecosystems. The 1,000 m³/person/year line divides the figure in two zones. Semi-arid countries on the left-hand side could reduce their water use by increasing their water-use efficiency, and thereby manage a larger population. Countries on the right would need to mobilize more irrigation water to feed their current population at the targeted nutrition level. The problem would escalate when the population grows as indicated by the arrows. Two types of constraints have to be kept in mind: on the one hand, the change needed may be too rapid for a society to manage because of limitations in coping capability. On the other hand, the mobilization level needed may be too high to be realistic.

*M. Falkenmark *et al.*, *Ambio*, vol. 27, no. 2, March 1998.

1 G. Baechler, "The anthropogenic transformation of the environment: a source of war? Historical background, typology and conclusions", *Report of the International Conference in Monte Verità, Ascona, 3-7 October 1994*, ENCOP – Environment and Conflicts Project, Zürich: ETH, 1994.
2 M. Falkenmark, "The massive water scarcity threatening Africa – Why isn't it being addressed?", *Ambio*, vol. 18, Stockholm, 1989, pp. 112-118.
3 ECOSOC, *Document E/1995/87*, United Nations, New York, 1995.
4 M. Falkenmark, C. Rockström, "Curbing rural exodus from tropical drylands", *Ambio*, vol. 22, Stockholm, 1993, pp. 427- 437.
5 J. Rockström, *On-farm agrohydrological analysis of the Sahelian yield crisis: Rainfall partitioning, soil nutrients and water use efficiency of pearl millet*, Ph.D. thesis in natural resources management, Dept. of Systems Ecology, Stockholm University, Sweden,1997.

m^3/person/year	water scarcity	situation	people/flow unit
25,000	well–watered	Low levels of technology are sufficient: rain-fed agriculture is largely adequate, with limited irrigation required.	40
22,000			45
20,000			50
13,333			75
10,000	moderate problems	Intermediate levels of technology are sufficient: rain-fed agriculture is no longer sufficient and limited water transfer schemes may be considered relevant.	100
8,000			125
4,000			250
2,000			500
1,666	water–stressed	High levels of technology. Large water transfer schemes and limited inter-basin transfers are needed.	600
1,250			800
1,000	chronic scarcity	Large-scale irrigation and very high levels of technological input are needed. Complex sets of inner-basin transfers and related water transfers are needed. Not affordable by most developing States.	1,000
666			1,500
500			2,000
454	beyond "water barrier"	Large-scale irrigation and very high levels of technological input are needed. Complex sets of inner-basin transfers and related water transfers are needed. Not affordable wby most developing States.	2,200
416			2,400
384			2,600
357			2,800
333			3,000

Conversion chart from volume of water per person per year (m^3/person/year) to number of people/flow unit (1 million cubic metres per year) Falkenmark's water barrier level* is 2,000 people/flow unit, which is an index for the level of water competition but also of the pollution load from these people.

If Falkenmark's water scarcity index is applied to southern African States using present population projections, in 2025 Angola, Botswana, Namibia and Zambia will reach the moderate problem level, Mozambique will be water-stressed, Lesotho, Tanzania and Zimbabwe will experience a chronic water scarcity and Malawi and Kenya will be beyond the "water barrier" (Adapted from A.R. Turton, "The impact of population pressure on the availability of water in selected states of Southern Africa: towards an integrated development strategy", in *Water for Africa '98*, Nairobi, July 1998, conference preprints.)

*M. Falkenmark *Water-related constraints to African development in the next few decades*, International Association of Hydrological Sciences, Wallingford, UK, Publication 164, 1987, pp. 439-453.

Nile, collecting run-off from upstream countries in the same drainage basin. This source may be threatened if any water is diverted upstream, outside the control of the downstream country. Throughout the tropics and subtropics, mismanaged irrigation projects are a frequent occurrence: the soil suffers from salinization and/or waterlogging. Agricultural production is not sustainable in any of these three situations, and may indeed collapse.

Concern for global food security is now increasing in view of the implications of aggravated water scarcity in the regions where most of the population growth is taking place. Moreover, there tends to be a poor understanding in the developed world of the fact that water constraints may complicate future food production in these regions.[6] African farmers are highly likely to suffer food deficits, as 95% of them depend on rain-fed farming, with its vulnerability to drought and erratic rainfall.

Predicting emergencies

In recent years, two global assessments have been presented of the world's regions that are most exposed to risk of food deficits in the next 30 years. The first study is diet-based, and compares water availability in different regions with the water needed for complementary irrigation to secure the production of an acceptable diet for the population in 2025 in dry climate regions.[7] It concludes that at that time more than half the world's population will be living in regions where not enough water can be made accessible, either because of too rapid increases in demand or too large demands in relation to the overall availability. These regions – North Africa, West Asia, South

Asia, North China/Mongolia, East Africa, Southern Africa and West Africa – will therefore depend on large-scale food imports from elsewhere.

The other study is area-based and compares water availability with the water needed to irrigate all the currently irrigated area and to support industry and households at a conservative level.[8] The conclusion is similar: around half the world's population under threat from food-deficit problems unless food can be imported from better-endowed regions.

As part of the efforts of the Comprehensive Freshwater Assessment initiated by the UN Commission on Sustainable Development, a study has also been made on water resources vulnerability,[9] given the projected world population by 2025 and assuming a conventional development scenario (business as usual, no surprises). This study concludes that by 2025 water resources will be highly vulnerable in 16 countries. Three factors are taken into account: water needs in relation to overall availability, reliability of water resources, and coping capability based on per capita GNP as an indicator. The countries are located in five of the above regions: N. Africa (Egypt, Sudan, Libya, Morocco, Mauritania), E. Africa (Kenya, Somalia), S. Africa (Swaziland), W. Asia (Jordan, Yemen, Syria, Iraq), and S. Asia (India, Pakistan, Afghanistan, Azerbaijan).

A further way to diagnose water stress is to analyse dependence on imported water in international rivers. In the following countries, in 1990 withdrawals of water were already close to the internal availability (run-off generated by local rainfall) and most of the water was used for irrigation: Mauritania, Egypt, Jordan, Iraq and, to some degree, Tunisia.

Water and health during emergencies

An emergency consists of different phases, and the focus on the immediate needs for food, water and shelter broaden progressively. It is desirable to break dependence on relief as soon as possible, since in the long term it is unsustainable not only from the economic and ecological points of view but also for social reasons. Each emergency should therefore involve rehabilitating and improving on the pre-emergency society.

As regards relief efforts, several handbooks describe technical and management aspects of water supply, water treatment and sanitation in emergencies.[10,11] There is no need therefore to dwell on the water-engineering aspects, but rather briefly to emphasize a couple of socio-hydrological factors which can have a significant impact on the success of an emergency operation.

Emergencies generally necessitate very quick action. Conventionally, priority often goes to hospitals and schools. Even more essential, however, is the installation of functioning water supply and sanitation. Otherwise the hospital beds might rapidly be filled with relief personnel, too. Despite this, the need for a proper assessment before intervention, covering human, socio-economic and physical landscape parameters, cannot be over-emphasized.

Location of human settlements

The choice of where to set up a settlement, hospital, etc., should preferably be preceded by rapid catchment-based assessments of potential water supply, water quality and possible means of sanitation. Unfortunately, water engineers rarely get the opportunity to choose the location of a settlement because those fleeing a conflict have simply settled in an area where they feel secure. This complicates the process of finding sources of water and practical latrine systems. Sadly, hydrological considerations rarely converge with political will in the choice of settlement locations.

Rapid water assessments should include, besides the more technical topographic data, the following:

- seasonality of rainfall and river flow;
- upstream and downstream effects of an intervention;
- baseflow production of water (i.e. how many people can be supplied);
- the amount of water which should be supplied;
- capacity of the intervening agency (there is always water somewhere, but can it afford to capture and supply it?);
- possibility of using gravity-fed supply systems;
- needs to be fulfilled: drinking water, hospitals, livestock, irrigation;
- intended length of the intervention.

Provisional water supply and sanitation

Generally speaking, permission is needed to divert river flow or exploit groundwater. As it is much more expensive and risky to lift water, it is always recommended to try and capture water upstream and supply it to users downstream. However, even successful water engineers will always affect downstreamers. To cover household needs for cooking, hygiene and drinking, 50 litres

6 M. Falkenmark, ed., "Water scarcity as a key factor in global insecurity", *Round Table, Ambio*, vol. 27, no. 2, 1998.
7 M. Falkenmark, "Meeting water requirements of an expanding world population", *Philosophical Transactions of the Royal Society of Biological Sciences*, vol. 352, The Royal Society, London, 1997, pp. 929-936R.
8 D Seckler *et al.*, "World water demand and supply 1990-2025: Scenarios and Issues", *Research Report 19*, International Water Management Institute, Colombo, 1998.
9 P. Raskin *et al.*, "Water futures: Assessment of long-range patterns and problems", *Comprehensive Assessment of the Freshwater Resources of the World*, Background Report 3, Stockholm Environment Institute, 1997.
10 J. Davis, R. Lambert, *Engineering in emergencies - A practical guide for relief workers*, IT Publications/RedR, London, United Kingdom, 1995.
11 *Handbook for emergencies*, UNHCR, Geneva, Switzerland, 1982.

R. Depardon / Magnum

Tuaregs flee a severe drought in the Sahel. Their camel herds have been decimated and they cannot adapt to a sedentary way of life.

per person per day (l/p/d)[12] is enough, a volume that can be reduced to 5-10 litres in extremely water-poor settlements, such as the refugee camps outside Goma in the former Zaire in 1995. In order to ensure an adequate daily diet of food, at least 500 l/p/d are needed just to cover evapo-transpiration needs for the food crops. This must be included in the assessment if a water source capable of covering emergency water needs has to compete with irrigated agriculture.

The estimated life span of an emergency intervention and the financial and technical capacity of the agencies involved are also relevant in the choice of water and sanitation techniques. Gravity-fed water-supply systems have the advantage of being cheap and guarantee the provision of water even after the emergency personnel have left the site. They also leave the operation with a higher degree of freedom. If large investments are involved, such as in the establishment of a permanent or semi-permanent water-supply system, the consequences of a sudden change in the emergency – like people leaving a camp – will be more serious. Trucking of water should always be avoided if possible owing to the extremely high costs involved. In regions with ephemeral rivers, seasonal trucking might, however, be preferable to investment in large infrastructures to ensure water on a year-round basis.

Texture, structure and depth of soils are closely linked to water quality and quantity, and sanitation strategy. Shallow soils are extremely problematic from a sanitation perspective, since pit latrines will not be a viable solution. This was the situation in Goma, where one million people settled on a volcanic slope in the world's biggest refugee camp.

Avoiding conflicts with local farmers

Irrespective of where in the world an emergency occurs, if water is diverted from sources outside the settlement for use by disaster victims, the water availability for the local population surrounding the intervention area will be affected. Water withdrawals at one location in a catchment will affect water availability of downstream users. In regions where water is scarce, conflicts may arise over it. Serious conflicts may likewise occur over the land that water engineers have to occupy in order to install, for example, dams, tanks, contamination-free areas for water intakes, pipelines, defecation fields and water-harvesting catchments. Negotiations with farmers whose fields are to be dug up for pipe installation might be tough and may actually determine whether a water source can be used at all. In a recent example, the right to

dig to lay a pipeline had to be negotiated *plant by plant* with the local farmer over a distance of 3 kilometres.

This is a crucial point for emergency site management. It is not enough for coordinating agencies to negotiate the right to use a piece of land for a settlement. It is also vital to negotiate the right to exploit land, often far upstream from the site, where the water will have to be captured.
It is essential also to take advantage of local skills, since people usually know their own areas well. Moreover, even in the most remote bush regions in developing countries, trained technicians can generally be found to work with.

Facilitating rehabilitation

In order to facilitate rehabilitation it is crucial to understand the root of the conflict that has displaced people. It is easy to consider only the political environment when enabling them to return, but in cases where areas can only sustain a limited number of people, just allocating land to returning refugees would mean simply moving the conflict. At the root of an emergency is generally the fact that people's daily living is threatened. This includes water for households, food production and cattle- and water-related ecological services such as pasture and fish production. The livelihood security system as a whole must therefore be analysed, including the area's capacity to sustain life.

At the same time, there is no sharp transition from emergency to rehabilitation. It is vital to start working with integrated land and water management early in an emergency. In a largely rural society, as in most developing countries, this involves developing farming systems and managing crop water together with drinking water supply. Obviously, it is crucial to train local water-engineering and water-treatment staff already in the early phases of an emergency, set up the supply of spare parts and chemicals needed to treat the water, train the community in water-supply management and encourage it to take responsibility for established systems, and provide training in the construction of water-supply systems used in the area before the emergency.

Prevention rather than cure

Fundamental to avoiding emergencies, providing emergency relief and getting people to return home safely is the securing of access to water and food. An important way to prevent emergencies – or at least their most severe effects on human beings – is to reduce the vulnerability of the populations living in areas at risk. This includes ensuring that adequate amounts of water are available, as it plays a vital role in livelihood security in terms of food production, sanitation, health, drinking, cattle rearing, etc.

As demonstrated above, a proper diagnosis based on hydrological understanding of the landscape must be made at all stages: beforehand to prevent future emergencies; during the emergency to find safe sources of water for temporary settlements; afterwards to facilitate rehabilitation by improving livelihood security and providing an acceptable quality of life back home.

Four sets of measures are needed for any strategy aimed at reducing the threat of an emergency:

- simple ways to drought-proof the rain-fed agriculture in sub-Saharan Africa, mainly by developing supplementary irrigation based on rainwater harvesting and run-off collection (i.e. methods already generally known in India);[13] and combined schemes to conserve soil and water to ensure that as much local rainfall as possible really enters the root zone;
- sanitation to avoid the spread of infectious diseases;
- urban food security, based partly on food imports and partly on peri-urban agriculture;
- income-generating activities to reduce poverty and improve the people's ability to buy their own food.

Some of these considerations are relatively new to the International Red Cross and Red Crescent Movement, where the focus used to be on relief rather than prevention and rehabilitation, although this has changed in recent years. The Movement increasingly considers relief efforts and issues connected with displaced people also in socio-economic and sustainability terms. The central task is to ensure access to water and food as a base for people's daily life. A people without water is a people without a home....

12 See Les Roberts, p.96.
13 A. Agarval, S. Narain, "Dying wisdom. Rise, fall and potential of India's traditional water harvesting systems", *State of India's Environment*, A Citizen's Report, no. 4, Centre for Science and Environment, New Delhi, 1997.

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dying for water

For some years now, "water and war" has been a topic of widespread debate. Experts and the media have repeatedly underscored the strategic importance of this vital resource and the concomitant risk of tension and conflict. Some analysts seem at times even to confuse water security with national security and it is easy to see why. Not only do today's major environmental challenges affect water, among other things, but a number of difficulties also arise in connection with water itself: the growing scarcity of drinking water, the problems engendered by drought and deforestation, increasing salinity because of excessive pumping, and the imbalance between the needs of an expanding population and the quantities available. But whatever role water-related matters play in the outbreak of an armed conflict, to speak of "war for water" or a "water war" implies that water is the focus or cause of the confrontation. Such situations may be common today, but we should not forget that water can in addition be used as a method or means of warfare and can also be affected by hostilities.

Water used for hostile purposes

Water has been used for military purposes since time immemorial, in several different ways, and such hostile use continues to this day. The fact that water was at hand often proved decisive when a site was chosen for a city, fortress or encampment. The remains of the great ancient civilizations clearly indicate that water-based constructions could be used against enemy troops and that there was a definite military advantage to be gained by flooding fortifications or besieged towns.

Modern examples abound. The British damaged the major German dams in the bombing runs of 1943. During the Korean and Vietnam wars, dams and dykes were not spared the bombs. In Afghanistan, the traditional irrigation system was brought to a standstill in the early years of the conflict – in other words, from the time Soviet troops invaded the country in 1979. During the Gulf war, the allied bombing raids put Iraqi hydroelectric power stations out of action. In January 1993, the Peruca dam in Croatia was seriously damaged by the Serbian militia.

One of the inherent dangers of destroying hydroelectric power stations – by accident or design – is that of water contamination. This is an important point because the effects last well beyond the end of the war and have implications for the population at large. On the subject of using drugs to poison water, Plato suggests in his Laws that in addition to monetary compensation, the guilty party should be required to purify the source or tank. This did not, however, prevent the Greeks from poisoning water in their wars, although they were certainly not the only ones to do so.

In modern armed conflicts, even were the general prohibition under international law on the use of poison to be complied with, water could still be contaminated as a direct result of military operations against water installations and works. Indeed, destroying or rendering useless part of a water production system is sometimes enough to paralyse the system as a whole. If repair work is held up because of continuing hostilities or for other reasons, such as a shortage of spare parts or inadequate or poor maintenance and cleaning procedures, there is an obvious and considerable risk of contamination, shortages or epidemics.

In some situations, the party with control over water resources has the upper hand. Gaining that control thus becomes a definite strategy in, for example, cases of occupation and internal conflicts. The ensuing complex problems are further exacerbated when the occupation extends over a long period or is designed to create an irreversible situation. An occupying power may, for instance, expropriate land, thus swallowing up springs and wells; may totally or partially prohibit the people in the occupied territories from irrigating the land, from using the water sources and watercourses to grow crops or run or develop their holdings as going concerns; may prevent the occupied population from siphoning off surface or groundwater or reaching aquifers; and may impose pumping quotas. In addition, it may establish settlements in the occupied territory and provide the settlers with incentives, safeguards and facilities, including with regard to water resources. These are all so many ways in which the occupied territory can be emptied of its original inhabitants. Of course, such moves do not affect just the population but also crops and livestock.

What can a peasant farmer do when faced with an armed soldier who blocks his access to water...?

In civil wars, which today account for most of the armed conflicts in the world, the use of water by the belligerent parties constitutes a serious threat to the population concerned. The expression "environmental or eco-refugee", which has become fashionable recently to describe people displaced as a result of the effects of armed conflicts or other disasters on their natural environment, is symptomatic of the serious damage these can do. Just taking as an example the hostilities carried out in a period of internal conflict, destroying or rendering useless a source of drinking water or a safe water supply can in very short order deprive the local population of an essential commodity; in the case of a "hostile" population or a population in an arid region, it is easy to imagine just what the outcome would be.

While thirst may sap the morale of troops on the battlefield, the lack of a safe water supply may force a population into exile and condemn crops and livestock to wither and die. To attack water is to attack an entire way of life. Even when water is available, military operations make access to it no easy matter.

War's effect on access to water

One party to the conflict may take any number of steps to prevent people from having access to water or from restoring the water-supply system. Suffice it to offer a few examples. What can a peasant farmer do when faced with an armed soldier who blocks his access to water for personal use, for livestock or for irrigation? What's to be said when a hydraulic plant, water installations, supplies and irrigation works or the path leading to them have been mined? "Dying for water" is not a straightforward matter of private squabbles about rights of access, or a long march in the desert searching for water, but a real danger inherent in today's armed conflicts. Stories about civilians who, when the domestic water supply has been cut off, have been targeted while queuing in front of a public water-collection point are unfortunately all too true. Given the strike force of modern weaponry, the nature of the materials used in their manufacture and the extent of their effects, they can in and of themselves directly cause water degradation, raise more obstacles to water supplies and place civilians in greater danger then ever before.

Despite the neutrality of humanitarian assistance, relief personnel are not spared the ill-treatment meted out to civilians, and relief supplies may be destroyed, stolen, plundered or diverted by armed bands. Only when humanitarian workers, along with their relief resources, are treated with due respect by all parties to the conflict can they do their job. Repairing and restoring water installations, works and facilities require complex operations which involve bringing together the necessary technical expertise, equipment and manpower. Any action against one of these components hampers the others and makes access to water well-nigh or completely impossible, thereby heightening the risks to the civilian population despite the protection it is granted under international law.

...populations affected by hostilities against water sometimes need that commodity even more than medicines or food rations...

What the law says

Although international humanitarian law applicable in armed conflicts contains no specific regulations on water protection, it does have a number of rules relating to the subject. First, it should be remembered that this branch of international law primarily seeks to protect any individual who is in the hands or in the power of the enemy, and that the assistance or relief which is their due is inconceivable without a guaranteed minimum level of health and hygiene – in other words, without water, which is the life-giving element in any and all circumstances.

Humanitarian law is also designed to protect civilian objects, including those indispensable to the survival of the civilian population. Article 29 of the *Convention on the law relating to the non-navigational uses of international watercourses*, adopted by the General Assembly of the United Nations in 1997, stipulates:

"International watercourses and related installations, facilities and other works shall enjoy the protection accorded by the principles and rules of international law applicable in international and non-international armed conflict and shall not be used in violation of those principles and rules".

General protection under the law applicable to armed conflicts extends to more than international watercourses, and the four main prohibitions laid down in that law are worth noting:

- the ban on employing poison or poisonous weapons;
- the ban on destroying, confiscating or expropriating enemy property;
- the ban on destroying objects indispensable to the survival of the civilian population;
- the ban on attacking works or installations containing dangerous forces.

The four prohibitions, to which should be added the provisions on environmental protection, are expressly mentioned in the instruments relating to international armed conflicts, and the last two are also laid down in the law applicable to non-international armed conflicts. Starvation as a method of warfare is explicitly prohibited regardless of the nature of the conflict, and the concept of objects essential for the survival of the civilian population includes drinking-water installations and supplies and irrigation works. Immunity for indispensable objects is waived only when these are used solely for the armed forces or in direct support of military action. Even then, the adversaries must refrain from any action which could reduce the population to starvation or deprive it of essential water.

On the subject of works or installations containing dangerous forces, humanitarian law explicitly mentions dams, dykes and nuclear electrical generating stations. Even where these are military objectives, it is forbidden to attack them when such action could release dangerous forces and consequently cause heavy losses among the civilian population. The ban also extends on the same terms to other military objectives at or in the vicinity of such facilities. Immunity from attack is waived only when one or other of the works, installations or facilities is used in regular, significant and direct support of military operations and if attacks are the only feasible way to terminate such support.

So as best to ensure the protection of the civilian population and civilian objects, humanitarian law provides for certain

J. Nachtwey / Magnum

Starvation as a method of warfare is prohibited

precautionary measures including their removal from the vicinity of military objectives and their protection against dangers resulting from military operations. Reprisals against civilian objects are forbidden, and this explicitly applies to objects indispensable to the survival of the civilian population and works or installations containing dangerous forces.

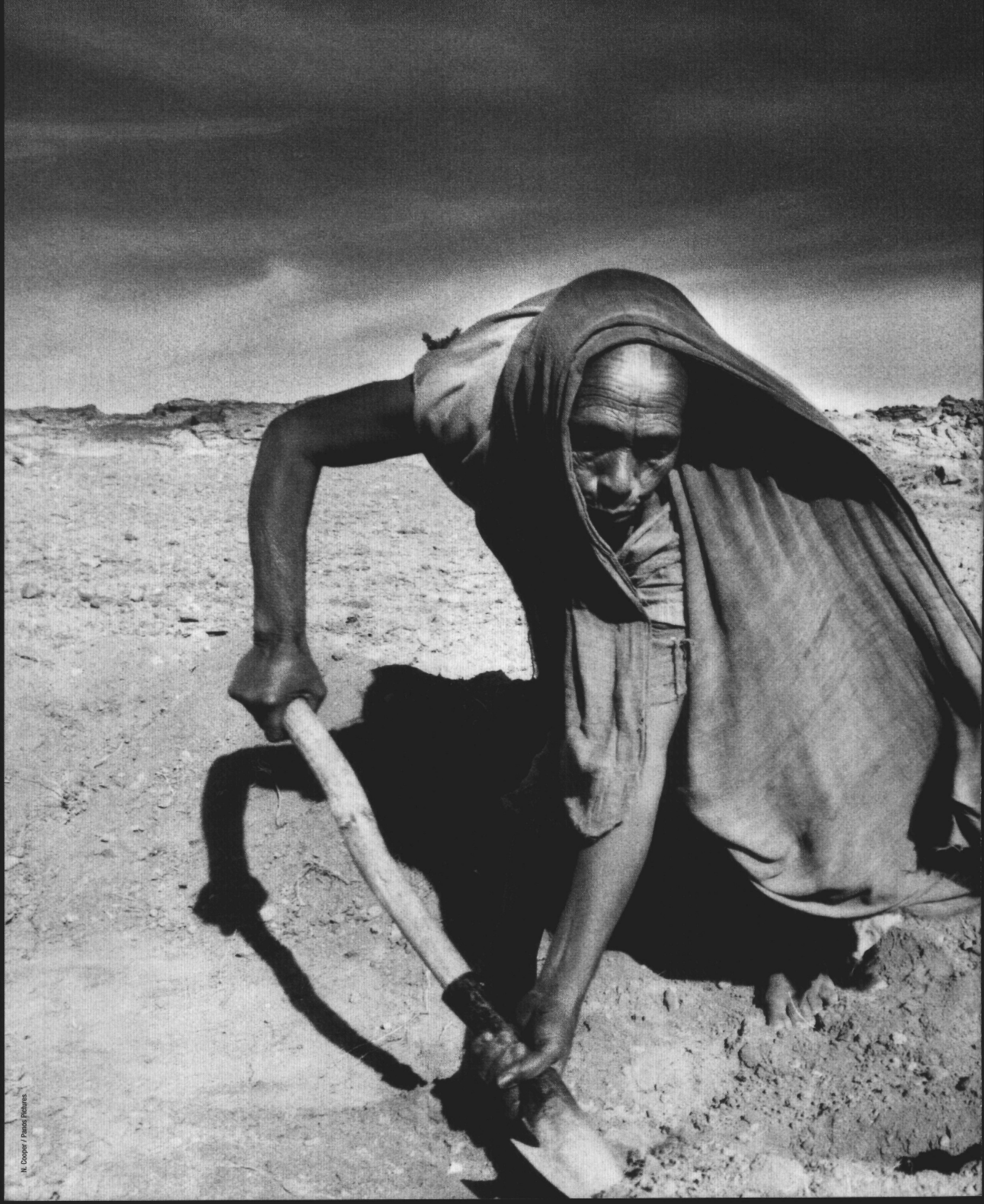
The appropriate sanctions are incurred when such prohibitions are breached. Among the acts considered war crimes under humanitarian law are the following "grave breaches": extensive destruction and appropriation of property not justified by military necessity and carried out unlawfully and wantonly, indiscriminate attacks on the civilian population or civilian objects, and attacks against works or installations containing dangerous forces. In addition, international criminal law has just extended the list of war crimes and applied them to non-international armed conflicts as well. Among the acts committed in international armed conflicts and classified as war crimes in the Statute of the International Criminal Court adopted on 17 July 1998 by the Conference of Plenipotentiaries in Rome, are attacks which cause widespread, long-lasting and severe damage to the natural environment, employing poison or poisonous weapons, intentionally using starvation of civilians as a method of warfare by depriving them of objects indispensable to their survival, including wilfully impeding relief supplies as provided for under the Geneva Conventions.

While it is important that the hostile use of water be qualified as a war crime, repressive measures are merely complementary to the preventive action which must be taken in all circumstances and which calls for compliance not only with the provisions of criminal law but with every relevant rule. The value of punishment or sanctions is not to be underestimated, but what populations need when their very survival is at stake is rapid and practical action.

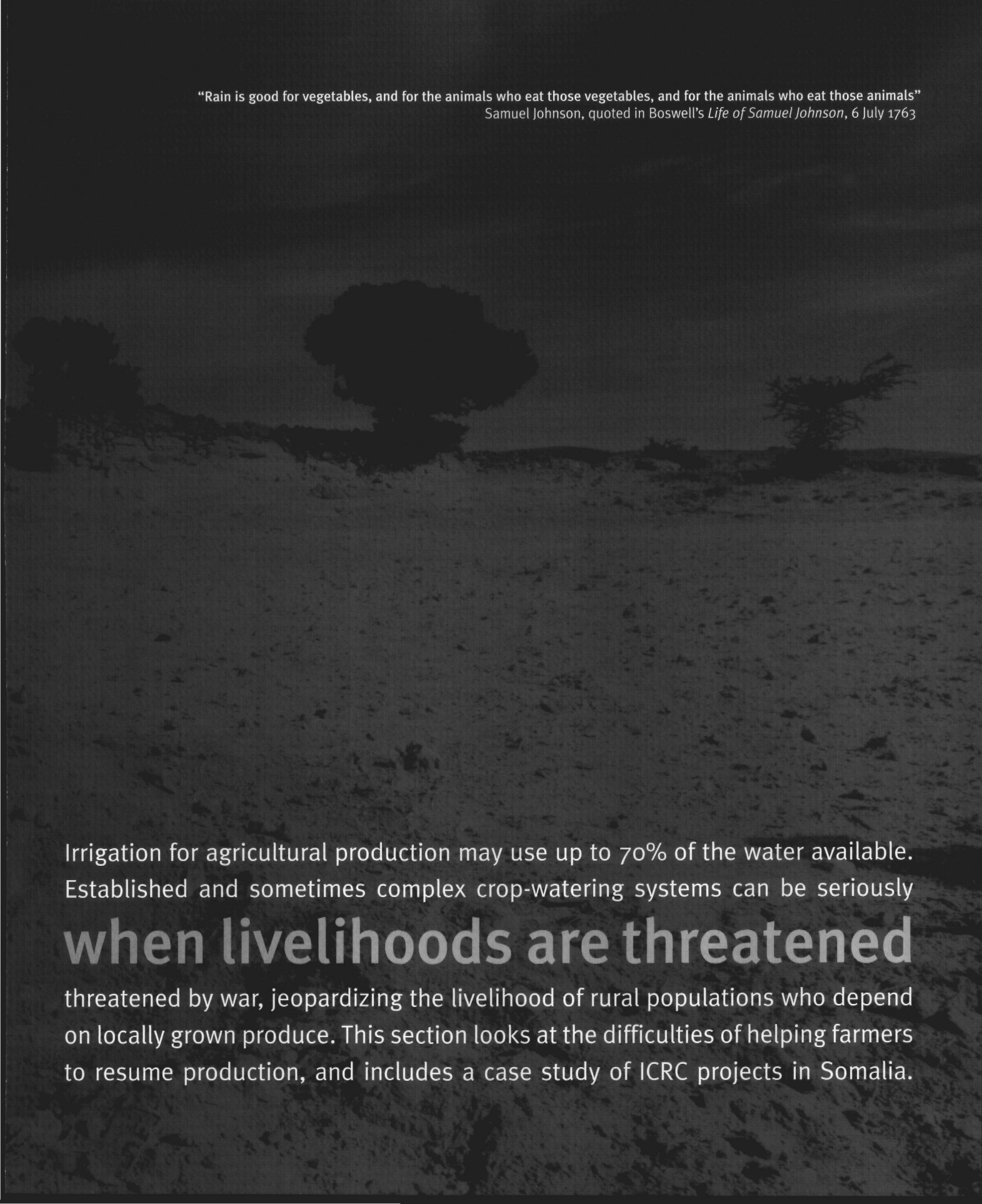
Treating water with respect

Closely considered, the damage done to water-distribution systems and the ultimate denial of access to this vital resource in periods of armed conflict clearly have ungovernable effects, the victims of which are civilians, civilian objects and even future generations of people and objects. If ever there were a principle to bring the armed forces up short and stand as an absolute benchmark for protecting a "commodity" as fundamental as water, it is that laid down in Additional Protocol I of 1977 to the 1949 Geneva Conventions: "In *any armed conflict*, the right of the Parties to the conflict to choose methods or means of warfare is not unlimited" (emphasis added by the author).

More than a "commodity" that people use and abuse, water is quite simply synonymous with life, and it would be more accurate to say that it owns mankind and not the other way around. Gratitude should make us treat water with at least a modicum of respect, even if war is the most ungrateful of human acts.



M. Cooper / Panos Pictures

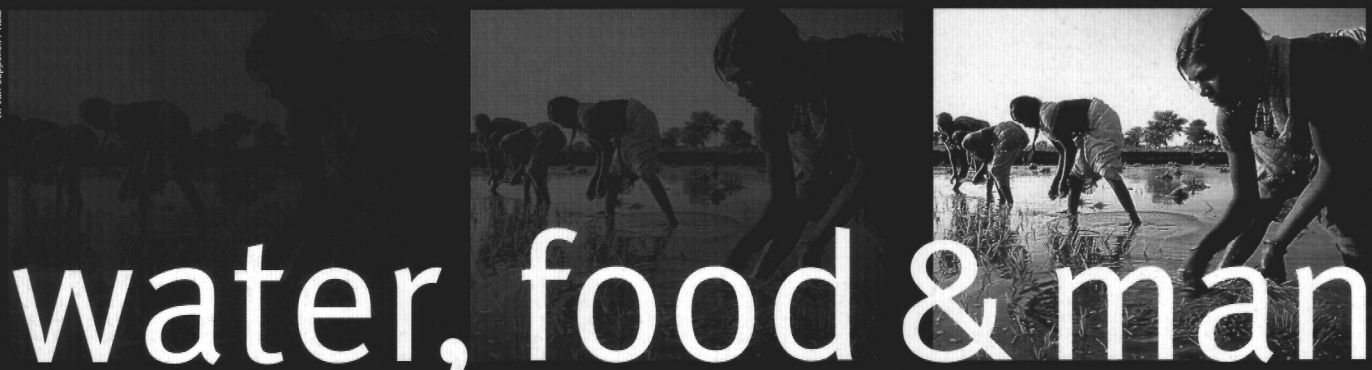


"Rain is good for vegetables, and for the animals who eat those vegetables, and for the animals who eat those animals"
Samuel Johnson, quoted in Boswell's *Life of Samuel Johnson*, 6 July 1763

Irrigation for agricultural production may use up to 70% of the water available. Established and sometimes complex crop-watering systems can be seriously

when livelihoods are threatened

threatened by war, jeopardizing the livelihood of rural populations who depend on locally grown produce. This section looks at the difficulties of helping farmers to resume production, and includes a case study of ICRC projects in Somalia.



W. Van Cappellen / Katz

water, food & man

François Grunewald, an agronomist, worked for a number of years in Africa and Asia before joining the ICRC, where for five years he coordinated programmes to rehabilitate agricultural systems affected by conflict. Since 1997 he has worked as an independent expert, travelling frequently to the field. He is closely involved with a French-based institute researching into crises, humanitarian strategies and links between the phases before, during and after crises.

When water-management strategies are being considered in times of conflict and post-crisis periods, it is important to look at the constraints that exist already in peacetime. An analysis can then be made of how the conflict, and the post-crisis conditions, have influenced these constraints.

Even if water were not vital for drinking, it would still be essential for man's survival. Indeed, it is essential for many food-production processes. The key to these processes is photosynthesis, the phenomenon by which carbon dioxide and water combine, using the sun's energy, to form oxygen and carbon compounds. The complex chemical hydrocarbons obtained are the basis of food for humans (cereals, tubers, etc.) and animals (grasses, cereals, etc.), the latter often ending up in one form or another on the plates of humans.

Constraints in times of peace

Sometimes water surpluses have to be managed. The broad deltas of Asia are based on controlling excess waters in certain periods. Farmers in these areas, where rice was first domesticated, rapidly learned to turn this abundance to their advantage: levelling off the floodwater makes it possible to build up reserves and have multiple growing seasons. The technologies of drainage and flood-dispersion networks, dams and various reservoirs were developed and diversified there. Because of the resulting reduction of risks, multiplication of growing cycles over the year and productivity gains, these areas are among the most populated in the world.

In many areas of the world, rivers arriving from highly irrigated zones cross inhabited regions in their journey down to the sea. The high water resulting from abundant precipitation further up the watercourse can be dramatic, destroying crops, sweeping away villages and herds and displacing populations.

By contrast, in arid climates (the desert, the Sahel, the Mediterranean area), water is "the rare factor". When plants require more water than is available from the rainfall, irrigation is needed. Most civilizations around the Mediterranean – the Egypt of the Pharaohs, Babylon on the plains of the Tigris and the Euphrates, the Mzabite communities of Gardaïa, the extraordinary system of Afghan *kareze* tunnels and the Saharan oasis systems, as well as many Asian societies – have developed around, and because of, irrigation. These systems have either a water-catchment basin or a patiently dug access channel to deep water tables. From there, canals transport the water and then distribute it through a finer network.

The floodwater protection dykes on the Juba (Somalia)

The Juba river, which has its source in the distant highlands of Ethiopia, is a crucial and determining factor in the dry landscapes and agro-pastoral life of southern Somalia. It is also an element of uncertainty. The area which could be flooded and subsequently planted with sorghum and maize depends on the level of its floodwaters. Once every 20 or 30 years, however, the river goes mad. The El Niño phenomenon often results in abundant rains over the entire Horn of Africa, causing a river swell, and the surplus water due to local rains can no longer run off. In an attempt to avoid these problems, a number of protection dykes have been built in recent years on certain particularly exposed parts of the banks of the Juba. These dykes have often worked well. Sometimes, however, as was the case in 1997, the river swell exceeds their capacity to contain it. The result is a catastrophe.[1]

E. Schade / Panos Pictures

Pumping or watercourse-diversion systems, technologies for well-sinking, boring or harnessing springs – all these are proof of man's inventiveness and capacity to survive in hostile environments.

Great strides have been made in irrigation in recent decades. Networks have multiplied in Africa, Asia and Europe. The water-recovery technologies applied are sometimes economical, involving systems based on sun, wind or conventional electrification. Others, on the other hand, are expensive because of their dependence on fossil fuel. In any event, all of them require trained personnel, permanent maintenance work and a regular supply of spare parts.

In these irrigated systems, gross costs, especially those associated with the operation of pumping infrastructures using fossil fuels (including depreciation), represent relatively high expenditure, which farmers can rarely meet (see box, p. 42). In crisis or post-crisis situations, when diesel

fuel, spare parts and other inputs are hard to come by and people's purchasing power is extremely low, such investments are rarely profitable.

Although the latest technological advances in micro-irrigation and a computer-assisted response to plants' water needs are not within the reach of all farmers, they nevertheless show how much importance is now attached to better use of a resource that requires prudent and sparing management.

The onus is now on management and redistribution of the resource. Setting up and maintaining the necessary infrastructures and equipment, and subsequent water management, are all areas requiring social and political organization. The allocation of irrigable land and the distribution of output and of the value added is at the forefront of the process of socio-economic differentiation. The development of irrigation also means that special attention must be devoted to pedological conditions. This is because regions of the world that experience problems of irrigation, drainage or a combination of the two often have soil with a high salt content or a subjacent salt-bearing horizon. If errors are made in water management, millions of hectares may be made impossible to farm.

Conflicts and water management

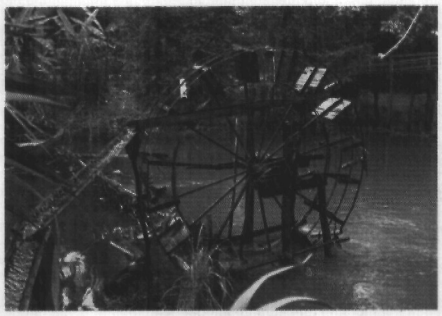
These infrastructures, which are often the fruit of patient work carried out over several generations, are extremely vulnerable to the turmoil that arises through conflicts. There are a great many indirect effects of wars on these networks as well as the direct effects

The Afghan *kareze*

In the high and dry plains of Afghanistan, agriculture is often impossible without irrigation. In these mountainous zones, much of the precipitation falls as snow, subsequently gently infiltrating the thick colluvia at the foot of the mountains. The Afghans have put in place an original system for harnessing this water: the *kareze* tunnels. These are underground galleries which can be several hundred metres or even kilometres long: they drain the infiltration water dispersed in the sediment, channelling it towards irrigation networks. Digging and maintaining the *karezes* is a difficult and sometimes dangerous task, as work has to take place underground with oil lamps, in galleries where progress often has to be made on one's knees. The results, however, are worth the effort and *karezes* are an important element in village life.

Deltas and polder

A fascinating feature of the Red River delta landscape in Viet Nam is that it is both flat and completely "anthropic". Built progressively by generation upon generation of farmers, this system of dykes and canal embankments controls the floodwater swell. The canals, often situated higher than the human settlements further downstream, counter the ever-present phenomenon of sedimentation throughout the delta. This is a true polder (reclaimed) landscape, such as may be seen in the Netherlands. As there, these artificial landscapes are very densely populated: with up to 1,200 inhabitants per square kilometre, they are among the most crowded on earth. If ever the infrastructure were destroyed, it would mean not only flooding, often submerging entire populations, but also nullifying the efforts of several centuries.



S. Sprague / Panos Pictures

1 See also Christoph Langenkamp, p.44.

Analysis of the operation of a motor pump (an example from Mali)

A motor pump powered by a diesel engine has been installed on a watercourse. Its purpose is to supply water for 20 ha.
Investment: US$ 2,000 per annum (cost of the motor pump amounting to US$ 10,000, amortized over five years)

Gross costs related to the use of the pump

Diesel:	US$ 2,500	Oil:	US$ 600
Spare parts:	US$ 1,200	Personnel costs:	US$ 800

Gross costs directly related to other aspects of production

Earthworks:	US$ 2,000	Labour:	US$ 4,800
Fertilizer:	US$ 2,000	Pesticides:	US$ 1,000

Total costs: US$ 16,900

Gross product: US$ 20,000 (20 x 4 x 250 = US$ 20,000, number of hectares x yield x price per tonne)

Gross margin: US$ 3,100 (gross product minus gross costs)

(such as bombing or blowing up of installations). For instance, irrigation systems are no longer maintained because of the lack of staff, financial resources, etc.

When these infrastructures are affected by war, the first consequence is certainly the emergence of food disasters. But what also occurs very quickly is the degradation of the infrastructures and disappearance of the systems and rules under which society operated. Wars may lead to the destruction of irrigation infrastructures or make them unusable by establishing a front line separating the source of water from the territory to be irrigated. In the former Yugoslavia, the great plain of Poljie, near Trebinje (Dalmatia) and the plain of Bencovac (Krajina) are examples of irrigated production systems which were paralysed by the conflict. The water is on one side, the land to be watered on the other, and in between are the minefields and field guns.

Which solutions?

A feature of times of conflict and post-crisis periods is that all the constraints which existed in peacetime are made worse.

The constraints in time of conflict and post-crisis periods are many: rare or unavailable human resources, difficulties in the supply of fuel and spare parts, vulnerability of the smallest investment to plundering and embezzlement, etc.

Before embarking on the establishment or repair of systems which will restore the productive power of water, the constraints and opportunities which exist in the particular circumstances must be analysed:

- availability of human resources and reality of their skills;
- state of social cohesion for collective works;
- ownership of territories and irrigable plots;
- nature and intensity of risk factors (crime, resumption of hostilities, etc.);
- availability of power supply and state of fuel and oil supply chains;
- market outlets for product sales and purchasing power of potential client populations;
- state of supply chains for spare parts.

Experience shows that, in the difficult conditions under which humanitarian workers operate, the need to make shrewd diagnoses is often underestimated. The desire is to act fast and there is no thought of how also to act well. As soon as water management is involved, any mediocre or incomplete assessment immediately results in the failure of programmes.

It is usually easy to find solutions for the technical segments of programmes: most humanitarian agencies are able to find spare parts or supply diesel fuel. Enabling these strategic products to cross front lines, on the other hand, requires different negotiating skills and also, undoubtedly, recognized unfailing neutrality and impartiality. These, however, are by far the most complex human aspects. They are also the ones which are most time-consuming, and the ones which require the diagnostic abilities which those who have to deal with emergencies often lack.

It will soon be recognized that the major task in times of conflict and post-crisis periods is actually to limit the risks facing farmers and production systems. The solution will not always be irrigation, especially if that involves dependence on an input-supply system. In that case it might be the distribution of drought-resistant seeds. It will also be of prime importance to single out the areas in which farmers are well versed: known and identifiable pumping technologies, makes and models of motor pumps already in use before the conflict and for which trained mechanics are available, etc. It will also be crucial to carry out a thorough analysis of the land equation (appropriation of irrigable land, use of land for cultivation under rainfall, management of pastureland, etc.), so as to ensure that the rehabilitation of water access systems does not benefit only large landowners or local dignitaries.

For this purpose it is often necessary to be able to identify local capabilities, especially national NGOs, farmers' groups

J. Hartley / Panos Pictures

Working on an irrigation system in Mali.

and women's associations. It is through dialogue with them that the major time-consuming traps can be identified and partially avoided. In many countries, owners of large agricultural holdings frequently have a stranglehold on irrigable land. Their leading positions, often as "pilot-farmers", makes them frequent intermediaries in international assistance. This is often enhanced in periods of crisis, when State technical services are often lacking, because humanitarian aid agencies then become virtually desperate in their search for partners. It thus becomes essential to try and identify other organized forms of society, particularly water committees and farmers' groups. Working with them will lead to an optimization of aid results and better redistribution of the crops obtained on irrigated land.

All this, unfortunately, is not easy to implement. Time – a rare resource in crisis situations – is often too short for in-depth analysis. Not only the experience and skills of aid officials, but also their modesty, their ability to listen and their sense of responsibility (as much in relation to victims as to financial backers) are the only safeguards against aid being wasted and a failure to respond to the needs of those who, one fine morning, lost everything.

a precarious existence

Christoph Langenkamp is a horticulturist who, among other things, has been involved in tropical crop production. He has almost 10 years of experience in Malaysia, Kenya and Somalia, and has worked for the German Red Cross and the ICRC since April 1996. His main areas of expertise are rural development, irrigation and food security.

in southern Somalia

An arid to semi-arid country perched on the Horn of Africa, Somalia is inhabited by more than 6 million people. For years it has been the scene of widespread internal fighting based on clan loyalties and quickly shifting political alliances. In such prolonged war situations both relief and rehabilitation have their place.

J. Vink / Magnum

M. Tell / Katz

A problem from way back

Food security is all about availability and access to resources: in Somalia, the scarcest resource is water. The country's food security problems date back way before the war. The principal agricultural areas with the highest rainfall, situated close to the rivers, are mainly inhabited by minorities, who have been dispossessed and marginalized in the political system.

The active conflict spilled over into the agricultural areas of southern Somalia in 1991. Fighting, insecurity and the displacement of large sections of the population, coupled with a total collapse of all government and private services, caused a drastic drop in agricultural production, resulting in widespread food insecurity. The great famine of 1991-92 among riverine and displaced people, which later spread to the inter-riverine Bay region, caused a huge loss of human life and prompted the ICRC's largest-ever relief operation.

Again and again since then, farmers and agro-pastoralists have needed assistance, unable to manage alone. Often, the war deprived them of their principal coping mechanisms – sufficient stocks and freedom for them to move to better places. To break the cycle of "recurring emergencies" and to boost recovery towards a degree of self-reliance, the ICRC initiated two pilot agricultural rehabilitation programmes, in the Juba valley and the Hiraan region. The main purpose was to deal with the most deficient resource – water.

Rain-fed farming and recurring floods – a dilemma in the Juba valley

Fertile alluvial soils and an annual precipitation of 400-750 mm in the lower Juba valley combine to create some of the most suitable agro-ecological conditions for crop production in Somalia. People move into the area because of "abundance of water", which is very attractive for farming communities. A high Tsetse fly population and incidence of trypanosomiasis make the area unsuitable for rearing and grazing of livestock, thus easing competition between farmers and pastoralists.

Ironically, water, the principal attraction of the area, poses the greatest risk. The Juba, Somalia's main river, meanders slightly and bursts its banks in its lower sections twice a year (see Figure 1 and Table 1, p. 50). Since flooding occurs during the rainy seasons, extended crop production only becomes viable once basic flood-protection structures have been built. These structures are usually small earthen bunds or dykes, 1 to 1.5 m in height. They can contain most of the small May flood wave (see Figure 1), keeping safe the rain-fed crop of the long *Gu* rains of April to July. Occasional floods every two to three years are welcomed by subsistence farmers, as they can plant crops into the receding waters.

Irrigated large-scale – formerly government-owned – farms have enjoyed better flood-protection structures. These earth dykes are at least 3 m high. However, years of neglect during the war, severe termite infestation (an average of eight nests per kilometre) and occasional trenches for flood-water harvesting have rendered an always imperfect flood-protection system virtually useless, threatening the livelihood of more than 200,000 people.

In June 1996 most of the crops in the lower section of the Juba valley were destroyed by flooding. The floods were quite disastrous for an estimated 100,000 people, who lost the main crop of the year and could not safely plant into the receding flood, as yet another high water wave was expected for September. Although the ICRC distributed seeds, there was a tremendous risk of failure for the farmers. To reduce this risk, two of the worst breaches in the dyke system were rehabilitated at the request of the local communities.

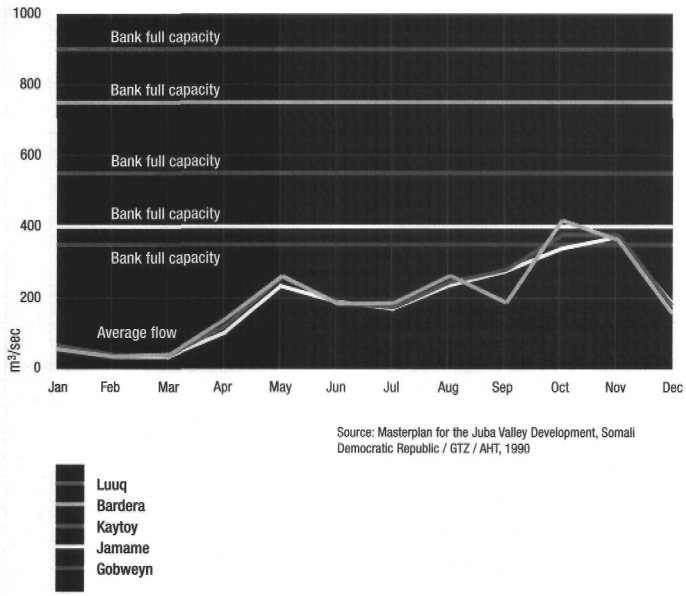
No flooding occurred in September 1996, but many more breaches were known to exist. A rapid survey was carried out in this potentially dangerous area, using hand-held GPS (global positioning system)

receivers. The results showed that more than 100 sections were damaged between Bua'ale and Kismayo, over a river length of roughly 200 km. Thirty-two dyke breaches with a total length of 450 m were identified, as were 38 eroded sections with a total length of 6,900 m. A further 33 potentially dangerous sites were pinpointed.

Following a request by traditional elders and authorities from the area, and with their active participation, a programme to rehabilitate the flood-protection structures was initiated. Qualified local Somali technicians were involved in the initial design and construction of the dykes, an approach which proved to be highly successful. Bulldozers and rollers for compaction were still available in sufficient quantities. However, the biggest problem was insecurity and the – at times – active conflict near the confluence of the Juba into the Indian Ocean.

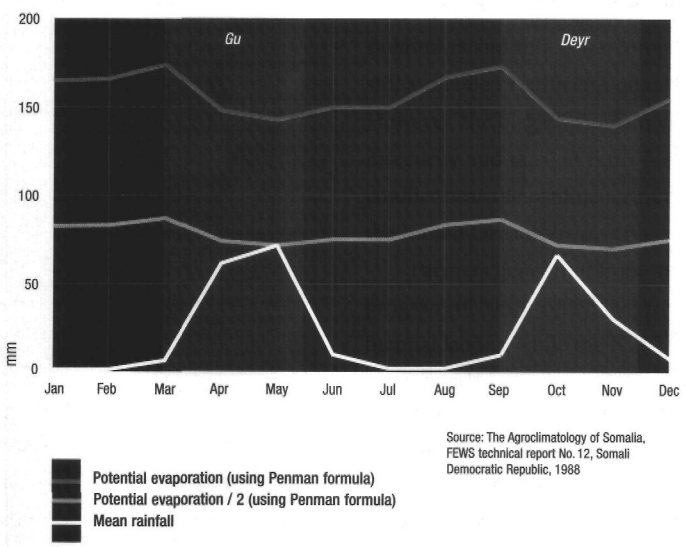
Farmers benefiting from the programme contributed by providing free manual labour, while the ICRC paid the costs. Breaches were fairly easy to deal with. More difficult and costly were the sections where the erosive force of the meandering river had washed away entire segments, the longest measuring 700 m.

Figure 1 **River flow and bank full capacity, Juba river, Somalia**



Source: Masterplan for the Juba Valley Development, Somali Democratic Republic / GTZ / AHT, 1990

Figure 2 **Rainfall and evapotranspiration in Belet Weyn, Hiraan**



Source: The Agroclimatology of Somalia, FEWS technical report No. 12, Somali Democratic Republic, 1988

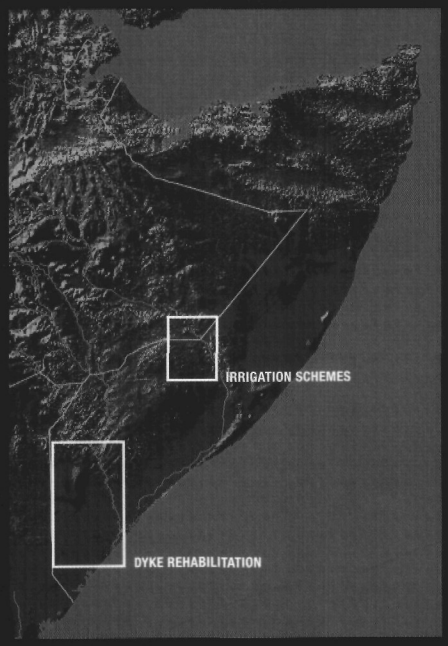


Figure 3

Somalia: Juba and Shabelle valleys

Dyke rehabilitation and irrigation programmes

Only major breaches are shown

Dyke breaches: rehabilitation *work in cubic metres*

- 10 - 110 m^3
- 110 - 200 m^3
- 200 - 360 m^3
- 360 - 750 m^3
- 750 - 1050 m^3

Erosion damage: rehabilitation work in cubic metres

- 200 - 600 m^3
- 600 - 1040 m^3
- 1040 - 2450 m^3
- 2450 - 5200 m^3
- 5200 - 14000 m^3

Temporary lakes

Between January and June 1997 hundreds of people using 12 bulldozers rebuilt more than 9,000 m of simple earthen bunds and dykes, closing all known gaps. The rehabilitated flood-protection structures contained the fairly high water of June 1997, allowing farmers to harvest their main crop in July 1997. If there had been flooding, at least 7,400 hectares of crop in the lowlands (*desheks*) would have been lost. Farmers would have lost at least 7,400 tonnes of maize worth around US$ 1 million.

The rehabilitation programme considerably reduced the risk of loss and failure for small farmers, stabilizing their livelihood and hence reducing their dependence on outside assistance. The programme cost of US$ 400,000 was considerably lower than the value of the crop saved and the assistance that would have been required had the fairly high waters of June 1997 flooded the area as in 1996.

Unfortunately, the torrential El Niño-related rains of October 1997 and subsequent floods (probably a 100-year return flood) partly destroyed the flood-protection system again. Nonetheless, the programme was a great boost in morale for the beneficiary community.

As at July 1998, no further damage assessment had been possible owing to increased insecurity and heavy fighting in the area.

Crop production in arid areas such as Hiraan: continued assistance or rehabilitation?

The second water-based rehabilitation programme was carried out along the Shabelle river in the Hiraan region.

As seen in Figure 2, Hiraan has quite an arid climate, with an annual mean precipitation of only 266 mm and high temperatures (an annual mean of 28.7°C).

As often seen in such marginal areas, farmers still grow crops and take high risks where, according to most textbooks, the area is not even remotely suitable for rain-fed crop production. Here they plant fast maturing sorghum (*Sorghum bicolor* (L.) Moench) and cowpea (*Vigna unguticulata* (L.) Walp.) during the *Gu* and *Deyr* seasons. The yields are poor and failure quite common, even though they use techniques such as early planting and rain-water harvesting to adapt to the adverse conditions.

Large communities thus depend on rain-fed sorghum production but, deprived of most coping mechanisms in case of insufficient and unreliable rains, they have had to be assisted time and time again.

The area is predominantly inhabited by Hawiye (Hawadle and Gugundhabe) and associated clans, and most of the farming population adjacent to the river are Bantu. Serious fighting occurred during 1994 and 1995 when a non-resident clan occupied the territory, looting all movable assets.

Before the war, more than 100 pump-fed irrigation schemes had existed in the region, ranging from small, private schemes covering less than 1 hectare to large government-funded schemes covering more than 500 hectares. After the recapture of the area by the resident clan, only very few were operational: most irrigation structures were found to be damaged and many pumps had been either looted or destroyed. In the aftermath of the conflict, the ICRC decided to improve the weak food-security situation by rehabilitating several irrigation schemes.

The communities to benefit from the programme were chosen according to socio-cultural and technical criteria. One element was all important: the communities had to be experienced in irrigation techniques and to have had an irrigation scheme before the war. Finally, 11 communities whose irrigation schemes had collapsed were selected. Eight schemes had a target net irrigation area of 200 hectares and three schemes a net irrigation area of 20 hectares. Most of them had operated for many years as cooperatives and had frequently enjoyed government support.

It was vital that the programme be spread over different groups, and considerable effort was put into having it accepted by the society. The aim was to avoid an imbalance in the area which could have caused a deterioration in the perpetually fragile security situation. One principal rule for the reconstruction was to keep everything as simple as possible, without using complicated equipment or irrigation technologies. The priority for the farming community was to grow staple foods through supplementary irrigation. This concept not only suited the farmers but also made the programme more acceptable for the people because it improved regional food security and caused prices of staples to fall.

In fact, the technical aspect of the rehabilitation was the easiest to deal with. Using the topographical fact that the slope of the land runs away from the river bank, the water had to be pumped only to the top of the river bank, from where it flowed by gravity through a system of open canals into fields where basin irrigation was practised. Salination is now becoming a problem, as the schemes have no drainage system, but the floods every few decades probably ease the situation.

The management of the pump sets and the distribution of water is regulated by water-user associations which collect US$ 0.25 per pumping hour for servicing. Farmers are organized into small groups

Table 1 **Average floods of Juba river**

District	mean annual floods (duration)				discharge of super floods			bank full capacity	ICRC rehabilitation (1997)
	1 day	3 days	10 days	20 days	5-year	20-year	100-year		
Luuq	918	848	758	664	1,200	1,650	2,300	900	
Bardera	840	814	740	656	1,150	1,450	2,850	750	
Kaytoy	748	730	682	614	950	1,250	2,400	550	upstream start
Jamame	627	623	595	545	750	1,050	2,400	400	half way
Gobweyn	na	na	na	na	na	na	na	350	downstream end

Source: adjusted from: Masterplan for the Juba Valley Development, Somali Democratic Republic / GTZ / AHT, 1990

Table 3 **Technical details of irrigation pumps**

Irrigation scheme	engine	pump	capacity 6 m total head	capacity 9 m total head
area	type	type	m^3/h	m^3/h
± 200 ha	4 cyl. Lombardini diesel	Speck NORM 250-200	600	500
± 20 ha	2 cyl. Kirloskar diesel TV 2	Kirloskar NV9D 125 x 125	na	216

Source: adjusted from: Masterplan for the Juba Valley Development, Somali Democratic Republic / GTZ / AHT, 1990

who irrigate together on one day and usually belong to the same extended family. During irrigation, they share the work of distributing water and provide the fuel required that day. Farm gate prices of cereals often exceed US$ 200 per tonne and allow farmers to run a profitable business even if market prices fall.

The ICRC provided the irrigation pumps, helped to rehabilitate the main canals which extended up to 5 km in length, provided the initial fuel and ran a small but highly motivated team to support the water-user associations and facilitate the social acceptance of the rehabilitation programme. Farmers rehabilitated the secondary and tertiary canals and rebuilt the bunds between the fields. Some fields were completely overgrown by thick bush and had to be cleared again. This work was a great burden for the farmers in terms of labour. They already had to work at least eight hours a day to ensure their daily survival: most of them collected and sold building materials, firewood or animal fodder. All this in a very hot and difficult climate.

Farmers in this region do not calculate irrigation schedules – they just act according to experience. Still the model calculation for the larger system was as follows: at a proposed supplementary net irrigation gift of 2 times 50 mm, a minimum area of 200 hectares to be irrigated, 60% conveyance losses and 90 pumping days of 14 hours each, the minimum required pumping capacity was 400 m^3/hour at low river water levels. To allow for a margin, pumps with a capacity of 500 m^3/hour were eventually installed.

Assuming production of 3,000 tonnes of cereals per year, the total farm gate price of one year's production, US$ 600,000, already exceeds the entire programme cost of approximately US$ 500,000 for the rehabilitation and subsequent support for two seasons. On top of this, the programme succeeded in strengthening the livelihood of thousands. More than 1,500 farming families now have a more stable livelihood, and an additional 1,500-2,000 hectares under irrigation are contributing to the region's food security. This fundamental achievement is worth much more than repeated assistance. Of course, such benefits can be lost any time in a war, but the people's reaction made it well worth the effort.

Meeting immediate needs with a long-term view

For farmers in the extreme climatic conditions of Somalia, regulation of water is

Table 2 **Performance of irrigation schemes**

District	irrigation schemes season 1 no.	target area season 1 ha	actual season 1 ha	participating families season 2* no.	target area season 2* ha	irrigated area season 2* ha	participating families season 2* no.
Belet Weyn	7	460	380	1,043	860	900	1,100
Jalalaqsi	4	350	575	452	750	800	500
Total	**11**	**810**	**955**	**1,495**	**1,610**	**1,700**	**1,600**

* figures estimated by field staff

the single most important factor in the production system. The rehabilitation programmes described above sought to improve the balance between lack of water and excessive water to sustain crop production, thus improving food security.

The aim of such programmes is to *complement* relief efforts. They go beyond providing the primary human needs of water, food and shelter: they enable war victims to have their livelihood system restored. Furthermore, the resulting renewed or reinforced dignity of beneficiaries should not be underestimated.

These rehabilitation efforts are similar to development programmes, but a fundamental difference lies in the fact that, by improving the provision of water, they tackled the primary need of the beneficiary community: food.

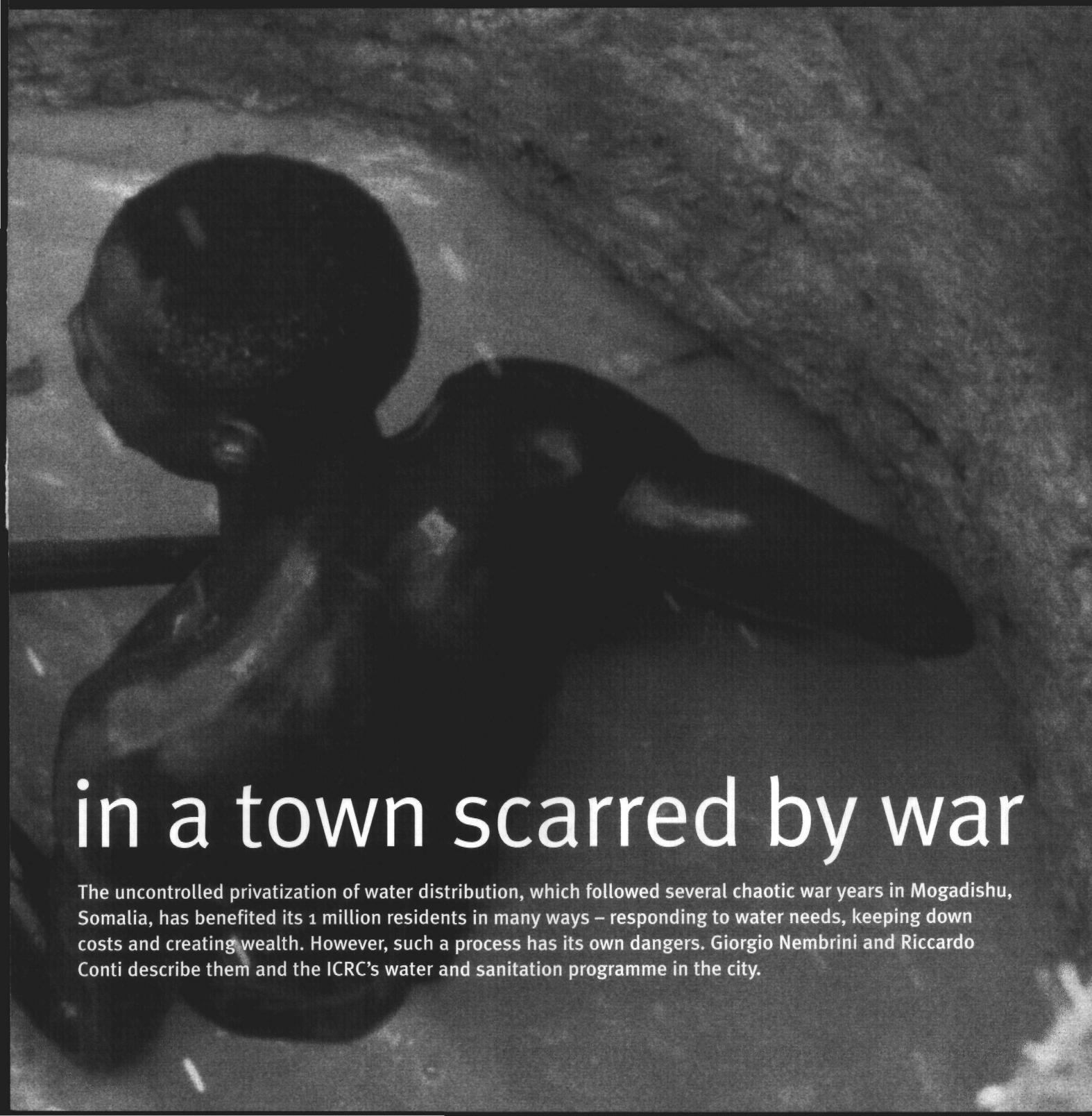
Generally speaking, rehabilitation programmes in war situations require much more speed than in times of peace, as the security situation can change at any moment and beneficiaries are usually much more dependent on the success of the programme. This also means that they are much quicker to assume responsibilities in implementing them.

A paramount condition for success in difficult circumstances is that the intervention is socially acceptable and properly balanced. However, long-term planning and a sufficiently detailed look at all aspects is often impossible. Herein lies the challenge.

There are over 500 hand-dug wells like this in Mogadishu, a town scarred by war.

K. Bain / Panos Pictures

Pier Giorgio Nembrini has a Ph.D. in analytical chemistry, specializing in water treatment and environmental analysis. He was head of the ICRC's Water and Sanitation Unit from 1983 to 1995, and until 1997 he coordinated the ICRC's activities in this field in the Horn of Africa and the Great Lakes. He is now working as an independent consultant. Riccardo Conti is a hydrogeologist and mining engineer, with experience in hydrogeophysical techniques and mining exploration. He worked for 10 years in the private sector before joining the ICRC in 1988. Having carried out many missions in Africa, Asia, Europe and the Middle East, he is now based at the organization's headquarters in Geneva, Switzerland, where he is responsible for the Water and Habitat Unit.



in a town scarred by war

The uncontrolled privatization of water distribution, which followed several chaotic war years in Mogadishu, Somalia, has benefited its 1 million residents in many ways – responding to water needs, keeping down costs and creating wealth. However, such a process has its own dangers. Giorgio Nembrini and Riccardo Conti describe them and the ICRC's water and sanitation programme in the city.

By the end of the 1980s, Mogadishu's water supply was already on the verge of collapse. Fuel shortages, looting and technical breakdowns – which went unrepaired for weeks for lack of spare parts and because of security constraints – made water distribution through the poorly maintained network very erratic. Complete breakdowns could last for weeks and large areas of the town were deprived of a single drop of water for years. The situation was even more precarious in the 1990s owing to the damage inflicted by the civil war. In the aftermath of the 1991 war, an attempt was made to run the system, when some agencies helped the local water board to maintain minimum distribution by providing it with fuel, new generators and spare parts.

It soon became clear, however, that the city's water problem would not be solved simply by supplying fuel and spare parts. Moreover, it would take years for the country to reach a political settlement that would restore the donors' confidence sufficiently for them to make the huge investments necessary for such a town. In the meantime, the inhabitants had to survive using hand-dug wells and boreholes located within urban areas and drilled in response to industrial and economic expansion. Many hand-dug wells were also equipped with motorized pumps.

Improving the water supply

The total collapse in mid-1995 of the distribution network that depended on the Afgoi well-fields convinced the ICRC of the need for a programme to drill and rehabilitate boreholes, in addition to the usual maintenance of hand-pumps. The aim of the excercise was to increase the water supply to most of the city. This was done at the sites of former productive boreholes, which were either not operational or in poor condition, but which were dug sufficiently far from the sea to avoid salinization problems. Other agencies, such as ACF,[1] were concentrating on rehabilitating hand-dug wells supplying water to internally displaced people. UNICEF [2] was supplying the chemicals required to disinfect most of the wells during cholera outbreaks.

The ICRC's programme financed the drilling and equipment of the new boreholes, and the "owner" of the borehole was then responsible for operating it and distributing the water. Between the beginning of 1995 and the end of 1997, six new boreholes were drilled, tested and each equipped with a submersible pump. The diesel generators to power the pumps were installed in protected premises (University Residence Camp, Gupta, Muuri, Yakshid, Daynile and Medina). Four boreholes (Black Sea, Livestock, Big Pipe and Gulwadayasha) were cleaned and equipped, and 12 hand-dug wells were equipped with submersible pumps powered by diesel generators (two in Medina, two in Bermuda, four in Mogadishu North and four in Mogadishu South). Some boreholes located in critical locations, like the one supplying water to Digfer Hospital, were completely rehabilitated. Others, such as the one in Sheikh Adan Camp, had been running without problems since 1992.

Water quality and quantity

At the beginning of 1997, the ICRC carried out a survey aimed mainly at monitoring the effects of saline intrusion related to possible overharvesting. The results (Figure 1) showed that the inland movement of the saline wedge, expressed as the 3,000 micro-siemens/cm boundary, was close to 2 km since the last record in 1980.[3]

The situation was not considered dramatic as far as salinity was concerned.[4] However, salinity not only influences public health (overly saline water will not be used for drinking) but also affects the price of water, reducing its economic value.

In Figure 2 the location and type of wells surveyed per district were positioned on a geo-referenced map using GIS (Geographical Information Systems) software, and the wells used by the donkey cart water vendors (the traditional method of distribution in Somalia) were selected. It immediately became obvious that only wells with an acceptable level of salinity were used, i.e. the ones located fairly far from the seashore, the best being those situated close to or north of the 21 October road (about 6 km from the shore). Most of the vendors obtained their water from the wells between 3 and 5 km away.

From the data it is also possible to calculate the quantity of water abstracted every day from the aquifer and tentatively assess the overall income from the city's water trade. If we make the same assumptions as UNICEF [5] – i.e. one borehole produces 15 m^3/hour, a hand-dug well equipped with a motorized pump about 6 m^3/hour, a hand-dug well (with or without a hand-pump) about 1 m^3/hour, with wells in use for approximately 10 hours a day – the estimated abstraction is currently close to 24,000 m^3/day, and probably slightly higher if we bear in mind that some boreholes have an output close to 20 m^3/hour and operate for more than 10 hours a day.

1 ACF: *Action contre la faim*
2 UNICEF: United Nations Children's Fund
3 A. Gibbs and Partners, Consulting Engineers, *Source investigation for Mogadishu water supply expansion*, Vol. 1, Technical Report, 1980.
4 P.G. Nembrini, R.G. Conti, "Water for Mogadishu: Water supply in a war-torn town", *Bull. angew. Geol. 2/2*, December 1997.
5 *Results of the recent assessment of water sources in Mogadishu city*, UNICEF, 1995.

Figure 1

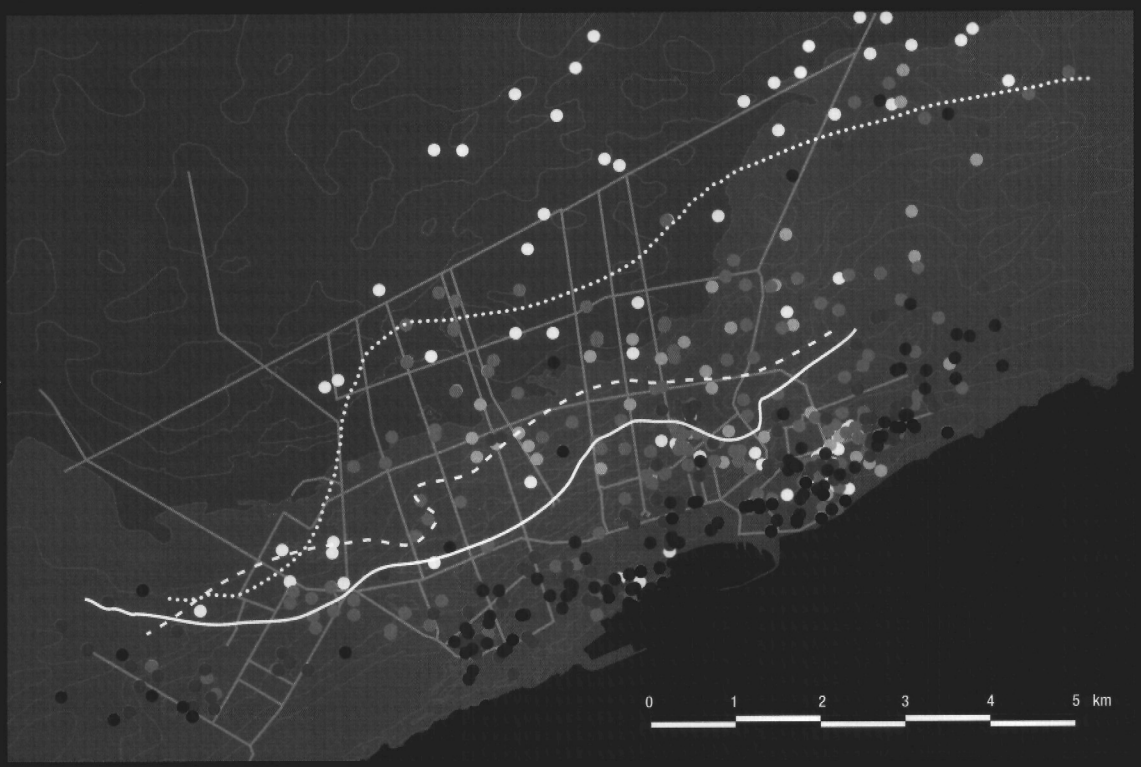


Figure 2

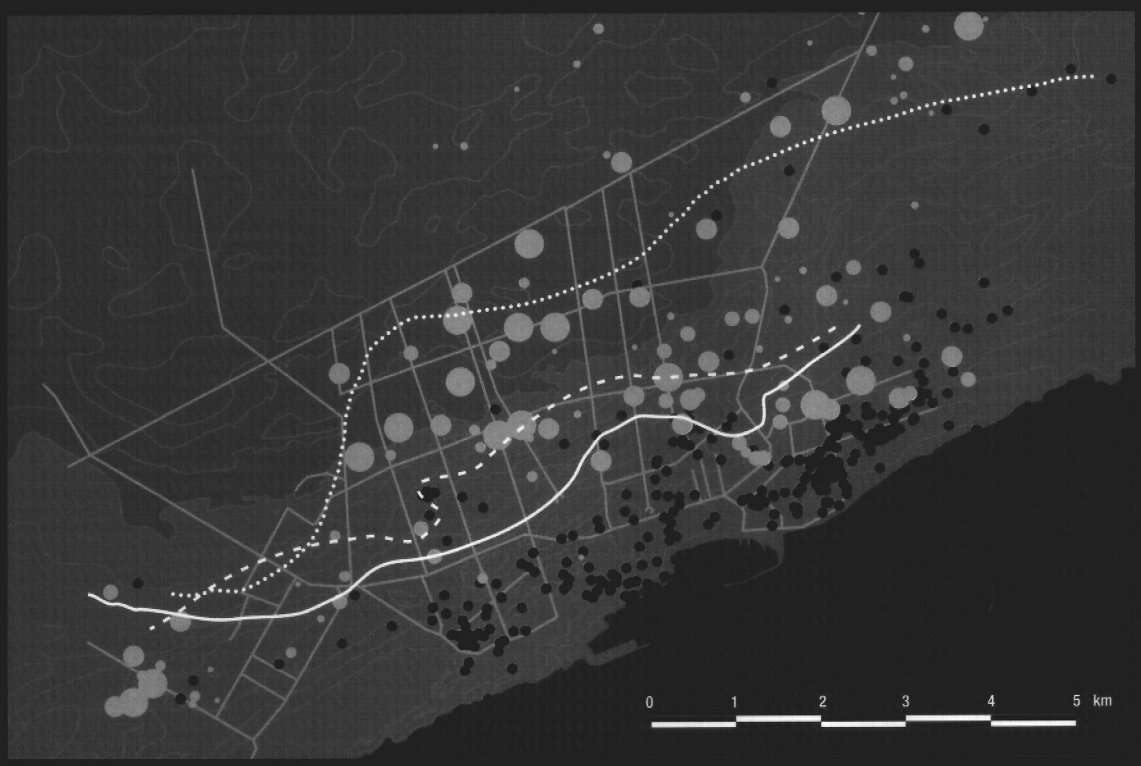


Table 1 **Wells in Mogadishu and donkey cart loads per day (by district), 1997**

District	Hand-dug wells with motorized pump	Hand-dug wells with hand-pump	Hand-dug wells	Borehole and pump	Total	No. of donkey cart loads (1 load=200 l)
Karaan	44	23	77	2	146	7,828
A/Aziz	37	27	74	-	138	0
Shingani	-	2	12	-	14	0
Shibis	14	2	3	-	19	1,635
Bondhere	4	3	9	-	16	771
H/Weyne	4	6	25	-	35	0
H/Jajab	6	22	36	-	64	235
Wabari	4	3	14	-	21	226
Yakshid	31	2	3	5	41	6,747
Huriwaa	15	8	-	3	24	2,904
Wardhigley	17	-	3	4	24	7,290
H/Wadag	16	1	3	3	23	7,110
Hodan	13	-	5	2	20	4,094
Daynile	9	-	-	1	9	980
Wadajiir	31	3	2	1	37	4,283
Darkenley	20	-	-	-	20	980
Total	**264**	**102**	**264**	**21**	**653**	**44,535**

According to these results, the number of donkey cart loads distributed per day is close to 45,000, about 9,000 m³/day, probably with some 4,000 donkey carts in operation.

The water business

Many well-owners had to equip their wells with a pump to cope with their own needs, and also to improve their income. The water is sold to the donkey cart vendors at a fairly standard price, varying from 500 to 750 Somali shillings per 200-litre drum,[6] up to a maximum of 1,000 shillings. The water is then sold to the consumers according to the carting distance, at around 2,500 shillings and up to 3,000 shillings a drum. It is nevertheless distributed free to users living close to the wells, provided that the containers are not too big (between 5 and 10 litres).

Since the 1995 UNICEF survey mentioned above, the way in which wells are equipped has changed in keeping with the demand. The number of hand-dug wells equipped with motorized pumps has increased from 75 to 264. The number of wells used to supply the donkey cart vendors has also certainly risen, as shown in Figure 2, even if precise data on this increment are lacking. With the exception of the wells drilled or equipped by the ICRC, the majority have been equipped by their owners and are privately managed. Owners have invested resources to run their systems, and expect to earn enough to recover their investment and buy the necessary spares for maintenance and repair purposes. Data on Middle Shabelle from ETC[7] show that the minimum annual operation and maintenance cost for a borehole, calculated for a 50-m-deep borehole at a pumping rate of 12 m³/hour for a mean daily operation of 7 hours, is close to US$ 10,000. Total annual income is some US$ 17,000, with a net annual income of about US$ 7,000, which decreases the deeper the level at which the water is struck. This calculation assumes a private enterprise scenario and includes drilling costs, installation of the pumping set, interest rates on capital borrowing and operation and maintenance costs.

By analogy, the calculation for hand-dug wells at a pumping rate of 4.2 m³/hour for 8 hours/day from a 50-m-deep well shows a lower annual income but a higher net unit income (income/hour/m³), the capital cost of digging and equipping the well being lower. This means that it is tempting for private-sector owners to dig and equip highly productive hand-dug wells instead of boreholes, provided that the demand for water is high. This was, and certainly still is, the case in Mogadishu and explains why there has been such an increase

in the number of wells equipped with a motorized pump. Borehole drilling or equipping is left to humanitarian organizations like the ICRC, which can restrict their action to places in dire need of water, but with the risk that they may create conflicts with people who are already running commercial water-supply systems. The intervention must be carefully analysed, balanced and community-oriented. For instance, leaders may be helped so that they can, in turn, care for displaced people, as in Sheick Aden, or hospitals may be prioritized, as in Benadir or Digfer, where water is essential and must be provided in large quantities. There is, of course, always a temptation for well-owners to obtain some support from any organization, to cover part of the capital cost or part of the operation and maintenance costs, in order to enhance their net unit income.

Increased harvesting is, of course, exacerbating the movement of the saline wedge inland and this may drastically raise the salinity, thus decreasing the value of the water for sale. For the time being, this situation is not giving any cause for alarm, and the 1997/98 floods have certainly helped to restore the previous boundaries. However, overabstractions may significantly increase the salinity of the water in neighbouring wells and reduce their commercial value for years, thereby raising tensions between owners.

A. Noston / ICRC

The traditional method of water distribution in Somalia.

6 US$ 1 = 7,000 Somali shillings as at March 1997.

7 *Evaluation of water projects and assessment of water needs in Hiraan and Middle Shabelle regions*, Environmental Technical Consultants, Kenya Consultants, November 1996.

Between 1994 and 1997 55,000 people suffered from cholera in Somalia: over 2,000 of them died.

Spread of disease

In the four cholera epidemics that struck Somalia from 1994 to 1997, over 55,000 people fell ill and 2,100 died. Drinking water was assumed to be the major source of infection in 1994, when *Vibrio cholera 01* was cultured from water samples collected from wells in cholera-affected areas. However, changes in vibrio transmission modes were suspected, as the vibrio was found in only one water sample taken in 1995 and in none of those collected in 1997.

Mogadishu has been hit several times by cholera epidemics and was the point of origin for the last three. The course of the 1997 epidemic was well documented, even if it did not reach the proportions of the previous ones.[8] Mogadishu suffered a further epidemic at the end of 1997 and beginning of 1998, certainly linked with excessive rainfall and extensive flooding assumed to be caused by the El Niño phenomenon. The floods triggered population displacement, which in turn exacerbated contamination of the water supply. Thousands of people were admitted to several cholera treatment centres scattered throughout the city and on its outskirts.

To identify transmission modes, the WHO[9] and MSF carried out a study[10] in March and April 1997. Contaminated drinking water was still considered to play an important role in transmitting the disease, even if other factors also contributed, including the consumption of food and drink bought from street vendors and insufficient water for adequate hygiene practices, especially hand-washing. Despite huge efforts to chlorinate wells, the chlorine levels found in water samples taken from wells and household storage were far below those recommended, and many water samples showed faecal contamination. Water is also contaminated after collection from the source, but several samples of water from the same well were found to be clean one day and contaminated the next, probably because of the erratic way in which they were being disinfected with chlorine. Most of the samples from the wells were bacteriologically contaminated and with the onset of the epidemics, most of the un-protected wells could be expected to become contaminated as well, putting an even greater proportion of the population at risk.

Mogadishu does not have a central waste-water evacuation network and most buildings dispose of their waste in septic tanks. Permanently displaced people use communal latrines, when available, or pit latrines. Percolation through preferential infiltration routes may lead to heavy contamination of the well water, particularly when these wells are poorly protected. This is the case for most wells in the displaced people's settlements located in the suburbs close to the seashore, where the higher salinity also allows the vibrio to survive for longer periods.[11]

The costs of epidemics are high, and not only in lives lost. Although treatment is fairly simple, the logistics required to provide rehydration fluids can be expensive. During the 1997 epidemic, the weekly supply through the ICRC to the treatment centres at Benadir Hospital and in Bermuda was about 420 litres of Ringer Lactate, which had to be brought in by plane together with other drugs and medical items. It can be assumed that the total weekly quantity supplied by all the organizations together was about twice that amount.

Need for vigilance

The uncontrolled privatization which has come about as an inevitable consequence of the chaos in Mogadishu triggers other dangers, as can be seen from the above data. Organized control of water use is more necessary then ever and this can only be done by an official service, usually the local water board.

In addition, the uncontrolled equipment of wells and boreholes with

powerful pumps and the sinking of new wells has modified the position of the saline/soft water wedge, which has shifted inland, increasing the salinity of the water in a large number of wells. Such developments must be monitored and managed, as the future of the water supply to the whole city could be threatened. The uncontrolled equipment of water sources has further collateral consequences, as it may contribute to poor protection of the water sources and increase the spread of waterborne or water-related diseases.

Monitoring will help to manage the underground aquifer and also assist the various players in deciding on their priorities if they want to reduce the high risk of contamination of the water and the recurrent outbreaks of cholera within the city. During the period of unrest, several humanitarian organizations tried to maintain minimum monitoring of water quality, but no measures can be enforced until law and order prevails. Guidelines can be established, but it will always be impossible to impose measures to manage private initiatives and avoid overharvesting practices or poor protection of this essential resource. Once the political situation is settled and centralized distribution resumes, the conflicting interests will have to be taken into account, and it may not be possible or even desirable to condemn the current practices. Only a precise study of the capacity of the aquifer will enable a new policy to be defined which will reconcile private interests with the common good.

8 M.T. Schick, R. Shoo, M. Neira, *Cholera control in complex emergencies: Lessons from Somalia, 1994-1998*, WHO, personal communication.
9 WHO: World Health Organization
10 M.T. Schick, *Cholera transmission in Mogadishu, Somalia*, A case control study, WHO/MSF, Spain, June 1997.
11 R.G. Feachem *et al.*, "Sanitation and disease, Health aspects of excreta and waste water management", *World Bank studies in water supply and sanitation*, John Wily & Sons, 1983.

Figure 3 Cholera admissions and deaths in major health centres, Mogadishu (1998)

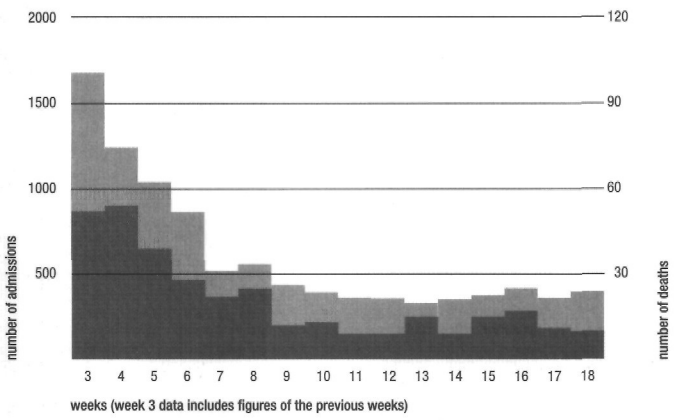
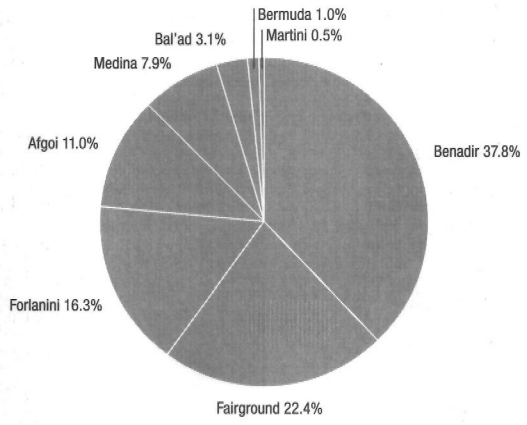
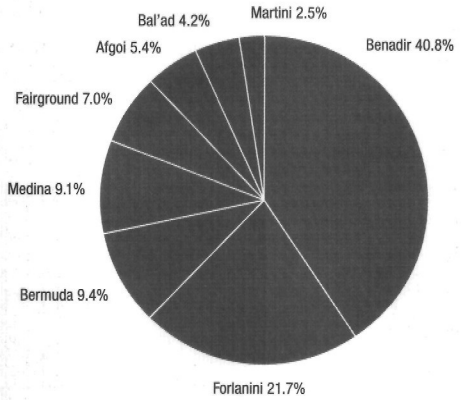


Figure 4 Cholera treatment centres, Mogadishu (1.1.98 to 1.5.98)

Number of deaths = 392

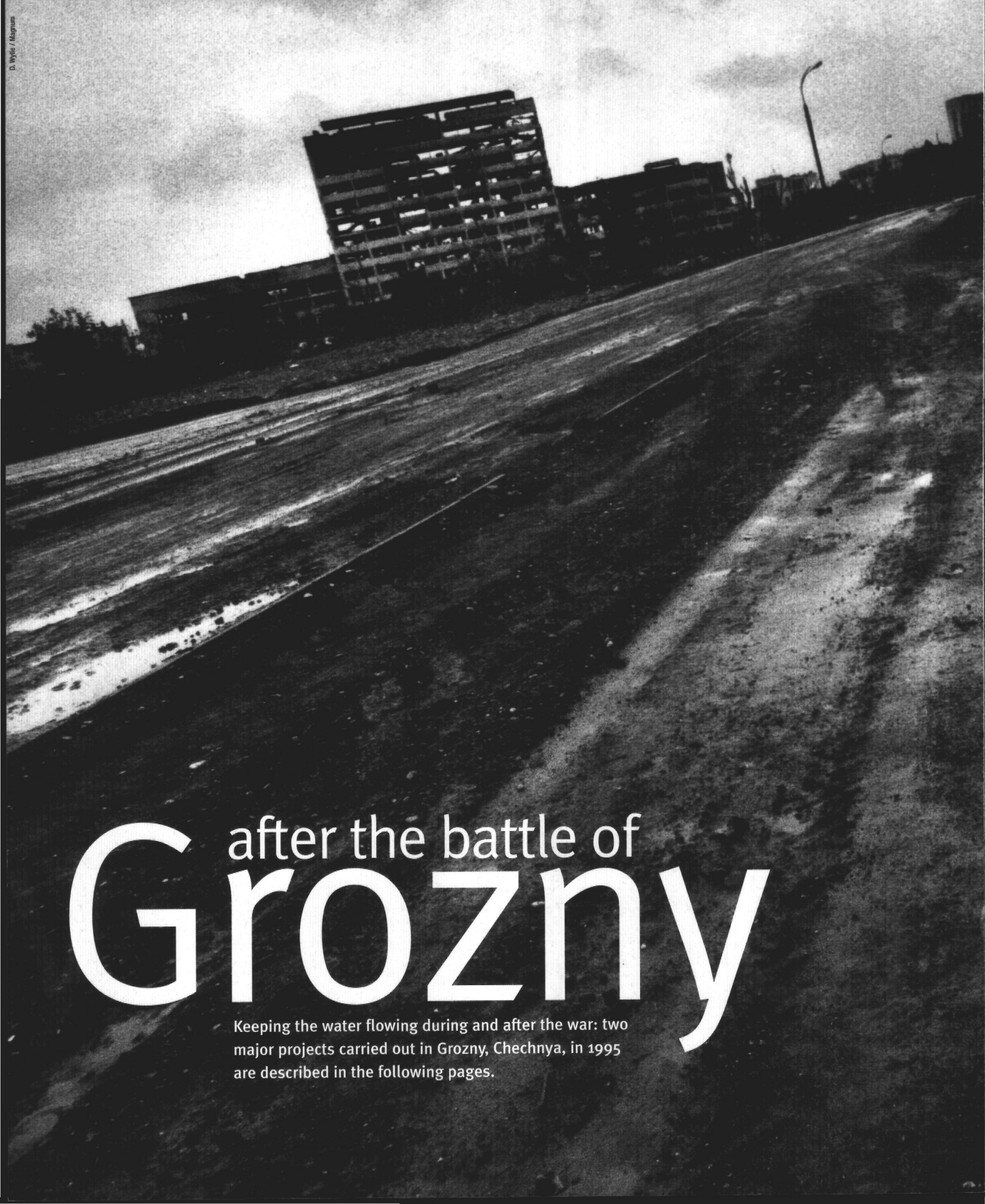


Number of admissions = 9447



Benadir (ICRC)
Bermuda (ICRC)
Afgoi (Fed.)
Martini
Forlanini (MSF-B)
Fairground (ACF)
Medina (ACF)
Bal'ad (Fed.)

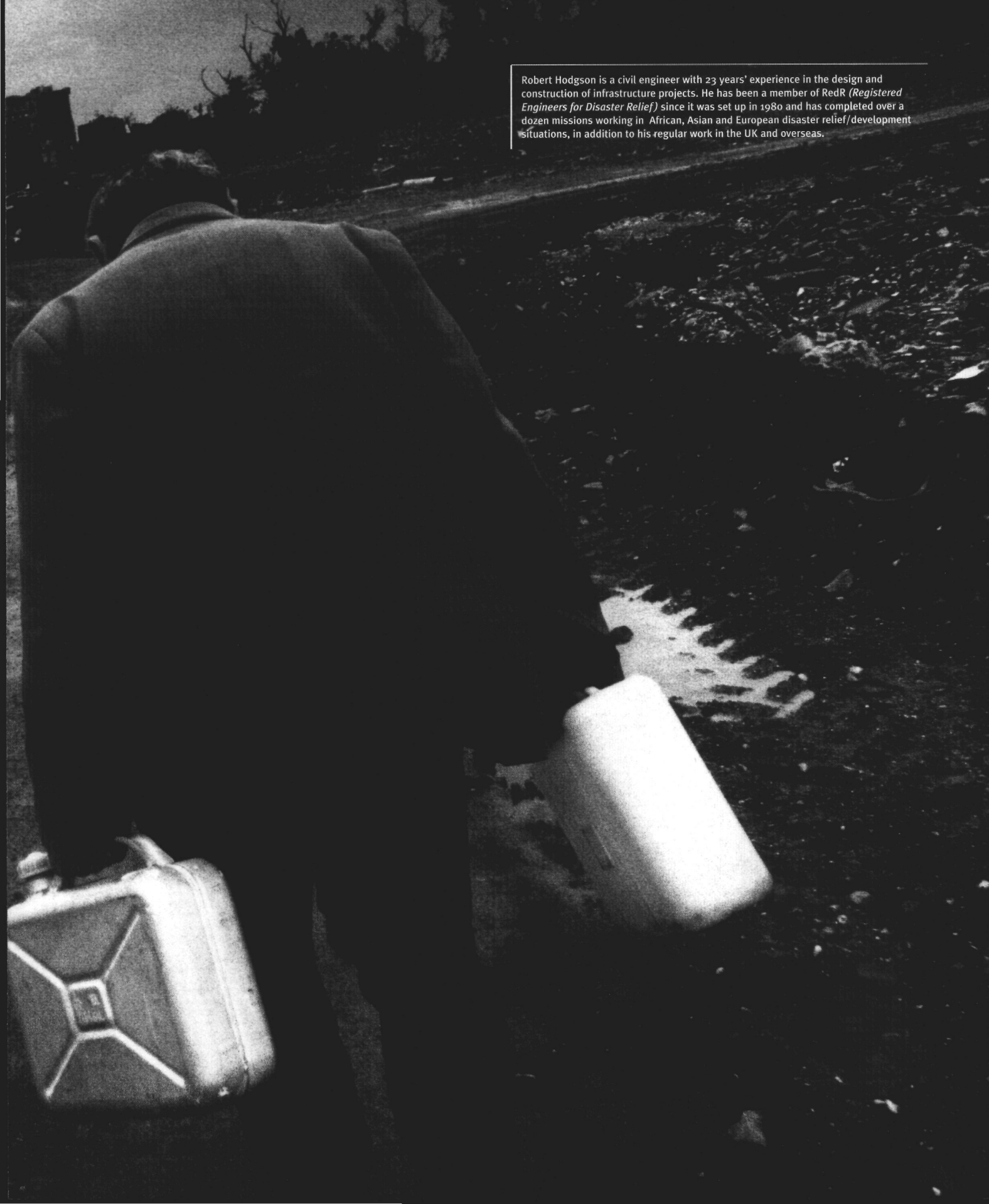
Fed.: International Federation of Red Cross and Red Crescent Societies
MSF: *Médecins sans frontières*



D. Wylie / Magnum

after the battle of Grozny

Keeping the water flowing during and after the war: two major projects carried out in Grozny, Chechnya, in 1995 are described in the following pages.



Robert Hodgson is a civil engineer with 23 years' experience in the design and construction of infrastructure projects. He has been a member of RedR *(Registered Engineers for Disaster Relief)* since it was set up in 1980 and has completed over a dozen missions working in African, Asian and European disaster relief/development situations, in addition to his regular work in the UK and overseas.

If we knew when and how a hazard was going to strike, it would not become a disaster. The course of conflict is particularly difficult for an outsider to predict. Military advantage often lies in surprise, and unexpected factors such as the weather tend to come into play. Success in providing relief calls for good management of such uncertainties.[1]

Not all the chaos requiring management will be directly attributable to the changing fortunes of war. Even in well-developed economies, major natural disasters have been followed by periods of inflationary prices, labour shortages and general lawlessness.[2,3] It is not surprising to find similar conditions accompanying armed conflict.

Nevertheless, reconstructing an established water infrastructure requires stable conditions. Surveys have to be done, substantial large materials must be procured and transported, regular power and fuel supplies are needed and skilled workers must be found and paid. The following chapter describes some experiences made in a water-supply rehabilitation project attempted during the conflict in Chechnya, which has been well documented.[4]

Grozny, 1995-98

The relief agency MERLIN[5] worked in Grozny from March 1995 until early 1998. Chechnya has endemic cholera and the summer months there are very hot; this combination, together with inadequate public water supplies following the destruction of central Grozny by the Russian Federation military in December 1994, prompted MERLIN to join the ICRC and MSF[6] (Belgium) in addressing the water needs of the city.

Clearly, trucking water to temporary distribution points could not satisfy the needs of 300,000 people, so MERLIN started providing the local water utility, Groz-Vodakanal, with materials, equipment and machinery to replace resources lost during the fighting. However, deteriorating security during the autumn of 1995 delayed the beginning of major reconstruction work, and renewed fighting following the December presidential elections halted what little had been started.

MERLIN continued its emergency programmes through its highly motivated local staff until, a year after the 1996 cease-fire agreement, it was again possible to contemplate resuming rehabilitation of the water supply. A reassessment in October 1997 identified a series of modest projects which Groz-Vodakanal could implement in partnership with MERLIN to restore at least intermittent public water supplies to all parts of Grozny. The first two were well under way when the abduction of the representative of the principal funder, UNHCR,[7] halted all further work.

What did the Grozny experience teach us ?

Not everyone suffers equally during war. Those with money usually escape the fighting, those with materials or services to sell (such as the truck drivers of Grozny) make a good living for a while and many middle managers find themselves unexpectedly promoted. It is worth remembering that, just as in any other disaster, the principal victims in war tend to be the poor, the landless, widows and children, because they are inherently vulnerable.[8] Many of Grozny's vulnerable and marginalized groups live around the edge of the city, where low pressure and disconnected pipework made public water distribution particularly difficult.

Undertaking permanent infrastructure rehabilitation

Temporary water distribution using trucks has a very important role in the initial stages of a relief operation. At one time the combined ICRC/MSF operation was distributing 3 million litres of water per week throughout Grozny. Every effort was made to target the worst-affected parts of the city, but this massive (and expensive) undertaking still could not satisfy the basic demands of a modern urban population. The only cost-effective long-term option available was to rehabilitate the public water services.

In practice, relief agencies are likely to take on infrastructure repair work only in cases where the proper authorities do not have the resources, will or skilled manpower to do it themselves, as was the case in Grozny. The decision may well turn on a financial calculation of the significant cost-saving that can be made by eliminating the need for trucked water distribution.[9] Hardware rehabilitation often needs to be accompanied by institutional development of the managing utility to ensure future maintenance of the system.

1 R.L.P. Hodgson, "Appropriate approaches, top-down or bottom-up?", *Report on "Water under Fire" workshop*, ed. A. Ozerdem and S. Barakat, University of York, 1996, pp. 33-40.
2 R. Giepel, *Disaster and reconstruction, the Friuli (Italy) earthquakes of 1976*, Allen & Unwin, 1982, 202pp.
3 E. Haas, B. Kates, M. Bowden, *Reconstruction following disaster*, MIT Press, 1977.
4 C. Gall, T. De Waal, *Chechnya, a small victorious war*, Pan, 1997, 416pp.
5 MERLIN: Medical Emergency Relief International
6 MSF: *Médecins sans frontières*
7 UNHCR: United Nations High Commissioner for Refugees
8 P. Blaikie *et al.*, *At risk*, Routledge, 1994.
9 J. Ockelford, "How do we work with host governments and other NGOs for the good of the refugees?", Technical Support for Refugees, *(Proceedings of the 1991 Conference)*, ed. R.A. Reed, WEDC, 1993, 68pp.

Alain Oppliger is a water and sanitation engineer with the ICRC. For 10 years he worked in such countries as Afghanistan, Sri Lanka, Mali, the former Yugoslavia and the Caucasus. He was one of the first expatriates to go to Grozny, Chechnya, during the fighting in February 1995. Now based in Geneva, one of his tasks is to follow the water-trucking programme he set up then, which continues today.

Grozny: Adapting water distribution to crises and the needs of the urban trapped

Following the extensive damage inflicted on power supply lines and, consequently, the complete grinding to a halt of all pumping stations, the ICRC began in February 1995 to implement a programme to supply a minimum amount of drinking water to the urban-trapped population.

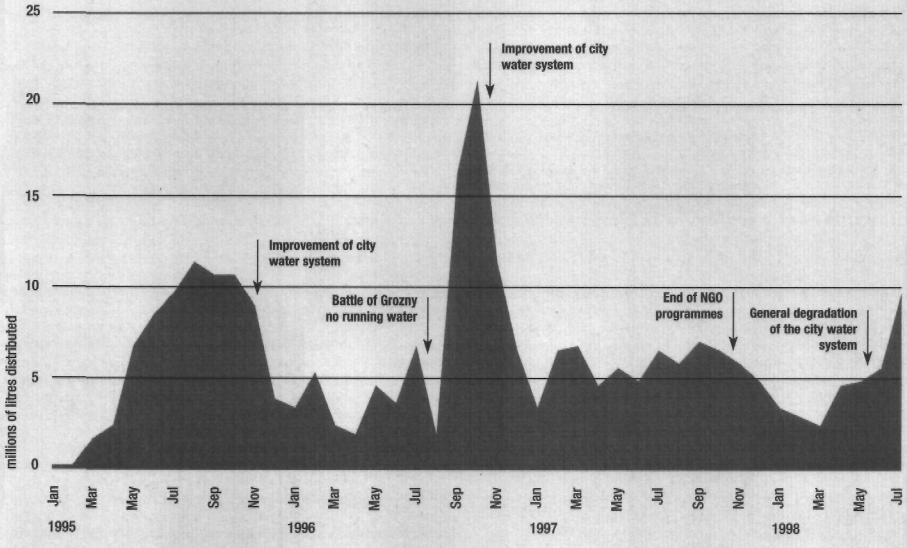
A water storage and treatment plant had to be set up to supply the huge fleet of tankers (up to 50) in charge of distribution to the different suburbs. The quantities distributed were adapted to the demand according to the improvement of the city distribution network, even if a minimum of about 5 million litres per month had to be maintained to cope with the needs of several suburbs (estimated population close to 20,000) still lacking water.

On 6 August 1996 the last offensive to recapture the city triggered a new emergency, and water distribution from the ICRC station reached an unprecedented level, up to some 23 million litres in October, an amount which then decreased sharply in the following months when the city water supply resumed.

Despite the relative stability achieved at the end of 1997, the 5-million-litre level had to be maintained into 1998. It even doubled at the beginning of July because of the hot climate and because the operation and maintenance of the network system were worsening. The shape of the distribution curve reflects the deteriorating situation. In particular, the peaks represent the hardship suffered by the population since 1995. The question now is: how long will it last?

E. Bouvet / ICRC

Water distributed in Grozny from the ICRC water station



Preparing to act

Before undertaking permanent rehabilitation work, the relief agency should make a systematic study of the options available, including:

- the other resources available to the utility companies;
- the extent to which the failure of the water system predates the conflict;
- the technical skills available in the city;
- the sources of materials and equipment needed for repairs;
- the adequacy of power supplies;
- the likely future course of the conflict.

If specific projects are identified, the progress of the work can be more easily monitored and the impact on the target population assessed. Public utilities tend to request supplies of a generic nature ("wish" lists) for as yet unknown emergency repairs. While these needs cannot be ignored, a full appraisal of the distribution system as a whole is essential. The 1997 assessment in Grozny resulted in a plan to bring water within the reach of all residents in the space of a year or so. Specific elements were formulated within the plan, identifying the major inputs as well as the benefits to be expected from each one. To shift the focus to "new" construction work, it was necessary to reorient the thinking and planning processes of Groz-Vodakanal, normally a maintenance utility. The process considerably strengthened the line of responsibility for the work at all levels. It seems that the sooner that the necessary work can be broken into manageable segments, the more satisfactory the partnership is likely to be in the long term.

It took over two years to establish this degree of understanding in Grozny. When MERLIN arrived in 1995, the city administration was still being reformed and it was hard to identify the decision-makers. Russia's limited tradition of charitable work meant that the nature of the humanitarian ethic was not understood and initial approaches to the city engineers were rebuffed.

The donors' timetable

Major donors normally need to fix a timetable of funding and objectives. Unfortunately, the fortunes of war fluctuate, so this inflexibility creates unnecessary tension among field workers and can lead to very wasteful use of funds, as expenditure is accelerated to beat deadlines which are being ignored by the non-humanitarian players in the field.

Using local suppliers

Equipment provided for the rehabilitation of a water system must be compatible with existing installations and of types familiar to maintenance engineers. These requirements tend to rule out the supply of internationally sourced materials which, when transport costs are taken into account, will in any case often be more expensive than locally available items.[10] However, in an unfamiliar market the supplier holds the cards. Therefore, a knowledgeable local purchase officer is vital if supplies are to be procured on time and at reasonable prices. For example, under the centrally planned administration of the former USSR, everything was specified by a number. In the absence of catalogues, foreigners unfamiliar with equipment specifications had to inspect the equipment before buying. If nothing suitable was in stock, a return journey of almost a week to the nearest stockist could be wasted.

The alternative was to buy second-hand machinery locally. This was considerably cheaper but there was no guarantee of the origin of the equipment. Large items such as trucks and excavators can be traced but it was almost impossible to determine how the borehole pumps on offer had been obtained. Clearly, there is a dilemma here, in that satisfying a short-term need may encourage future thefts, possibly of the very same items again. Likewise, the decision to buy on the spot automatically creates another class of project beneficiary: the local businessman who may immediately start working the system that he knows to his own advantage.

Involving the community?

Close pre-disaster links with the community are vital in understanding the needs and developing appropriate responses.[11] Such links seldom exist in relatively sophisticated societies such as those of Chechnya, so what alternatives are there?

In Grozny, the local staff created a vital link with the city's people. They may not personally have been the worst affected, but every one of them had relatives and neighbours in the vulnerable categories outlined above. They also provided a powerful counterweight to the interests of the administrators and MERLIN's counterparts in the City Hall.

The water needs of urban victims

The most vulnerable are usually interested mainly in returning to their pre-war lives. First of all, they seek sufficient food, shelter, clothing and water. Once these are available, they start to recall the other symbols of luxury which they have lost. Thus, the demand for water will grow as fast as it can be supplied since consumers who are

accustomed to water on demand will expect that state of affairs to be restored. City dwellers with piped water in their own homes normally use, and so will demand, a lot more than the 15 to 25 litres per head per day[9] allowed in refugee camps. For example, in one city in Bosnia, as soon as water was available, the local residents started to wash their carpets and other fabrics. This unexpected, though quite understandable, demand put a major strain on the water-trucking operation.

Sophisticated consumers are also much more cautious about what they drink. The residents of Grozny had suffered poor water quality for years and were used to boiling their water. This probably explains why the anticipated disease epidemics did not materialize. Many people would not take treated water from a local lake because they feared industrial contamination.

Infrastructure rehabilitation: top-down or bottom-up?

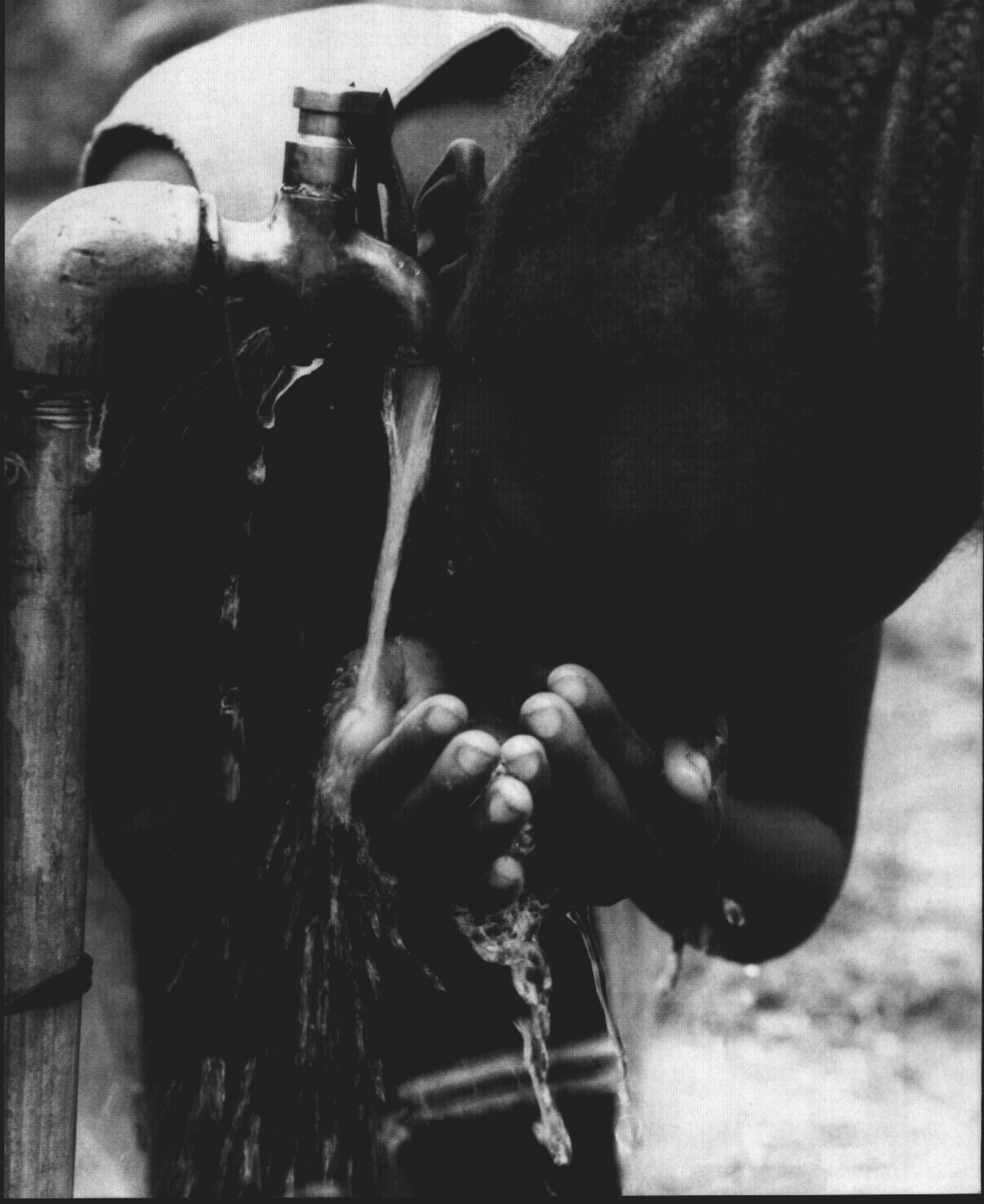
MERLIN's programme set out to support local infrastructure needs during a conflict. It proved difficult to undertake long-term construction work in the confusion caused by changing military circumstances and mutual misunderstandings. Politicians, suppliers of materials, transport operators and local military commanders all had their own agendas and objectives during and after the conflict.

The top-down approach, in which materials are all brought in from elsewhere and the relief agency calls most of the shots, can give rapid results but does not create a sustainable set-up. The materials are unfamiliar and spare parts expensive or difficult to obtain. Such an approach seems to work best for temporary quick-fix solutions which are independent of the established infrastructure, especially just after the disaster.

A preferred approach is the bottom-up one, which provides locally available and affordable materials and equipment to support the efforts of indigenous administrations and technical departments to get water flowing through the pipes. The programme must be objective-oriented and flexible enough to adapt to changing situations rather than driven by some arbitrary time-scale. The aim must be to support long-term community recovery until conditions are sufficiently settled for commercial firms to resume work (as is now happening in Bosnia, for example).

Careful investment of time in selecting and training local technical staff helps to maximize the support that can be given to the utility company, is vital in ascertaining the real needs of victims and eases the eventual handover to the community.

10 R.L.P. Hodgson, D. McCauley, "Logistical advantages and disadvantages of the local purchase of relief goods", *Proceedings of the 12th International Logistics Congress*, Athens, 1996, pp. 141-164.
11 R.L.P. Hodgson, "Community participation in emergency technical assistance programmes", Technical Support for Refugees, *(Proceedings of the 1991 Conference)*, ed. R.A. Reed, WEDC, 1993, 68pp.
12 See Les Roberts, p. 96.



Mary Daly is a public health physician with 17 years' experience in clinical medicine, health systems research and community development in southern Africa. She is currently deputy programmes director for Development Workshop, Angola.
Carlos Figueredo is an agricultural engineer with many years of experience in rural community development and agricultural systems research in Angola. He is currently field director for Development Workshop in Huambo

inheriting a water project

Angola: Development Workshop inherited an emergency water project from the ICRC in 1998. Mary Daly and Carlos Figueredo suggest how the transition from emergency management to sustainability can be accomplished smoothly.

Development Workshop[1] (DW) "inherited" an emergency water project in Angola from the ICRC at the beginning of 1998. We deliberately use the word "inherit" because the transfer of responsibility for the project included the transfer of trained staff, vehicles and equipment. A common donor, Swiss Humanitarian Aid (SHA), facilitated the transfer of project management from the ICRC to DW. When SHA requested DW to assume continued management of the project, it clearly indicated that it attributed major importance to the introduction of strategies which would ensure sustainable management of the water points in the long term.

The district (municipal area) of Huambo is in the central Planalto area of Huambo province. Annual rainfall averages 1,200 mm, with rain occurring between September and April (see graph: 1996-97, dry year, and 1997-98, heavy rain). Normally, sources of water are limited during the last months of the dry season and the early months of the rainy season. During this time people walk long distances and wait for long periods to collect water and many communities experience conflicts over access to water.

Many rural and peri-urban residents of these areas have wells in their yards and there is also a significant number of "public wells". Normally, there is an abundance of water during the period from November to June. But most of these water points are not protected and constitute a source of disease transmission, reflected in a high incidence of diarrhoea, with frequent mini epidemics in the villages during the rainy season.

The prolonged conflict in Angola has affected the Planalto area consistently and more severely than other areas since 1980. There are constant population movements and increasing population concentration in the immediate surroundings of Huambo city. The city water system has been destroyed. In many villages, bodies were thrown down wells, and in some cases prisoners were incarcerated in wells until they died.

The ICRC's emergency action: a classic response

The ICRC built 80 water points, 8 sources and 72 wells in one year. Given the situation, the speed at which the work was completed was spectacular. Wells were dug to a depth of 5-15 m; the majority of wells were 8 m deep. They were lined with concrete rings, reinforced with iron and covered with a reinforced cement lid. The pumps used had been manufactured by Van Reekum, mostly of the model type SWN 80.

The well construction – digging the wells, putting in place the concrete rings, lids and pumps – was done by local ICRC teams and managed by expatriate technicians. A theatre group was created to improve communication with the beneficiary population.

Development Workshop action

The ICRC project manager effected the programme handover, with an agreement on the subsequent transfer of equipment. The ICRC field team's clear commitment to a smooth programme transfer was crucial to its success.

DW began by negotiating a project agreement with the Provincial Directorate of Water (PDW). Under this agreement, the PDW provided the workshop space for preparing the materials for the well construction and also agreed to provide office space for the water project teams. The DW team reviewed the 80 existing water points. Twenty-four were empty or contained less than 1 m of water in the dry season. This was because they had been built when the water table was high and because 1996-97 was a relatively dry year. Those water points were rehabilitated for use in the dry season.

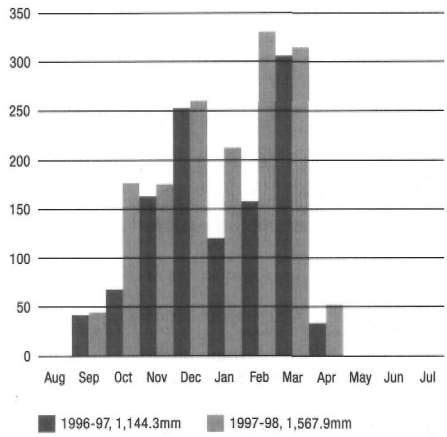
The technical modifications introduced by DW were as follows:

- Afri-Dev pumps were used instead of Van Reekum ones, as they were considered easier to mount and more straightforward to maintain, thereby facilitating user participation. They were also cheaper.
- The well design was modified to include an inspection lid. When the pump breaks down, the users can then collect water manually with buckets.

DW consistently emphasizes the importance of preparing users in order to achieve sustainable management of infrastructure and service projects. The role of local authorities in arbitration and regulation is also significant. In Huambo, the project began with the training of a team of "social mobilizers" to work with the user communities and their local authorities. The working model was modified on the basis of experiences of working with community water projects in peri-urban Luanda. Communities participate in the selection of sites and are responsible for digging the well either by paying for the labour or by contributing their labour to dig the well. In practice, most user groups opted to pay teams which had previously worked for the ICRC to dig the wells. The cost for the community varies between US$ 300 and 500. Initially, many communities were opposed to the idea that DW intervention was conditional on their active participation. They argued that "ICRC teams had built the wells for nothing for them and why should this new organization require them to contribute?" The mobilizers opted for the following negotiating position: "the ICRC had indeed built 80 wells but 20 of them were non-operational and had been effectively abandoned by the users because

1 Development Workshop is a Canadian non-governmental organization (NGO) which has been based in Luanda, Angola, since 1980. It implements programmes in conjunction with local NGOs and government agencies.

Rainfall in Chianga, Huambo (in mm)



What the ICRC did in the Central Planalto, Angola, May 1995 to December 1996

- Rehabilitated the Kulimahala water treatment station.
- Ensured an autonomous water supply for Huambo hospital, with internal water distribution.
- Sunk 72 wells and rehabilitated 8 springs in the municipality of Huambo.
- Built or rehabilitated 160 water points (springs and wells) in 22 municipalities of Huambo province.
- Rehabilitated the gravity-fed water supply in the towns of Caala and Bailundo.
- Built or rehabilitated 25 water distribution points and washing areas in Caala.
- Rehabilitated the secondary water distribution network in Bailundo.
- Built or rehabilitated 60 water points in Kuito,Kunje, Chinguar and Calucinga (Bié province).
- Rehabilitated 2 gravity-fed systems in Ganda and Alto Catumbela (Benguela province).

Special attention was paid to recruiting and training the maintenance team to repair hand-pumps which had been installed in the past (under a UNICEF-funded project) or were currently being fitted on new ICRC public wells or those under repair. However, the ICRC did not provide any logistical support for the programme, which was under the responsibility of the Huambo water board. Selected mechanics and technicians were able to repair and maintain the existing pumps and set up a clear inspection and maintenance schedule.

Encouraging community participation

All ICRC water and sanitation projects undertaken in the Central Planalto were designed in direct consultation with the Community Services Department and the local water authorities. The directors of the communal services of each municipality concerned were fully involved in preparing the sites selected. For each one, they chose between 20 and 30 workers from the community to carry out the agreed rehabilitation work. Each team was generally made up of 5 builders or plumbers and 20 to 25 helpers, who all received food for work and were directly answerable to the ICRC technical teams.

Taking the longer-term view, the project objectives also included training for the sanitation workers provided by the Community Services Department, thereby creating groups of people capable of operating and maintaining the infrastructures being constructed or rehabilitated.

Pascal Jansen has an M.Sc. in water engineering. He worked for two years at the *Compagnie générale des eaux* in Nancy, France, then for several non-governmental organizations in, amongst others, Haiti, Somalia and Ethiopia. He joined the ICRC in 1995 to coordinate water and sanitation programmes in the former Yugoslavia and Angola. Since 1997 he has been based in Nairobi, where he oversees such activities in the Horn of Africa and the Great Lakes.

of fairly simple maintenance problems".

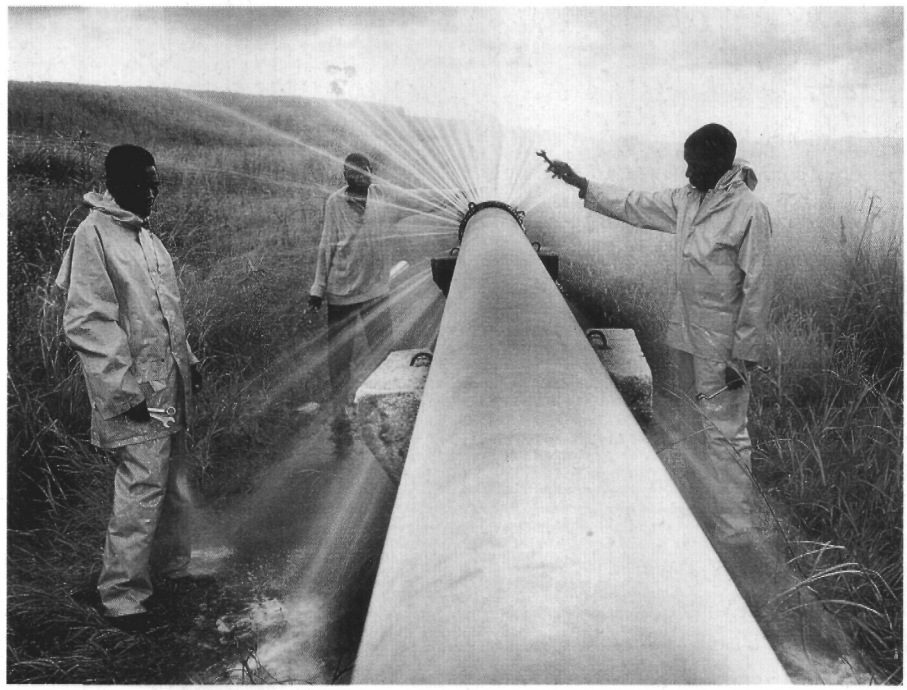
The mobilizers indicated clearly from the beginning that only communities which would accept the responsibility of maintaining their wells could be covered by the project. Local government and the PDW actively supported this position. After one year of experience in Huambo, DW concluded that the community management option for the water points was not only feasible but had already spawned the re-growth of a social capital in these communities which would facilitate other community development interventions.

What makes a smooth handover?

The DW team identified the following elements:

- the obvious commitment on the part of the ICRC project manager to effect an efficient programme handover;
- the excellent training that the national field team had received during the emergency phase of the project;
- the clear mandate from a common donor to make the project sustainable;
- DW, institutionally speaking, has a clearly articulated strategy on sustainable management of infrastructure and services with experience in the field.

The most significant problem encountered was the lack of project preparation for future sustainability. At an institutional level, DW would recommend that the ICRC's design approach to an emergency community water project be modified. The ICRC's interventions will always be ad hoc and short term. In this case, the intervention was a capital investment in a service provision, which should remain operational long after the intervention is over. Hence, the design of the project should be structured to fulfil the demands of its expected function, rather than giving priority to quantitative outputs within a limited time frame. In this case, this would have meant paying more attention to existing information on seasonal rainfall from previous years and being more sensitive to the issue of who would look after these water points following construction. In quantitative terms, one quarter of the investment in wells was lost, but in qualitative terms, the investment in human capital (a trained technical team) was immeasurable.



L. Luzemo / ICRC

The ICRC's water and sanitation project in Caala.

Christine Aziz is a freelance journalist based in the UK, where she is a regular contributor to British newspapers and magazines. She specializes in humanitarian issues, particularly those concerning women, and has reported from Africa, Afghanistan, Iraq and India. She has contributed to *The Afghan Handbook*, published by the International Center for Humanitarian Reporting.

IRAQ

THE WATER TRAGEDY

The sophisticated water installations of Iraq, wholly dependent on spare parts from outside the country, have been laid waste by the years of neglect since the Gulf war. The result has been a catastrophic decline in public health. Christine Aziz, Evaristo Oliveira and Jost Widmer look at the lingering consequences of the war for Iraq and the hopes raised by the UN's "oil-for-food" resolution.

In the name of God, the Merciful, the Compassionate:

"...and We made from water everything alive..."

Surat 'The Prophets', Verse 30, The Koran

incomplete dreams

The Euphrates river sprang from the Paradise of the Old Testament and also watered one of the Seven Wonders of the World, the Hanging Gardens of ancient Babylon. According to classical Greek writers, streams of water emerged from elevated sources to flow down sloping channels that watered the entire Garden.

The Euphrates is an ancient and historic river serving as the primary trade route from India to the Mediterranean sea. It is also the site of one of the world's earliest and most important civilizations – Mesopotamia – located on the grasslands between the Euphrates and its sister river, the Tigris. Time has bulldozed the famous Hanging Gardens, and Babylon and Mesopotamia are now part of modern-day Iraq, but the Euphrates and Tigris rivers still have romantic and biblical associations. However, the reality is far from romantic.

Originating from Turkey and flowing through Syria and Iraq, the Euphrates river joins the Tigris in Iraq and becomes the Shatt al-Arab waterway. The Tigris river, originating from Lake Hazar, becomes the border between Turkey and Syria for a distance of 40 km before entering Iraq and joining the Euphrates.

Ever since man settled in these regions, the two rivers have been the major sources of drinking water for both inhabitants and livestock and have irrigated surrounding agricultural lands. Mesopotamia was probably the first region of the world where humans gained mastery over major rivers. Irrigation and flood protection were vital to farmers who fed the inhabitants of the world's first-known cities built in Mesopotamia more than 5,000 years ago. This was generally a matter as simple as the element's formula of H_2O, until the complex world of the 20th century developed, with its fast-growing populations and increased demand for water. Iraq's solution was to invest in highly sophisticated water-treatment and pumping facilities, thus creating a dependency on imported technology and engineering skills. Prior to the Gulf war the country was in the process of updating its water system and had begun constructing new treatment plants to replace outdated plants built in the '50s and '60s. It was an expensive solution, but money was no obstacle for one of the richest oil-producing countries in the world – until 1990.

An emergency without precedent

The Gulf war severely damaged Iraq's infrastructure, interrupting the power supply and consequently the operation of pumping and treatment facilities. The new plants remained nothing more than incomplete dreams. Within a matter of weeks an emergency without precedent was created, with millions of people lacking safe drinking water. The imposition of sanctions by the United Nations in 1990 meant that the situation could only get worse, artificially prolonging the effects of war.

The task that confronted the humanitarian agencies in Iraq was daunting. Raw sewage spilled into major rivers. In Baghdad both sewage and treatment plants for the city ground to a halt during the first week of the Gulf war for want of electricity. In 1991, a Harvard study team reported[1] that at least twice as many children were being admitted to hospitals with gastro-enteritis as before the war, and of these twice as many

died. Typhoid and cholera became epidemic. A vicious circle had been created that has not yet been broken; most Iraqis lack the resources to ensure a proper diet for themselves and their families despite government subsidies, thus making them vulnerable to diseases carried in contaminated drinking water, which in turn are difficult to treat because of the ongoing scarcity of drugs and equipment. In 1989, approximately 5% of water in Iraq was found[1] to be contaminated. By 1996 this figure had risen to 35%.[2]

Lack of drinking water immediately after the war was the direct result of electricity shortages and the situation is getting worse. The low availability of power – averaging 50% in rural areas – is severely affecting food production. Frequent cuts and unstable supply place additional strain on the installed electrical equipment, leading to premature deterioration. A recent UN statement observed that a staggering $10 billion[3] would be needed to re-establish electricity – far beyond the means of UN Resolution 986.[4]

"Looking at water alone does not give the full picture," stressed Mr Jost Widmer, an ICRC water and sanitation engineer based in Baghdad. "The water industry is entirely dependent on electricity. It is difficult to return to the standards that were set before the Gulf war, even though actual damage to the water facilities was very limited, because of the lack of power."

The ICRC's emergency water programme, shared with a number of humanitarian agencies, began in Baghdad and was extended to several towns in the provinces, later expanding to rural areas. Mr Faris A. Asam, section director of the Baghdad Water Authority, succinctly outlines the practical difficulties that are constantly encountered, regardless of good intentions and the careful planning of long-, medium- and short-term objectives. "The Karkh water treatment plant provides drinking water to 70% of Baghdad's population... production conditions are far from ideal and every day we run up against a number of problems, the main one being how to obtain sufficient spare parts. Then there is the problem of purity of our chemicals: the ones we use to purify the water contain around 30 times more impurities than before the embargo, and this damages the alum and chlorine dosing equipment which subsequently requires more maintenance. Another huge headache is that of sewage plants: we do not have the funds to maintain them properly. The effluent produced is contaminated and should not be in the river: so the quality of the water downstream from Baghdad is really bad. You have to see the whole water-treatment process as a continuous one: if one link in the chain breaks, the whole thing breaks down."

A recent (1997) UNICEF/government of Iraq survey on the availability of water and sewage systems reported that more than half of the rural population did not have adequate access to potable water, while for sewage disposal some 30% of the total population, predominantly in the rural areas, were without adequate services. Much of the waste is discharged directly into rivers and streams, so that much of the supplied water is contaminated or below acceptable standards.

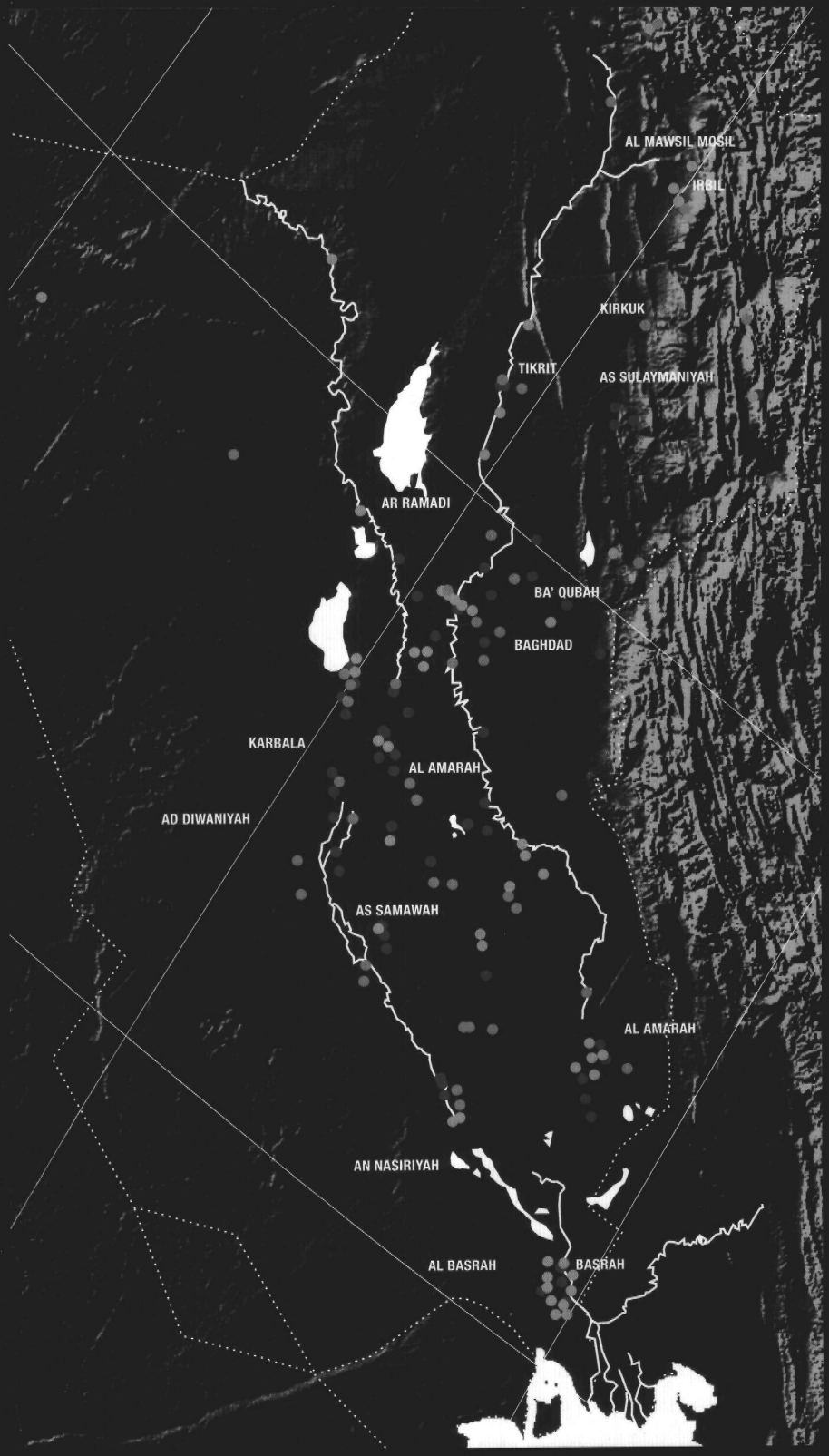
According to Professor Tony Allan, a Middle East water expert at the School of Oriental and African Studies in London, the nature of a country's water policy prior to war will determine to some extent the problems that follow. "The weakness of the Iraqi position with respect to its use of land and water was expressed in 1990. By then it was importing 90% of its food and not using its water wealth to secure food security."

Suddenly Iraq was faced with an urgent need to produce its own food. Surely with so much water around this would not be difficult? Professor Allan points out otherwise. "The misconception of the lowlands of the Tigris, for example, is that if there were to be sufficient water it would be easy to develop productive agriculture. In fact, the soils of both Syria and Iraq are poor and very expensive to reclaim for irrigated agriculture. Both countries spent huge sums in the '70s and '80s on trying to reclaim land without success. The incentive now for Iraq in the present crisis is much higher and it is likely that in the present stressful circumstances, more progress will be made in land reclamation and increasing productivity of both land and water."

An FAO/WFP[5] Food Supply and Nutrition Assessment Mission to Iraq reported that an estimated 2.76 million hectares were planted to cereals in 1997 –

A recent UN statement observed that a staggering $10 billion would be needed to re-establish electricity – far beyond the means of UN Resolution 986.

1 Given the difficulty of obtaining reliable information on this subject, such figures should be treated with caution.
2 United Nations Children's Fund/Ministry of Health, 1996
3 One billion: one thousand million
4 See Evaristo Oliveira and Jost Widmer, p. 78.
5 FAO/WFP: Food and Agricultural Organization/World Food Programme



Iraq

Location of ICRC projects since 1995

- Programme 1995
- Programme 1996
- Programme 1997
- Main rivers
- Boundaries

The boundaries on this map do not imply official endorsement or acceptance by the ICRC.

some 13% lower than in 1995 (previously the lowest year since 1991). The Mission also observed large unplanted areas in central and southern regions, particularly in the Al-Kut area, where some 300,000 hectares of previously reclaimed, cultivated land have been abandoned owing to rising soil salinity and lack of irrigation water, farm machinery and inputs such as fuel and fertilizers. Increasingly, the tendency to food production has led to competition between the legitimate needs of agriculture and the supply of drinking water. "We very often have to see the government's Irrigation Department and we all have to fight to get what each water sector needs," Mr Widmer said. "And it's getting worse because of the electricity shortages combined with manpower shortages and lack of funds."

A massive rations programme provided by the government of Iraq has prevented widespread malnutrition and starvation and reflects a policy that one foreign aid worker referred to as "the government will do it for you" attitude. This can lead to difficulties for programmes that require a certain amount of initiative and independence. "There is an attitude prevalent in the Middle East that the government will do it for you, and that replace is better than repair," observed Yvonne Klynman, Programme Officer in Iraq for CARE International. "Agencies like ours cannot overcome this. It's a long battle in these water projects to try and get across to the engineers that maintenance is better than replacing and that they don't have to have someone standing over them telling them what to do."

In 1994 CARE stopped working in the north of Iraq to concentrate on the south where the need appeared to be greater. The shift led to a greater focus on self-help within the community. The agency already has an established record in the rehabilitation of water-treatment plants, but sees increasing value in working in schools and directly with the community. In conjunction with UNICEF, it is carrying out an integrated water project which works through the local People's Council in order to involve residents in the maintenance of rehabilitated sites and is working in 50 schools. "The focus here is on latrines and drinking water," Ms Klynman said. "We are developing integrated projects in which we principally improve the sanitary conditions in schools and have health-training linkages between schools and health clinics. You can't teach children who are constantly being ill because of sub-standard water."

Money, which once flowed as fast and as free as the Euphrates in Iraq, is now as valuable a commodity as water. Restrictions on the sale of Iraqi oil and the freezing of the country's assets has meant that any rehabilitation is dependent on the generosity of donors. "The problem is that Iraq's water problem does not have the same appeal as Africa for example. Most people in Baghdad have water piped into their homes and this does not have the same appeal to donors as village pumps," Ms Klynman said. The oil-for-food agreement also led to the mistaken belief that the Iraqis are no longer suffering and in need.

There are many factors in Iraq that affect attempts to bring water to domestic taps and agricultural land. Most are related to the events of the last eight years, but other factors operate regardless of war and sanctions. Population growth has increased the demand for water. Since the Gulf war the population has risen from around 17 million to 22.9 million. "The Middle East has had to cope with rapidly rising populations since the middle of the 20th century and Iraq is no exception," Professor Allan said. "When Iraq was oil rich, this increase was not a significant challenge. With the new economic restraints of the 1990s, the demographic challenge has been very serious because food importing and infrastructural developments are no longer possible."

The steady rise in Iraq's population is unlikely to be constrained; President Saddam Hussein's last known edict on family planning was made in the '80s and emphasized spacing of children, rather than the promotion of smaller families.

Another factor which remains on the sidelines for the time being is the sharing of the waters of the Tigris and Euphrates between Turkey, Syria and Iraq. This is a cause of tension between the three countries which continues to simmer.

Irrespective of the wider political implications, individuals like the ICRC's Widmer have to confront the problems of water in Iraq on a daily basis. Going to the heart of the matter, he said, "Our water and sanitation team should not have to be here at all."

Evaristo P. Oliveira is a water and sanitation engineer, seconded to the ICRC by the Canadian Red Cross Society for the past three years. He has carried out three very different emergency assistance missions, in Bosnia and Herzegovina, Angola and Iraq. He has just completed his mission to Iraq, which lasted 19 months.
Jost Widmer has been working as a water and sanitation engineer with the ICRC since 1987, and has carried out missions to Ethiopia, Angola, Irian Jaya, Iraq, Malawi and Yemen. His main area of expertise is water supply in towns and prisons. He has followed the ICRC's water and sanitation programme in Iraq since 1993.

"Oil-for-food": too many expectations

UN Resolution 986 was never really supposed to be the long-term solution to needs in Iraq, but expectations ran high and the disappointment runs deep.

In 1997 a major development broke the stalemate over UN Resolution 986 ("oil-for-food"), drawing much attention from around the world. Under the agreement, known as a Memorandum of Understanding (MoU), Iraq was able to make purchases out of oil revenues fixed at US$ 2 billion for a six-month period. These purchases were limited to articles which could alleviate the plight of the Iraqi population, and were to cover part of the essential needs in terms of nutrition and health, and in the water and sanitation sectors. The operation had to be quick and efficient.

As far as water and sanitation materials were concerned, some US$ 40 million was used under the first MoU and its subsequent six-month extension. This amount was divided more or less equally between the Kurdish north and the rest of the country. According to a census carried out in 1997, the population in the north is estimated at 3.5 million, out of 22 million in the whole of Iraq.

From the day of signature of the agreement until the first items were delivered, over 16 months elapsed. Then the National Water Board office was suddenly caught up in a frantic whirl of drawing up the long list of items to be ordered (this was the Iraqis' first opportunity in over six years to buy equipment). To do this, it took the bulk of the information from an existing data base which had been set up by UNICEF[1] and CARE International on the basis of information from most of the 1,500 water-treatment plants across the country. Obviously, the needs outstripped the means, and priorities were set. However, planning proved to be extremely difficult. All contracts had to be approved by the UN Sanctions Committee and coordination

difficulties were common. As for the provincial water boards, they never had a clear idea of what to expect until the day of delivery *in situ*: this usually made installation planning very difficult, and they were still expected to adhere to a strict time-frame.

At international level, many of those concerned thought that the initiative would go a long way towards solving the humanitarian issue. A high-ranking official from ECHO[2] concluded a visit to Iraq at the time by announcing an end to funding from August 1998. Today, ECHO's position has changed and the financing of humanitarian organizations in Iraq is to resume, with a shift towards the centre and south of the country.

Already in the first stages of the agreement, the ICRC water and sanitation engineers predicted that certain aspects of the implementation of such a programme would require serious consideration: a realistic time schedule, a choice of equipment in line with the practical goals to be reached and installation of the material. The ICRC knew from experience that the procurement process, including Sanction Committee clearances, averaged six to nine months even without any delays. It was also aware that the choice of materials would have to be very wide to provide a significant and simultaneous solution to the problems of water quantity and quality across Iraq (and well beyond the scope of the MoU). Lastly, it knew that "proper" installation by the provincial water boards would be nearly impossible in many of the plants receiving materials.

The second consideration deserves particular attention. The process of treating water consists of successive stages involving filters, different groups of pumps, chemical dosing equipment, control valves, etc. Under the MoU, hundreds of pumps and chemical dosers and tonnes of chemicals were purchased. However, it must be borne in mind that the weakest link in the chain determines its strength. A large number of the water-treatment plants which received equipment still see no significant improvement in quality since, for instance, the filters and settling equipment were not touched. In many cases, the new equipment simply enabled a larger quantity of unsafe water to be produced. It is a little like having 20 tyres with which to repair 20 cars: either 5 cars are completely restored or 10 with only 2 tyres each... Although this is a simplistic view, the results are often similar. In addition, the installation problems are obvious: no tools, a lack of experienced technicians, poor logistics.

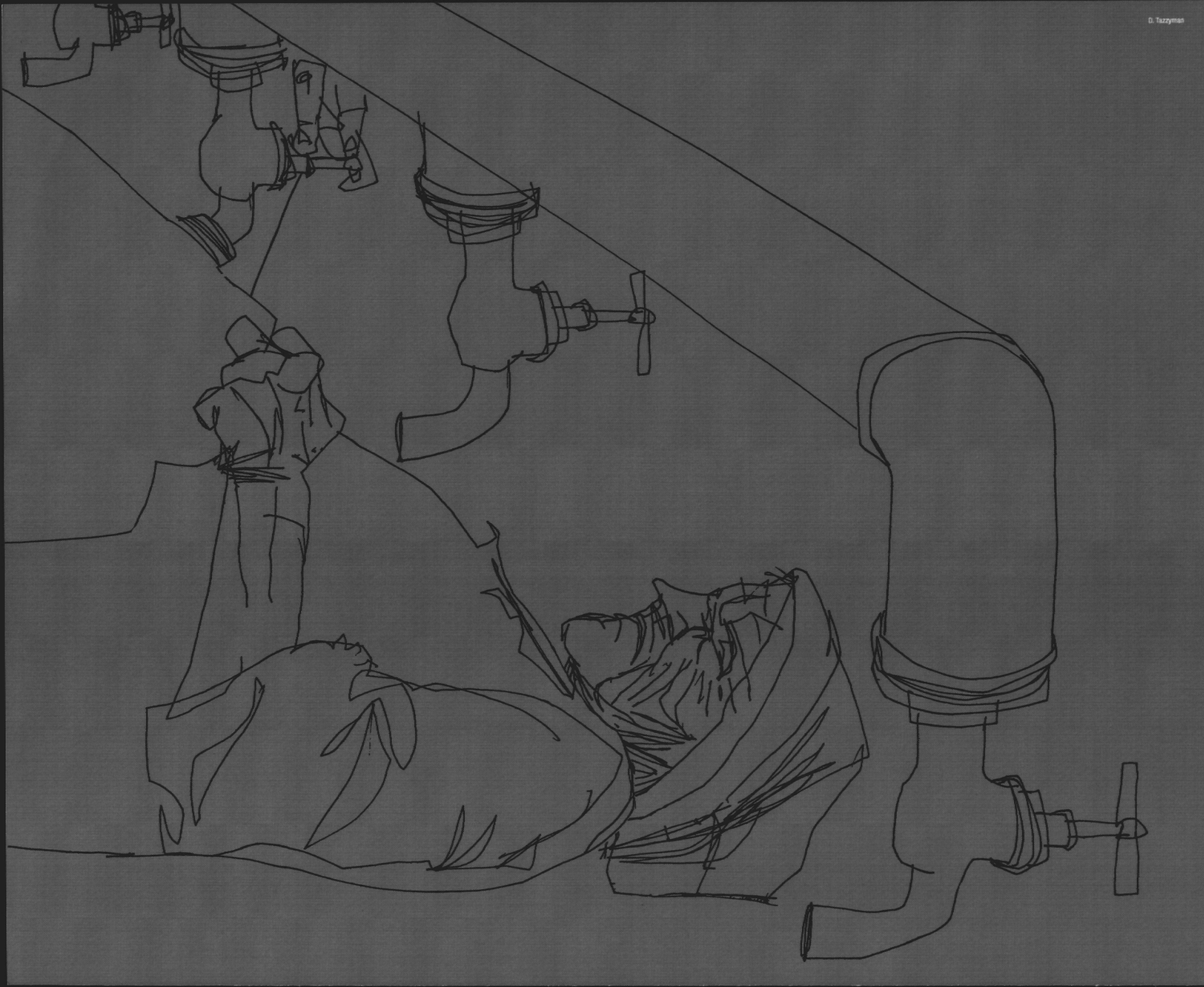
Last but not least, the national water and sewage infrastructure has now been deteriorating at an accelerated pace for several years. The oil-for-food resolution cannot possibly respond to all the growing needs in all sectors, nor was it ever supposed to. The reasons are many: revenue from oil sales is still less than one-fifth of what it was before 1991. Implementing all four phases of the resolution since 1996 has been slower than expected: by July 1998 only 6% of all water and sanitation equipment ordered had reached its destination. Production of crude oil is limited and this sector also needs to be properly rehabilitated before the allowed quota is reached. Just bringing the equipment into the country does not solve the problems: it needs to be properly installed and backed up by more general work on the existing equipment and stuctures: the "human" infrastructure will therefore be severely tested. Finally, despite the adoption in February 1998 of Resolution 1153 raising the limit on sales from US$ 2 to 5.2 billion, revenues under the fourth phase will probably be much lower than expected.

The UN agencies involved are aware of the above and have taken action to speed up the procurement process. Recommendations have been made for an integrated inter-sectorial approach so that an effective impact can be achieved. This approach requires a great deal of planning, outside expertise and, above all, a commitment from the international community. Nobody is able to predict yet to what extent that commitment can be obtained. Given the present situation, the best that can be hoped is that consecutive MoUs will significantly slow down the deterioration.

How the ICRC has adapted to the MoUs

In the three ICRC water and sanitation programmes prior to 1997, some 70% of the budget was spent on pumps. With the implementation of the first MoU, a large number of pumps arrived in the country, and the major obstacle is now that the means to install them properly are lacking. The ICRC is therefore shifting its efforts from supply + installation towards installation (of MoU equipment, too) + repair + maintenance of existing equipment and structures.

1 UNICEF: United Nations Children's Fund
2 ECHO: European Community Humanitarian Office


D. Tazzyman

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Katayon Faramusova is a physician with more than 20 years' experience in health care and public health issues in Tajikistan. She acts as a specialist on disaster preparedness for the Red Crescent Society of Tajikistan. During the typhoid outbreak in Dushanbe and other regions of Tajikistan, she ran the public health campaign, carried out in conjunction with Red Cross/Red Crescent programmes, to educate the public in prevention issues.

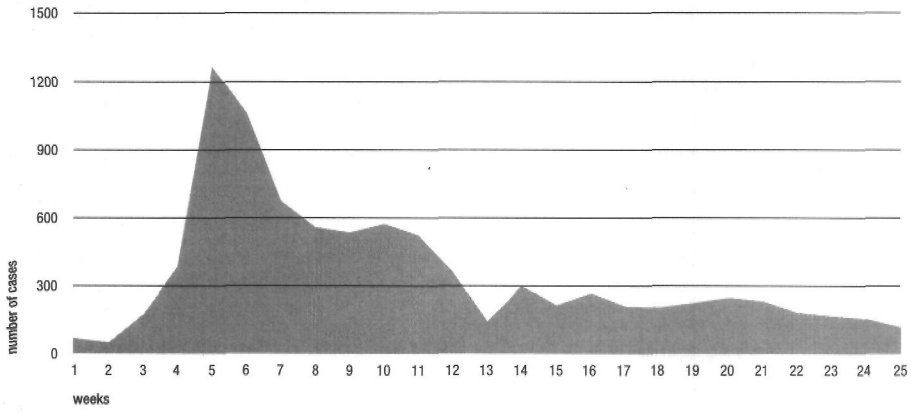
the achilles heel of modern water systems

Les Roberts and Katayon Faramusova explain how cross-contamination problems associated with economic decay can interact with those arising from conflict, citing the example of a major typhoid outbreak in Dushanbe, Tajikistan.

Until the past decade, complex emergencies were generally thought of as involving displaced populations. In some rare circumstances, such as the Biafran conflict, or Mogadishu during the early 1990s, large numbers of people found themselves in dire straits despite the fact that they remained in their homes with all their material possessions. In these cases, the "urban trapped" were a minority of the population in crisis, and the relief community's response was often similar to the approach taken with displaced people in refugee camps. Efforts typically focused on immunizing against diseases that could be prevented with vaccines, nutritional monitoring and food distribution, along with other measures seen as meeting primary needs.

Yet in recent years, in Bosnia, Iraq, Armenia, Chechnya and elsewhere, people have found themselves existing for extended periods with a deteriorating infrastructure and collapsing social and medical services. In Sarajevo during the summer of 1993, diarrhoeal rates were three times higher than pre-war summer levels and hepatitis A rates seven times higher.[1] While such health problems were of secondary importance to the prevailing violence, they nevertheless hint at the anguish associated with living in a city where the provision of water by the authorities had fallen below 2 litres per person per day during the month of July. During 1993, Sarajevo also experienced dramatically lowered fertility rates, as well as increased rates of TB infection and post-operative secondary infections. Each of these morbidity indicators gave a different insight into the various facets of suffering of Sarajevo's urban trapped.

Figure 1 **Number of new typhoid cases per week (January–June 1997)**



Sources: Ministry of Health, Tajikistan; International Federation of Red Cross and Red Crescent Societies, Dushanbe; Centers for Disease Control and Prevention (CDC), Atlanta

The case of Tajikistan

War is not the only cause of protracted social deterioration. Demographic Health Surveys have now been completed in three of the five Central Asian republics. In each case, conservative estimates of infant mortality are two to three times higher than comparable figures less than a decade before. Independence from the Soviet Union has meant economic and social upheaval, but has not involved any outbreaks of violence in these three countries. However, all the Central Asian republics have experienced drastic reductions in income and GNP, as well as an exodus of people with technical training, all of which has driven the process of social deterioration. Only in Tajikistan has the economic decay in Central Asia been accompanied by conflict. The 1992 civil war caused more than 30,000 deaths out of a national population of approximately 5 million.[2] This means that on a per capita basis, the civil war in Tajikistan has been the most violent of any in the former Soviet republics. It comes as no surprise, therefore, that in 1996 several thousand cases of typhoid fever occurred in southern Tajikistan, particularly in the city of Kulyab on the border with Afghanistan.

The relief community was nonetheless caught off guard when a major outbreak of typhoid fever struck in the capital, Dushanbe, during the winter of 1997. This is because typhoid was perceived as a summer disease by local authorities and because services in Dushanbe were believed to be much better than in the rest of the country. Unfortunately, economic constraints resulted in a shortfall of chlorine for water treatment in December 1996, and the outbreak of typhoid began the following month. During the peak of the epidemic, in the last week of January and the first week of February, more than 1,000 cases per week were being reported, with 8,900 cases occurring in the first half of 1997.

1 "Status of public health – Bosnia and Herzegovina, August-September 1993," *MMWR*, Vol. 42:50, pp. 468-77.
2 O. Roy, *The civil war in Tajikistan: Causes and implications*, US Institute of Peace, Washington, DC, December 1993.

This outbreak, perhaps the largest single typhoid epidemic of the past half-century, was not caused by a contaminated water source or food supply as is generally the case in smaller outbreaks, but was instead caused by the deterioration of the city's infrastructure. In particular, it was caused by a process known as cross-contamination.

Cross-contamination

Cross-contamination in a water-distribution system has been well known and studied for decades. As referred to by engineers, it is the process by which hazardous liquids, primarily sewage, are inadvertently transferred into potable-water pipes. This happens under three conditions:

- contamination of the liquids around a pipe from broken sewage lines, latrines, or hazardous materials spread on the surface of the ground;
- a break in a water pipe;
- a moment in time when the pressure inside the pipe is lower than the hydraulic pressure of the contaminated liquid outside the pipe. In most modern systems, water pipes are pressurized to prevent this third condition from arising.

In many cities around the globe, where population growth has been dramatic or water lines and pumping stations have not been well maintained, water cuts[3] have become a daily routine. Not surprisingly, many of the largest waterborne outbreaks documented around the world over the past two decades have been driven by cross-contamination (e.g. typhoid in Dushanbe, Tajikistan, 1997,[4] and cholera in Cape Verde, 1994-97, Guinea-Bissau, 1996,[5] and Trajillo and Piura, Peru, 1990[6,7]).

The ideal situation

In most modern water systems, three measures are taken to ensure that water which is safe and pure when leaving the treatment plant stays that way until it reaches the consumer. The first is to add extra chlorine so that if the water is exposed to an influx of pathogens as it travels through the pipes, the chlorine will be able to kill the microbes before anyone ingests them. The extra chlorine is referred to as free chlorine or residual disinfectant.

The second measure is to keep the water pipes pressurized. This way, if there are cracks in the pipes (which is unavoidable in large systems with many, or even thousands of, kilometres of pipeline) the fluids will move from inside the pipe to the outside and not vice versa.

Finally, sewers are configured to keep sewage away from water pipes. Specifically, sewers should not be pressurized, should be buried in separate trenches from the water-supply lines and, ideally, should be lower than water-supply pipes. Note that either continuous pressure or enough free chlorine to disinfect any contamination is sufficient to protect the water supply. The two measures together ensure protection and provide a margin of security even during the inevitable water cuts or lapses in chlorination.

The situation in many impoverished and war-torn cities

Frequently, several factors conspire against the urban trapped to undermine the protective measures listed above. For example, many urban areas have no sewers and people use latrines. Piped water in the absence of sewers causes vast quantities of water to be conveyed to an area where it often ponds or raises the water table because there is no system to evacuate the water once it is delivered and used. Thus, pathogens in latrines can easily permeate the groundwater and surround water pipes.

Likewise, a lack of funds and personnel diminishes the ability to undertake standard measures to maintain pipes. Pipe itself, or the materials needed to install it, may be in short supply. For example, the city of Tuzla, Bosnia (population 300,000), went without water for more than a week in September 1993 because a main supply line had burst and the authorities did not have access to the fuel needed to drive a truck and backhoe[8] to the site. The aid organization IRC,[9] by providing just 40 litres of diesel fuel, enabled the water service to be re-established. In addition to the difficulties of maintenance, bombs can destroy pipes. Bombings in London during December 1940 and January, April and May 1941 each led to periods of water consumption at least 20% above pre-attack levels, due to panic reactions and use in fire-fighting, with the elevated consumption often lasting for several weeks.[10] Thus, periods of conflict often increase the need for pipe repairs but diminish the ability to complete them.

Next, water cuts are a frequent occurrence in many places at the best of times, either because of electricity cuts, extreme water usage and wastage by the population (such as for irrigation) or

3 Or "outages", in North American parlance.
4 J. Carpenter *et al.*, *Epidemic typhoid fever in Dushanbe, Tajikistan*, CDC, Atlanta, 15 April 1997.
5 A. Rowe *et al.*, *Epidemic cholera in Guinea-Bissau*, 1996, manuscript in preparation.
6 D.L. Swerdlow *et al.*, "Waterborne transmission of epidemic cholera in Trajillo, Peru: Lessonsfor a continent at risk", *Lancet*, Vol. 340, 4 July 1992, pp. 28-33.
7 A.A. Ries *et al.*, "Cholera in Piura, Peru: A modern urban epidemic", *J. of Inf. Disease*, 1992, Vol. 166, pp. 1429-33.
8 A mechanical excavator which draws towards itself a bucket attached to a hinged boom.
9 IRC: International Rescue Committee
10 Abel Wolman, unpublished data.

Sewage entry to waterpipes

The exact means by which the water pressure in a pipe becomes negative and draws in contamination can vary. Leaking and buried water pipes will always lead to saturation of the subsoil around the area of the crack. The level of pathogens in this water depends on the distance to the nearest pathogen source (such as faeces on the ground, a cracked sewer pipe or a latrine), the amount of water that has been leaking from the pipe and the subsoil conditions.

Figure 2 (a)

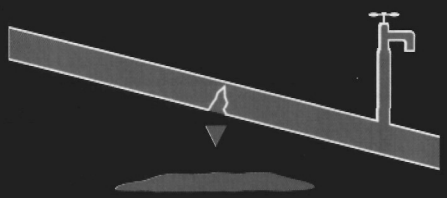


Figure 2 (b)

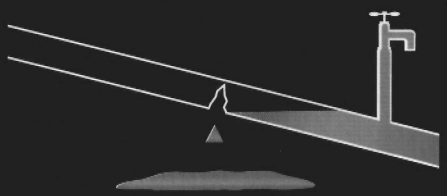
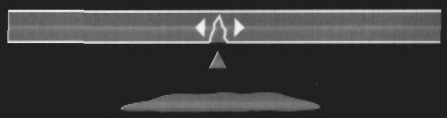


Figure 2 shows three ways in which a vacuum or negative pressure can be created inside the water-supply pipe.

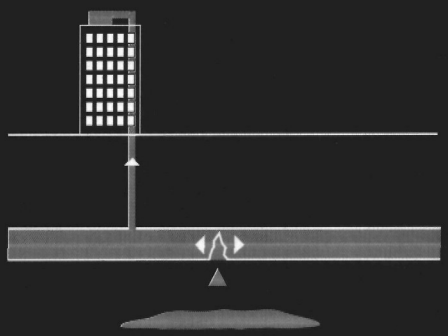
In Figure 2(b), water is running downhill in the pipe and the water level falls below the level of the crack in the pipe. If most of the taps are closed above this point, the descending water draws a vacuum inside the air-filled portions of the pipe and liquids are drawn in through the crack.

Figure 2(c)



In Figure 2(c), water is travelling through a loop in a pipe and the direction of flow is reversed. For an instant on one side of the crack, water is drawn in one direction by momentum while, on the other side of the crack, it is being drawn in the opposite direction. Note that water can never change its direction of movement in a pipe without a negative pressure existing at each point along the length of pipe, at least momentarily. If the change in direction is slow, the negative pressure may be insignificant and lead to little intrusion of liquids surrounding a crack.

Figure 2(d)



In Figure 2(d), a booster pump in a building pumps water directly from the water-supply line to the upper levels of the apartment building, which is above the level which the pressure in the supply line could have reached. Without a pressurized storage tank or a pressure break (such as an open storage cistern), the pressure in the supply line will be negative in the vicinity of the apartment while the pump is in operation.

Thus, a vicious cycle may develop. Because the pipes leak, the authorities do not pressurize the pipes very much. The lack of pressure leads to frequent cuts. The frequent cuts lead to water-wasting behaviour such as leaving the tap on so one can see when the water is running or over-watering a garden in case the water does not flow for a few days. In some buildings, booster pumps may be installed to suck water from the supply pipes. Taken together, these factors create an environment which is ideal for the cross-contamination process.

Dushanbe, 1997

In the 1997 outbreak of typhoid in Dushanbe, epidemiological evidence detailed below showed overwhelmingly that the cause was primarily drinking water.[4] In a case-control study, drinking unboiled water during the 30 days before illness was associated with a sevenfold risk of developing typhoid, while drinking only boiled water was associated with a fivefold reduction in risk. The city was supplied by four water-treatment plants, two of which used a local river for source water and the other two (which constituted two-thirds of the city supply by volume) groundwater. A sanitary evaluation of the water system at the time showed that most areas with the highest attack rates were served predominantly by coliform-free groundwater sources. The level of faecal coliforms coming out of household taps was about four times higher than the flow-weighed average levels in finished water leaving the four water-treatment plants. Because faecal coliforms do not usually grow in pipes, especially at 5°C, it was clear that faecal material was entering the water supply after it left the water-treatment plants.

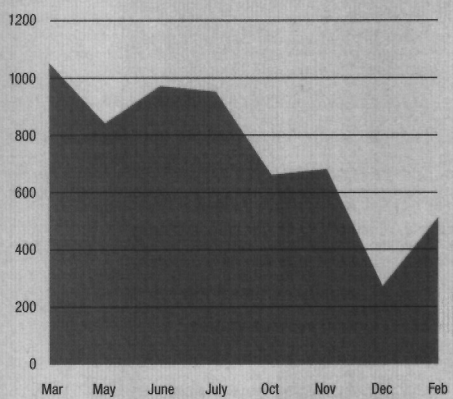
Sanitary surveys of one-hectare areas, which included interviews and inspections of three households per area, were conducted at 28 locations throughout the city. These spots were selected by randomly choosing two latitudes and longitudes within the confines of each of the 14 health clinic catchment areas in Dushanbe and then going to those coordinates guided by a GPS (Global Positioning System) Unit. Residual chlorine and faecal coliform levels were quantified at each hectare. These investigations showed numerous insanitary water-pipe connections with small-diameter water pipes often lying in the ditches which carried waste water away from neighbourhoods. In each household, interviewers quantified the amount of water which was running in broken toilets, taps or pipes, and the amount that was being wasted simply because people neglected to turn off their taps. The residents of Dushanbe were wasting an estimated 1,050 l/p/d (litres per person per day). Of this waste, about 650 l/p/d occurred in the home, with the remainder in communal areas within the hectares surveyed. Both within the home and in public areas, more than a third of the water wastage could have been prevented simply by turning off a tap. Thus, in Dushanbe at the time of the outbreak, water wastage accounted for approximately 80% of total municipal water production.

At the time of the outbreak, an estimated 11% of households experienced water cuts on a given day and many more experienced periods of very low pressure. In this setting of extreme water wastage on the part of the residents, it is likely that most of the water intermittency can be attributed to excessive use rather than shortfalls in system capacity.

Several international aid groups responded to the outbreak in Dushanbe with both technical assistance and material support for the local water utility. The International Federation of Red Cross and Red Crescent Societies and GTZ[11] took on leading roles to coordinate the international effort to diminish Dushanbe's susceptibility to waterborne outbreaks. Pumps were purchased and repaired to increase water pressure. Chlorine and coagulant were supplied to ensure proper chlorination. For a period of approximately two months following hyper-chlorination of the distribution lines and the re-establishment of proper chlorination on 4 April, the incidence of typhoid remained unchanged at approximately 300 cases per week. On 5 May, a month after chlorination had been "back to normal", only 5 out of 14 sentinel sampling sites in Dushanbe had even 0.1 mg/l free chlorine. In this setting, chlorination alone, as conducted by the utility in Dushanbe, was not sufficient to curb the waterborne outbreak.

To complement these efforts, the Federation has been undertaking a broad-reaching programme to promote water conservation and home treatment of drinking water. The programme has included television advertisements, the production of brochures, the writing of songs by famous regional musicians and presentations in schools. One facet has been the monitoring of household water wastage. Figure 3 shows the amount of household water wastage over time, displayed in litres per person per day.

Figure 3 **Water wastage, Dushanbe** (March 1997 – February 1998) in litres per person per day



Source: International Federation of Red Cross and Red Crescent Societies, Dushanbe

Of note is that the Federation's programme appears to have cut household water wastage by half in less than a year. Levels of typhoid in Dushanbe have been dramatically lower in 1998 than they were in 1997. Whilst it may not be prudent to attribute the reduction solely to this creative programme, it is nevertheless likely to have made a significant contribution.

because too many people are served by too little water. In some cities, the pipe diameters are so constricting, or the water source is so limited, that scheduled cuts occur daily.

Finally, many otherwise intelligent but only partially informed authorities feel that adding too much chlorine is bad for people's health.[12] In their minds, the chemical risks perhaps even outweigh the microbial risks associated with not chlorinating. In other areas, chlorine may be in short supply. Thus, free residual chlorine levels in many impoverished cities are woefully inadequate.

Preventing cross-contamination

The fundamental building blocks of a safe urban water supply are:

- successful water treatment;
- a chlorine residual in the distribution system;
- maintaining pressure in the distribution system.

How to achieve each of these steps varies from place to place and depends on the quality and constraints of the existing piped system. Of note is that most university courses and NGO programmes focus on initial water-treatment methods, yet it is often mainly shortcomings in the distribution system or contamination of water after collection that cause disease.

Maintenance of a chlorine residual in a distribution system is primarily a function of the total dose of chlorine at the water-treatment plants. At the onset of an emergency or during its acute phase, adding enough chlorine during treatment so that free residual chlorine can be measured at the end of the distribution system is the easiest and most practical measure to be undertaken. Proper flushing of the water-distribution system in order to "slough off" excess bacteria and other microbes which have built up inside the pipes can reduce the chlorine demand in the system and increase the level of residual chlorine. Proper system flushing can also extend the life of the water pipes, thus cutting down on breaks and leaks. In some settings, the addition of less reactive and more persistent residual disinfectants, such as chloramines, has helped maintain a residual throughout the system.

The maintenance of pressure throughout the distribution system is more complex. It depends on the driving force of the pressure (either pumps or gravity), and increased pumping capacity at the source or booster stations can usually result in increased system water pressure. Moreover, reductions in consumption (either intentional or through leakage) can usually result in increased system water pressure. Finally, pipe sizes throughout the water-distribution system control how much water can be delivered down a specific branch. Thus, undersized pipes attempting to meet too much demand can perpetually lead to insufficient water pressure in spite of increased pumping at the plant or decreased consumption among consumers.

To summarize, the specific water-supply measures that can reduce cross-contamination events are as follows:

- increasing the dose of chlorine at the plant;
- increasing system pressure by raising pumping capacity;
- flushing the water system to decrease chlorine demand;
- decreasing water consumption by the end-users;
- repairing leaks in pipes;
- replacing lines which are of insufficient capacity.

This list is generally in the above order of priority during an emergency because the top three measures are the quickest, often the most effective, and perhaps the least expensive.

11 GTZ: German Technical Cooperation

12 Studies in Western nations have associated the long-term consumption of chlorinated water with elevated rates of bladder cancer and some adverse reproductive outcomes. Yet these outcomes are relatively rare, perhaps affecting only a few individuals per million people exposed.

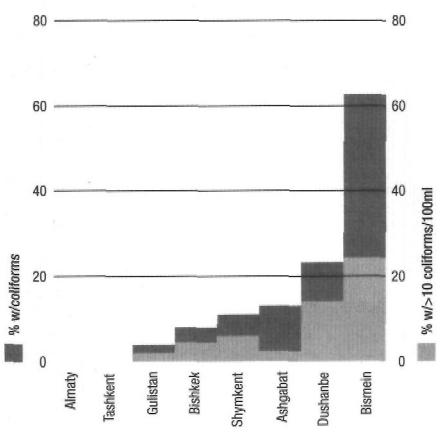
Table 1 **Sanitary evaluations in Central Asian cities (February – April 1998)**

	Almaty	Tashkent	Gulistan	Bishkek	Shymkent	Ashgabat	Dushanbe	Bismein
Sample population	2399	3208	1743	8127	1397	2434	2470	1090
Cuts in past 24hrs	0.6%	5%	16%	15%	1.3%	33%	11%	26%
Days of cuts in past month	1.1 days	1.6 days	8.3 days	1.3 days	0.4 days	6.1 days	4 days	7.2 days
Litre per day water production	280	750	250	420	400	700*(500)	1200	**
Litre per day household water wastage	64	173	57	205	168	290	1050	78
Pop. with chlorine at tap	99.8%	99.7%	70%	82%	16%	68.7%	0% (3/97) 5% (5/97)	0%
Percentage who boil water	48%	73%	92%	54%	74%	67%	75%	52%
Cost: US$/m^3	0.11	0.019	0.20	0.056	0.07	0.026	**	**
Risk of illness from cross-contamination	low	low	moderate	moderate	moderate	high	high	high

* denotes the amount which actually reaches the homes

** local authorities did not have this information

Figure 4 **Percentage of population drinking faecal coliforms by city**



Sources: CDC coordinated surveys, winter 1998

How other Central Asian cities measure up

Between February and April 1998, sanitary evaluations like those done in Dushanbe the year before were conducted in seven Central Asian cities by local officials in conjunction with scientists from the US Centers for Disease Control and Prevention (CDC). Included in the surveys were the four other Central Asian capitals. The results are presented in Table 1.

A couple of points are worth noting in this table. The only two cities which managed to have a chlorine residual throughout the distribution system, Tashkent and Almaty, were the only cities visited which had a regular system for flushing the supply lines. There also seemed to be an association between the cost of water and the safety of a supply.

Perhaps most important is that the conditions which promote cross-contamination seem to be rather widespread in Central Asia. While Dushanbe is on the less sanitary end of the spectrum, in terms of frequency of water cuts and the prevalence of residual chlorine, Bismein and Ashgabat, Turkmenistan, and perhaps Gulistan, Uzbekistan, are worse off than Dushanbe was in the spring of 1997. It is probably no coincidence that Bismein and Ashgabat are the only cities among the seven visited which have experienced typhoid outbreaks in the past two years.

Figure 4 shows the percentage of the population with faecal coliforms in their drinking water, and the percentage consuming >10 faecal coliforms per 100 ml. Comparing Figure 4 with Table 1, there is a strong association between the presence of cross-contamination risk factors (intermittency and no chlorine residual) and the proportion of people drinking contaminated water. Tashkent, Bishkek, Shymkent and Bismein use only coliform-free groundwater sources, while the other four cities rely partially on surface water. Of particular note is the fact that there is no correlation between the use of contaminated sources and the proportion of the

population receiving contaminated water.

When no chlorine was measured in a household during the surveys, a water sample was taken for faecal coliform analysis. Because the team was unable to process large numbers of microbiological samples, usually only one sample was taken per hectare when no free chlorine was detected. On 15 occasions, coliform sampling was done at more than one location within the same hectare. In six of those neighbouring samples, one household sample was positive while another was negative, and in two instances, the differences were too large to have occurred by chance (0 versus 11 and 0 versus 12 coliforms/100 ml). Moreover, most areas with positive coliform samples were hectares with single-family dwellings. These two points imply (but do not prove) that cross-contamination frequently happens at the final branches of a distribution system, perhaps even the private lines leading from the pipes in the street into the home.

Throughout Central Asia, urban water utility and health workers put a great deal of effort into monitoring water treatment, and generally treatment is done relatively well. Less attention is usually paid to household tap chlorine levels and, not by chance, chlorine residuals are not so well maintained in the region; local officials are often greatly mistaken about household chlorine levels. No monitoring of the frequency of water pressure cuts is carried out and it is no coincidence that water cuts are the primary threat to urban drinking water safety in the region.

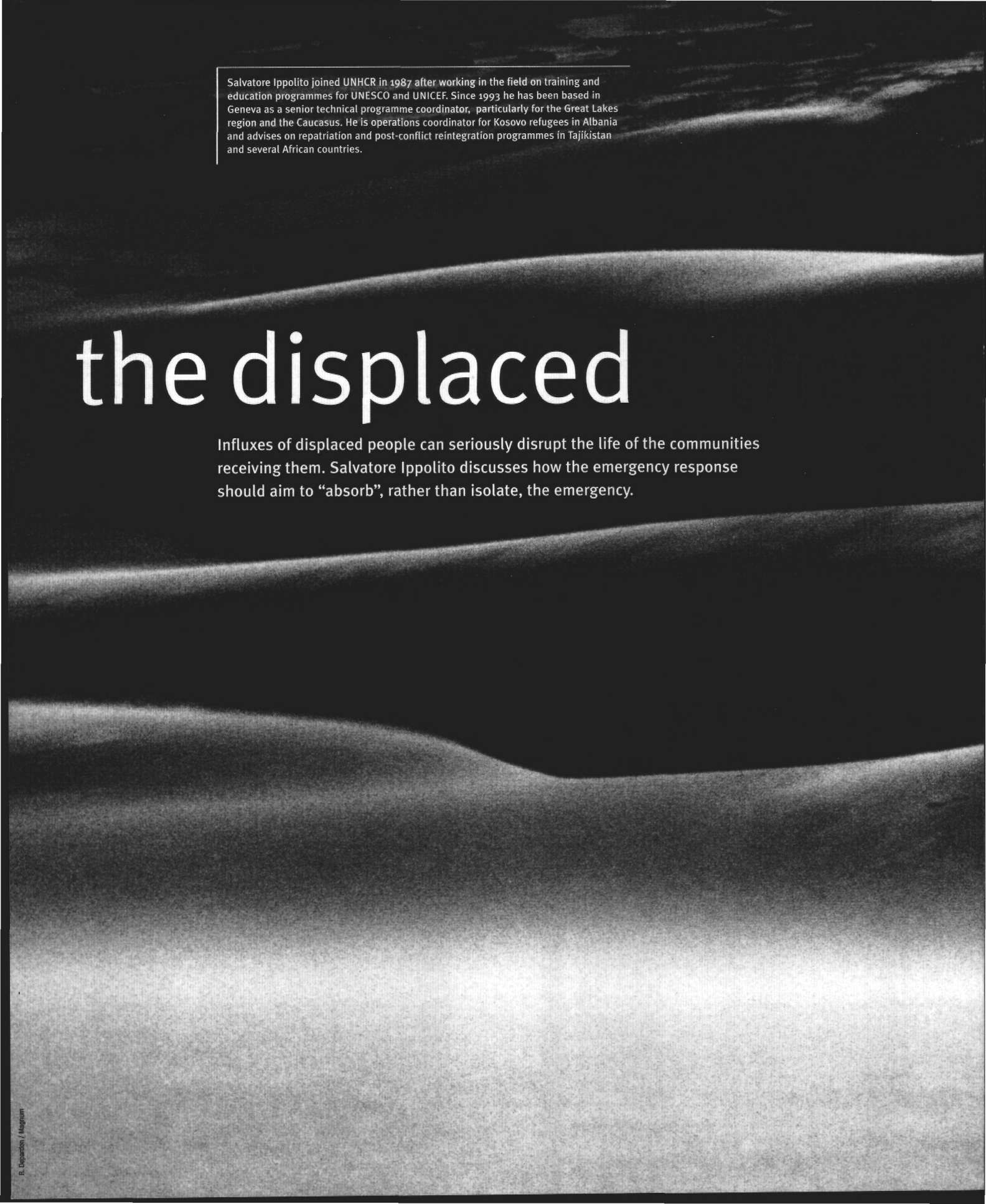
Urban decay and disease

The outbreak of typhoid in Dushanbe illustrates how the problems associated with economic decay, such as deteriorating pipe quality, can interact with problems of civil conflict. In this case, civil war resulted in the closing of the only chlorine production plant in Central Asia and significant population displacement back and forth across the border with Afghanistan, where typhoid outbreaks have been occurring for years. What is unusual about this response is that the Federation's education efforts have probably been the primary input to prevent a return of the disease in 1998. Disease control by community action, in this case water conservation, is not a standard approach for most epidemiologists. While disease caused primarily by water pressure intermittency is often unrecognized, in an era in which the urban trapped commonly become victims and urban decay is the norm, it is likely that death and disease due to intermittency will become a frequent diagnosis.

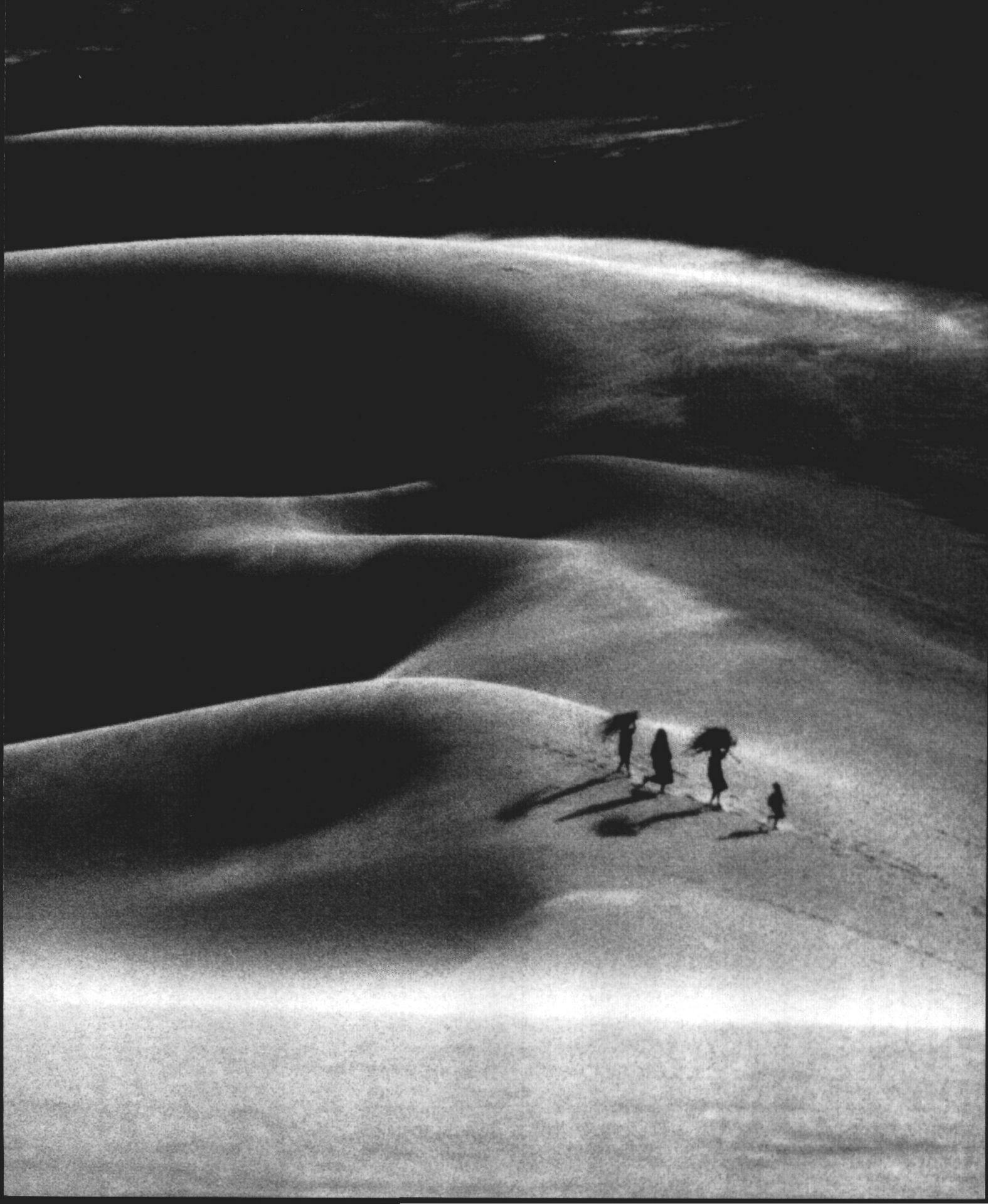
Salvatore Ippolito joined UNHCR in 1987 after working in the field on training and education programmes for UNESCO and UNICEF. Since 1993 he has been based in Geneva as a senior technical programme coordinator, particularly for the Great Lakes region and the Caucasus. He is operations coordinator for Kosovo refugees in Albania and advises on repatriation and post-conflict reintegration programmes in Tajikistan and several African countries.

the displaced

Influxes of displaced people can seriously disrupt the life of the communities receiving them. Salvatore Ippolito discusses how the emergency response should aim to "absorb", rather than isolate, the emergency.



R. Depardon / Magnum



There is a firm assumption among the international aid community that in emergency situations:

- external aid is absolutely necessary
- external intervention is vital and should focus on "beneficiaries";
- beneficiaries are waiting for standardized, pre-packaged assistance.

Experience of refugee and humanitarian programmes over the past 20 years has proved that many international interventions are questionable. Massive influxes of displaced people, whether or not they cross borders, can seriously disrupt the social and economic life of the areas and communities on the receiving end.

There are areas which are prone to sudden population movement or displacement. Some are subject to instant population displacement followed by an immediate return to normality. In others, displacement is "endemic" and may be constant or periodic. This can be due to political as well as ethnic problems, but also to demographic pressure on land. When the displacement is temporary, refugees wait for calmer times and then return home.

It is very often forgotten that a human emergency happens in an already established human and economic setting. The arrival of thousands of people in areas which are mostly remote, economically depleted and poor in resources should be considered as a possible strength for the local community. So the emergency response should start in the place of reception, with an analysis of the local conditions and with the aim of "absorbing", not isolating, the emergency event.

Cynically, it could be stated that the eruption of a human emergency in a particular place, under the present circumstances of international solidarity, could be – to some extent – a panacea for many of the chronic problems of the local community.

The massive arrival of aid, the substantial mobilization of resources, if well planned, could provide a good start for refugee absorption within a strengthened local community.

Low-intensity economy versus high-intensity use of resources in an emergency response

By definition, resources are limited. They are normally used in a very appropriate manner and/or under-utilized according to the level of endogenous "development".

In areas affected by large-scale human displacement, the intrusion of an international emergency response immediately introduces elements of high technology, foreign techniques and tools requiring high energy consumption. From the massive use of cash and introduction of higher salaries that normally accompany the deployment of international staff, to the self-contained emergency package, an international response can be very effective in delivering assistance to "beneficiaries" but very disruptive for local structures.

The accelerated use of natural and human resources overwhelms the local economy and depletes locally established services with the aim of assisting "displaced beneficiaries". At the end of the emergency, a devastated area is normally left to its fate, external investments are swallowed up in the daily assistance, very little is left over for the local economy, most local staff lose their jobs and some may assume new "international" functions for the benefit of relief organizations but at the expense of the local community.

How do you reconcile the "local" with the "external"?

What can the local community do to absorb the influx? What does it need, as opposed to what the international agencies can deliver, in order to cope with the massive displacement of people?

Focusing on the receiving community, we should study the

...local services and structures, which may have been misused or abandoned because of a lack of resources and a lack of national government interest, can be revitalized...

area in conjunction with the local structures, and design an operation which aims to benefit the local environment and economy in the medium to long term. If we take stock of local resources and plans, the displaced population can be absorbed in such a way as to empower local people in the management of the crisis.

The management of an emergency also provides a very good training opportunity: local services and structures, which may have been misused or abandoned because of a lack of resources and a lack of national government interest, can be revitalized.

The injection of skilled external staff should be carried out with this in mind, avoiding an independent intervention which, despite being effective in terms of visibility and creating the illusion of achieving immediate results, would not be sustainable in the long run.

The development of parallel "techniques" and standards such as those released during the last decade (health for refugees, water for refugees, shelter for refugees, etc.) should be reconsidered. The separation of humanitarian action in artificial and parallel environments for "beneficiaries" has demonstrated weaknesses: friction with local host communities, a depleted environment, exhausted resources, a huge diversion of aid by local "leaders" and political use of the humanitarian intervention.

The concept of "beneficiary" should be redefined and possibly revised. For decades, the humanitarians focused on individual relief for distressed people. The mechanisms of current population displacement, sometimes explicitly planned and/or explicitly organized, blend victims with perpetrators. The "beneficiaries" have their own deep-seated character, their own objectives, their own resources. We should take advantage of these strengths to learn more about the groups we claim to help. Some of them do not need help at all and never ask for it. Some do not need our "protection" because they have their own "protection mechanisms" (armed factions and their civilian supporters). Some are able to mobilize their own resources and find their way out of the crisis. In doing so, they stimulate the local host market and host community.

The humanitarian response should regulate and correct mechanisms in order to mitigate the inflation of prices and the over-utilization of resources.

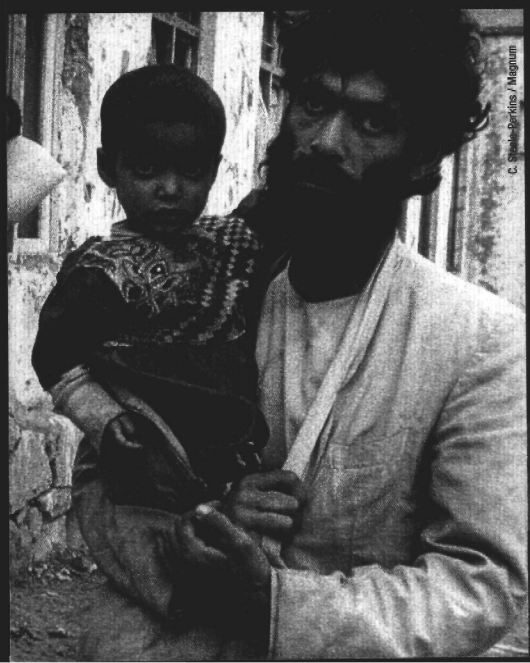
An invaluable chance to improve local living conditions

If planned properly, a humanitarian response can do for the local people, in a short period of time, what development programmes take decades to achieve. Planning the absorption of displaced populations poses the problem of accessibility and satisfaction of their basic needs. Water supply is always one of the weak points. The rehabilitation of local service systems will be vital for providing basic assistance to beneficiaries. Community/area-based projects should be designed during the first stage of the emergency response and take into consideration the satisfaction of common needs (those of both local and displaced people).

We are not talking about a mythical "development" but rather, in practical terms, how a local community, affected by an emergency, can improve its quality of life by providing assistance to people in distress. Rehabilitation or construction of water systems using external funds and technical support can thus take place in a very short period of time. Is it then sustainable? What perhaps should be asked is not just whether the planned water system is sustainable, but also the economy of the entire area. But that is another story.

Around the world and throughout history, people have constantly been displaced by conflict, and they probably always will be. Nevertheless, in providing assistance to people in distress, a community may in the end improve its own quality of life.

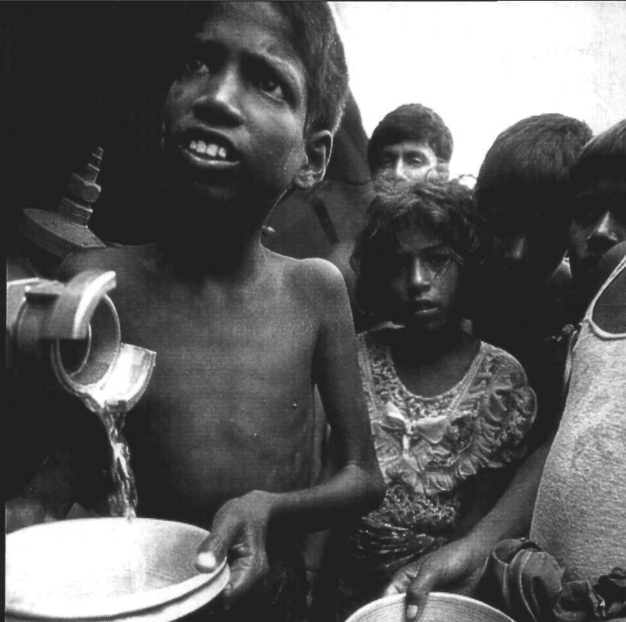
F. Scianna / Magnum



C. Steele-Perkins / Magnum

J. Nachtwey / Magnum

R. Hutchings / Katz



W. Van Capellen / REA / Katz

J. Nachtwey / Magnum

A. Majoli / Magnum

L. Freed / Magnum

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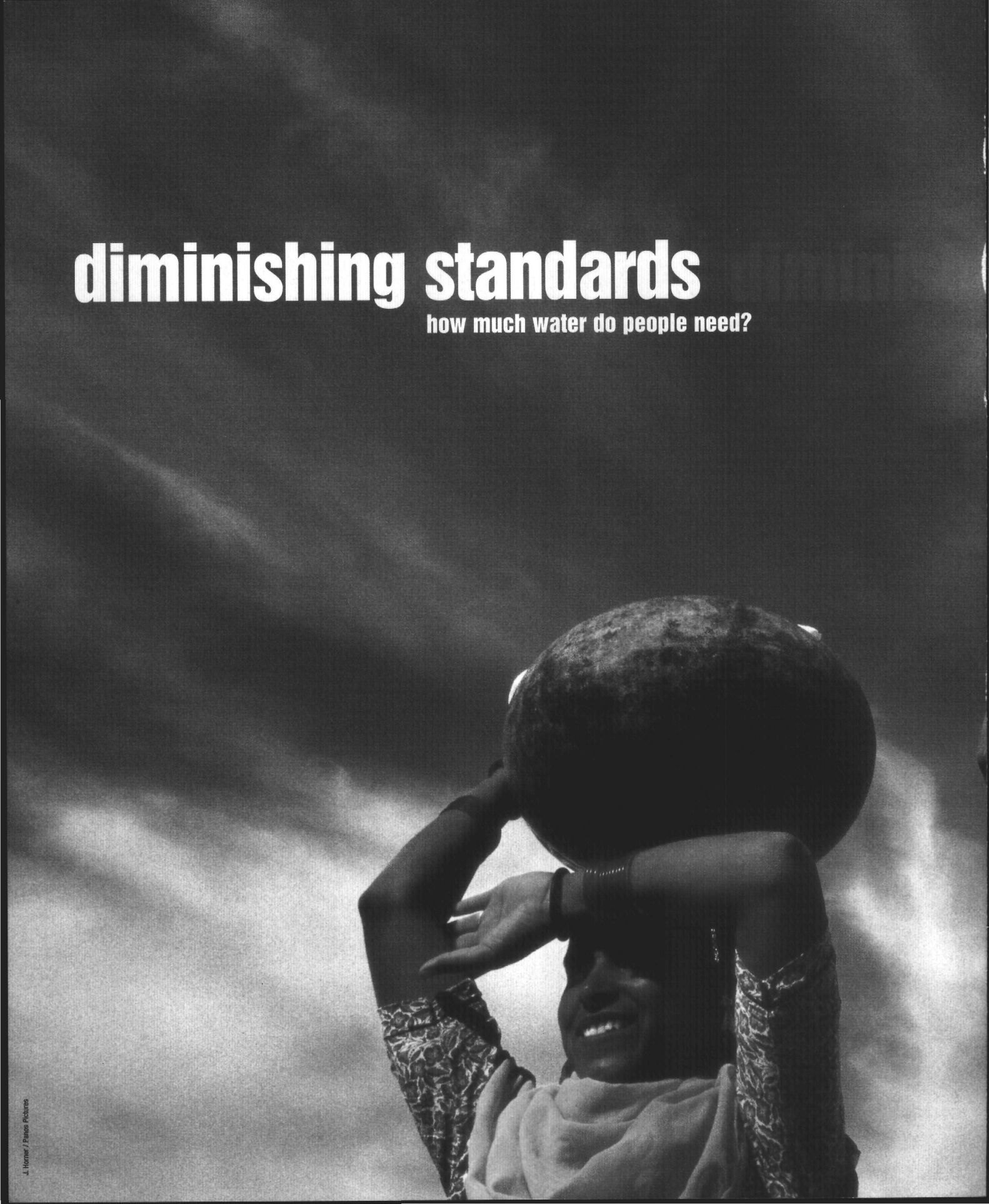
diminishing standards

how much water do people need?



J. Horner / Panos Pictures

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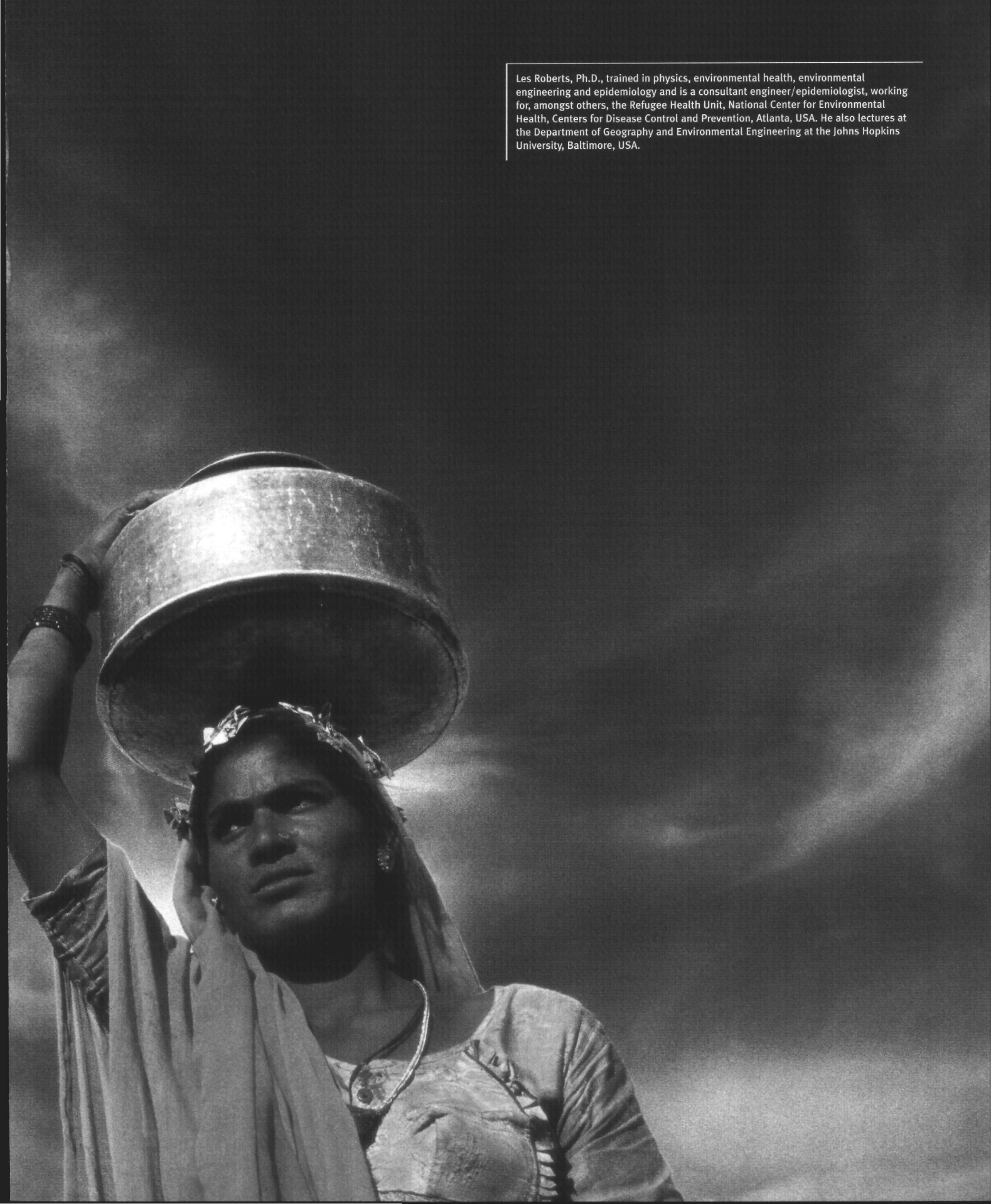

Water for drinking and cooking are certainly more essential than water to wash clothes.

T. Stoddart / Katz

W. Van Cappellen / REA / Katz

Most of what is known about preventing illness during emergency situations comes from the study of illnesses in populations during peaceful, stable circumstances which permit careful scientific investigations. While the psychological and nutritional stress seen in many populations in crisis does make them unique, it is generally assumed that the basic immunological and physiological responses observed by medical and public health researchers in stable populations apply to those in crisis as well. Thus, establishing the best practices and standards among emergency relief workers is usually an issue of "how to do" something rather than "what to do". When vaccinating children against measles, the only judgement involves the "how to" issues associated with organization and logistics. Once the "how to" questions are worked out, the "what to do" questions of how much vaccine to inject, what equipment to use and where on the body to vaccinate are already predetermined. Moreover, the efficacy of conferring public health protection once the vaccine is injected into a population is usually similar to that seen by researchers in stable populations.

Unfortunately, when it comes to providing water, the issues of "how to do" and "what to do" are, for the most part, interwoven. Goals can be set regarding the cleanliness of the water, the volume provided, how many hours a day the service will be available and how close to the people water will be delivered. Yet, to a greater extent than with the provision of food or medicine, the service provided is dependent on environmental circumstances. For example, deep groundwater sources are conducive to providing microbiologically safe water, but perhaps not in vast quantities. These environmental constraints give the water professionals a great deal more latitude, but at the same time a greater need for judgement than most other specialists working during emergencies. In particular, the standard for the quantity of water provided is seen as somewhat flexible. If an NGO only manages to provide 1,400 kcal of food per person per day to a population with no other food supply, this is viewed as an

Goals can be set regarding the cleanliness of the water, the volume provided, how many hours a day the service will be available and how close to the people water will be delivered. Yet, to a greater extent than with the provision of food or medicine, the service provided is dependent on environmental circumstances.

unsuccessful programme. Often this occurs because of circumstances beyond the control of the relief community or because donor funding was insufficient; and people are comfortable in saying that a programme is not acceptable without needing to blame any of the response personnel. In the water sector, rather than saying that a water provision programme is inadequate, there is a tendency to say that the standard is flexible and that these specific circumstances permit lower quantities of water to be provided.

UNHCR's[1] guideline regarding water quantity in the 1960s was adopted from that of the WHO:[2] 30 litres per person per day (l/p/d). This standard was not adapted from empirical data contrasting healthy populations with unhealthy populations, but was established by "experts" estimating the amounts of water needed for cooking, washing, drinking, etc., and then adding up the total daily requirements. In the 1970s the WHO standard was reduced to 20 l/p/d and the UNHCR target followed suit. In 1982 UNHCR declared the desirable goal to be 15 to 20 litres[3] and by 1992 it was calling for a minimum allocation of 15 l/p/d. But "when hydrogeological or logistic constraints are difficult to address, a per capita allocation of 7 litres per person per day should be regarded as the minimum 'survival' allocation. This quantity will be raised to

1 UNHCR: United Nations High Commissioner for Refugees
2 WHO: World Health Organization
3 *Handbook for emergencies, part one: Field operations*, UNHCR, Geneva, 1982.

Someone, somewhere, with a flush toilet and hot shower, may not think it worthwhile investing in sufficient water.

15 litres per day as soon as possible".[4] Again, the new target was based on what was actually occurring given the relief community's funding and workload, and was in no way based on human health data. At the time, the average water provision to an African refugee was perhaps only 12 l/p/d, in spite of the UNHCR standard.[5] While the new target is a "survival" ration, millions of refugees throughout the world currently receive between 7 and 15 l/p/d. The new "survival" target enables project managers to say that, while we are not providing an ideal quantity of water, provisions are well above the survival level. Thus, the diminishing quantity standard is fundamentally to provide political protection rather than public health protection.

There are many who will point out that water use habits vary between populations. In fact, many populations exist for extended periods with much less than 15 l/p/d.[6,7] Moreover, the water uses incorporated in the WHO minimum need estimate are not of equal importance. Drinking water and water for cooking are certainly more essential than water to wash clothes, at least over a period of a few days. Yet others have suggested that the minimum provision endorsed by international aid organizations should be 50 l/p/d.[8] Water consumption in many Western nations makes a 50 l/p/d target seem absurdly stingy. For example, US residents consume about 410 l/p/d of municipal water and almost 6,000 l/p/d when industrial and agricultural uses are included.[9] But people's habits and judgement have little to do with the fundamental issue: how is water availability in an emergency associated with morbidity and mortality?

Little controlled research has been done in the area of water and sanitation among refugees. The only known study to evaluate disease as a function of water quantity contrasted Mozambican refugee households who consumed <15 l/p/d with those who consumed 16-20; 21-30; or >30 l/p/d.[10] There was a steady association between consuming more water and less incidence of diarrhoea among children and, indeed, among all age groups combined. Households that consumed 10 to 15 l/p/d experienced 2.5 times more diarrhoea than those that consumed more than 30 litres, in a camp where faecal-oral diseases were the main cause of death. To evaluate this question further, field reports at UNHCR's Geneva office were reviewed in October 1996; however, field reports rarely included both health and water availability data and were often not standardized sufficiently to compare health experiences during different crises.

Water can be acquired on the spot or transported to anywhere in the world. As with medicine or food, there is not so much a variation in water availability from place to place as a variation in cost. The standard dose of vaccine is not meant to be "the minimum sufficient" dose for a specific child's weight and immunological history, but rather to be sufficient most of the time. Yet sanitary considerations are not like medicine, in that the needs are generally perceived to be most acute in the early phase of an emergency. This is because the vast majority of deaths often occur during the early weeks of a crisis,[11,12] and because immunologically naïve people arriving in insanitary settings are often the most susceptible to disease.[13] Thus, from a public health perspective, our guidelines should say "15 to 20 l/p/d are required during the acute phase of a crisis, but less may be sufficient in the later phases", rather than vice versa. There is a profound need for research to quantify the association between water availability and human suffering during crises. Until the data for proper cost-effectiveness evaluations exist, the water-sector professionals should be willing to state what their minimum target is and why it is not being met. Unfortunately, the answer will most often be because someone, somewhere, with a flush toilet and hot shower, does not think that the extra investment to provide sufficient water is really worth it.

There was a steady association between consuming more water and less incidence of diarrhoea among children...

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5 D. Mora-Castro, Programme for Technical Support Services, UNHCR, Geneva, personal communication.
6 R.H. Gilman *et al.*, "Water cost and availability: Key determinants of family hygiene in a Peruvian shantytown", *A.J.P.H.* 83, 1993, pp. 1554-58.
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responding to the needs of a migrant population

The abolition of apartheid legislation in South Africa led, amongst other things, to freedom of movement for all the country's citizens. People who had previously resided in poor rural areas moved to the cities in search of an improved quality of life. With little or no housing available, this migrant population erected shacks, initially on the edges of cities and subsequently on areas of vacant land within them. As most of these developments were in contravention of the town planning legislation, they were not at first formally recognized, and no engineering services were provided to them. With increased public health problems and a change in the politics of the country, an urgent need arose to provide basic water services to these informal settlements. Neil Macleod describes how this was done in Durban.

There are basically two approaches to water supply in South Africa. The first is the provision of a full-pressure supply to each house, coupled with water-borne sanitation. To provide this level of service, it costs approximately US$ 250 to install the reticulation and the same again to provide the connection from the house to the mains in the street. The full-pressure supply method is found mainly in formalized townships. It is not, however, affordable for households earning less than US$ 250 per month. The alternative is to place standpipes at intervals of approximately 200 m – a system most commonly found in shacks or informal areas, as they are known in South Africa. The cost of the reticulation in this case is approximately US$ 80 and the cost of providing the tap approximately US$ 20. It was found that families earning less than US$ 80 a month will not walk more than 100 m for water if they are expected to pay for it. The standpipe system leads to very low levels of payment, if any at all. For such a system to work, it is vital to have an established water committee and a stable community. This is rarely the case in informal settlements where people are fairly mobile and, with the existing political tensions, these two requirements are often not met. As a result, standpipe methods incur high levels of water wastage.

From discussions with these developing communities, it became clear that the women spend enormous amounts of time each day carrying water and this effectively prevents them from seeking formal employment. The method of carrying water in containers is also far from satisfactory and research has shown that the bacterial contamination of the water is high, with the result that these communities suffer from poor public health.

An alternative solution

To supply water to poor communities living in informal settlements a solution lying between the two above options was needed.

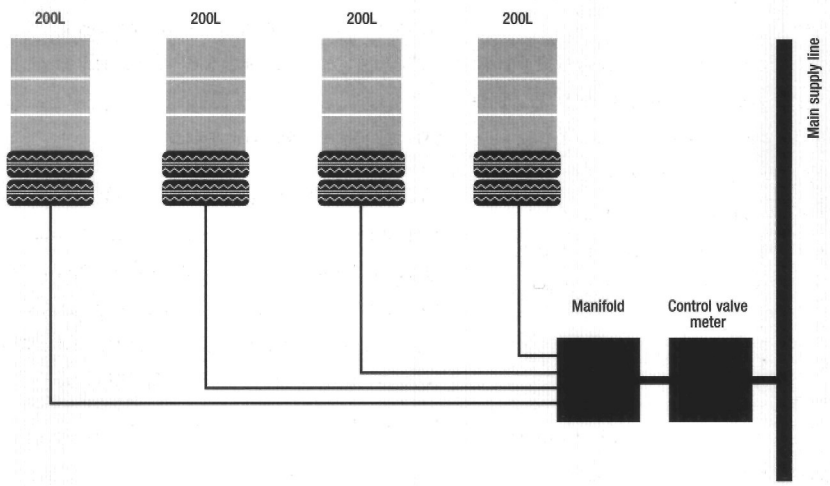
Discussions led to the idea of placing a tank of water at the front door of each shack and filling it once a day with clean drinking water. The intention was to achieve the following:

- provide an acceptable quantity of clean drinking water at an affordable price (approximately US$ 1.50 per month per household);
- provide water-supply infrastructure at low cost and in a flexible manner, so that it could be removed or relocated in the event of the township being formalized;
- control the volume of water supply each day, rather than controlling the price to be paid per month, using a system of prepayment for water supplied to avoid the incidence of bad debts;
- provide infrastructure so as to create employment and work opportunities within the community on an ongoing basis rather than just at the time the scheme was being set up;
- reduce administration costs to the lowest level possible;
- provide an assured supply of clean drinking water;
- provide infrastructure in a manner which makes it difficult to connect illegally to the water system and at the same time reduce water losses or unaccounted-for water.

The Durban tank system

Water is reticulated using small-diameter (less than 25-mm) polypropylene piping, which is laid along the major access routes or paths located within the informal area. At appropriate intervals, connections are made to this reticulation, and a manifold, which allows approximately 20 houses to connect to the water main, is installed. The manifold system is in two parts. In the first chamber there is a supply meter and a shut-off valve. In the second chamber there is a method of controlling the water supply to each of the households connected to that particular manifold.

Metro water ground tank system



The households then lay 20-mm diameter mains from the manifold connection point to their shacks. At a suitable location adjacent to each shack, a 200-litre water tank is installed on a plinth made either of concrete blocks or used car tyres filled with stabilized earth. To prevent the tank from overflowing when it is being filled, the inlet to the tank is controlled using a float valve. Similarly, the outlet from the tank has a valve which prevents the tank from being emptied whilst it is being filled. The tank itself is sealed to prevent pollution of the water.

Within the community, water bailiffs are appointed to control about 10 sets of manifolds each. This means that a bailiff is responsible for some 200 customers. In addition, bailiffs are entitled to install on their property a standpipe, equipped with a meter, from which they may sell water to those residents of the area who are not able to afford the costs of the tank system. Water from the standpipe is sold at a price which encourages bailiffs to promote the use of the tank system rather than the purchase of water from themselves at the standpipe. By providing the standpipe at the water bailiff's house, the possibility of theft and non-payment for water is considerably reduced.

At the end of each month, each customer pays approximately US$ 1.50 to remain connected to the manifold for the following month. On payment, customers are given a card issued by the water authority which entitles them to water for the next month. At the beginning of each month, they hand these cards to the bailiff. In cases where no card is received, supply to that particular house is disconnected until the card can be produced. The bailiff in turn returns the card to the water authority and is paid a royalty of approximately

US$ 0.30 per card returned per month.

At a fixed time each day, the bailiff then proceeds to open the main supply to each manifold and thereby fill the tanks through the manifold and the small diameter pipes which connect them to the main supply. This process is relatively quick and is usually completed in less than one hour (for 200 customers).

The advantage of this system is that it delivers a relatively small quantity of water to each site, so that waste water can usually be disposed of without creating public health problems. In conjunction with this method of water supply, VIP (ventilated improved pit) latrines are most commonly used.

T. Gassmann / ICRC

Problems faced

The following problems have been experienced during the past six years that this system has been used in Durban.

Initially, it was found that whilst the tanks were being filled, customers would open the outlet tap in an attempt to drain water and thereby obtain more than 200 litres of water per day. They would then sell this water to those members of the community who had not yet been connected to tanks. To prevent this happening, a valve was designed and installed on the outlet tap. Subsequent experience has shown, however, that once trust is built up as to the reliability of the system, the practice of draining the tanks ceases and, in fact, the full quantity of water is often not used each day, particularly if the family is relatively small.

Not everyone in a community can afford to pay for such a tank system, which costs approximately US$ 35 to install. By providing a standpipe at the water bailiff's house within a reasonable walking distance of customers who do not have tanks, water can be supplied to the whole community, whilst at the same time ensuring payment for the water.

Initially, the tanks were made of a blue plastic material. During the hot summer months the temperature of the water in the tanks reached 40°C, which was unacceptably high. By painting the tanks white, the maximum temperature dropped to 25°C. Tanks are now made using a two-layer process, with the outer layer in white plastic. This design change has dealt effectively with the problem.

Certain communities expressed the fear that the tank was too accessible and could be poisoned. This has been overcome in various ways, such as by providing locks on the top of the tanks, placing the tank on a high plinth or, as has been done in some cases, installing the tank within the structure of the house itself.

There was initial concern that the turnover rate of the tank would be insufficient and that the quality of the water would deteriorate. Tests have shown that the turnover rate is more than adequate and no adverse bacteriological results have been found in continuous testing over the last six years.

Certain customers indicated that 200 litres per day was inadequate. This problem has been solved by allowing customers to pay for and install more than one tank to serve their property. Therefore, in the case of schools and public facilities, up to four tanks may be installed at a single building. Of course, in allowing more than one tank per property, it is necessary to ensure that the sullage water is disposed of efficiently.

Effective in meeting the needs

The Durban tank system was developed in response to a particular need. It has gained wide acceptance because of its flexibility and because it meets the needs of communities for the supply of reliable, affordable water to people's houses. Some 8,000 families are now benefiting from the system.

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Silva / Agenzia Contrasto / Kent

water, wars and humanitarian futures

The contributors to *Forum* have tackled a wide range of issues and have looked closely at some cases where particular problems have arisen and appropriate solutions have been found. In the concluding chapter, Randolph Kent pulls together these strands.

More often than not, water is an indirect source of conflict.

"Water is a weapon," asserted the site manager of Turkey's Atatürk Dam. "We can stop the flow of water into Syria and Iraq for up to eight months without overflowing our dams, in order to regulate the Arab's political behaviour." This disconcerting assessment of water's power would seem to be a blatant example of the potential that water has as an economic and political weapon. From this perspective, water inevitably must be both cause and weapon of future wars and civil violence. For that same reason, it also has to become an issue of significant human rights as well as humanitarian concern.

However, the correlation between future wars and water is more complex than often assumed. While water has been used as a weapon over time, its potential as a *casus belli* is less directly evident. The interrelationship between the two has to be seen as part of a far more complex set of factors that reflect the ways that societies structure themselves and allocate their resources.

This is not to suggest that water and wars do not interrelate. Water for millions of people from Bosnia and Chechnya to Iraq and Somalia has already become an issue of fundamental humanitarian concern for populations trapped in the grim realities of conflict. Civilian populations – more than conventional military forces – are increasingly targets for violence, and the water that sustains these populations is dependent less and less upon conventional relief measures such as water kits and more and more upon the maintenance of large-scale water systems over time. A growing number of States have neither the resources nor the political authority to provide such basic services; and the demographic shift of peoples from rural areas to conurbations often leaves organizations such as the ICRC assuming responsibility for the water infrastructure of significant portions of a nation's population.

Such trends underscore three fundamental points. The first is that, more often than not, water is an indirect source of conflict. Socio-economic decisions that create disasters and emergencies, which in turn make access to water frequently life-threatening, are the real strands that link conflict, wars and water.

Secondly, global trends suggest that the demands upon water will increase at the same time that conventional structures of governance undergo profound transitions. In such circumstances, crucial decisions about water and the way it is used may depend upon the unpredictable decision-making process of a plethora of new types of State and non-State actors, in the developed as well as the developing worlds.

The third point is that water technology and engineering will most likely continue to ease some of the technical problems that vulnerable populations face during and in the aftermath of conflict. The fundamental issue for all, though, is the need to find ways to address the more basic political, economic and social issues that are so essential for ensuring, *inter alia*, the availability of water and access to it in the future.

Water and the ways we live our lives

"Our concerns about global warming are trivial compared to the issues that we face over water," remarked a senior official from NASA's Earth Sciences Directorate. Yet, that said, few essential commodities are wasted with the same profligacy as water, and the ensuing scarcity in turn holds out the potential for severe social disruption. Even Homer-Dixon, who dismisses so-called global water wars as a myth, concedes that the "real results of water shortages" (e.g., reduced food production, increased poverty and disease) "can undermine a State's moral authority

and capacity to govern and can tear apart a poor society's social fabric, causing chronic popular unrest and violence."

No one is suggesting that the threat of major water crises will necessarily be due to a lack of water, but rather to the way that water will be used and distributed. Intensified irrigation for agriculture, growth in industrial usage and burgeoning domestic consumption in rural and expanding urban areas all account for the increased use of water. This expanded usage has, though, not been balanced by an increase in the efficiency with which water is used. Water-usage efficiency in the developing world's agriculture, for example, is typically in the range of 25 to 40%. Water-usage efficiency in most of the developing world's metropolitan areas is about 50%. Leakage in some urban areas in Europe can reach 70 to 80%, and in the industrial sector, unnecessary wastage has been reported to be as high as 40%.

The inefficient use of water relates at the same time to the continuing assumption that water is a right rather than an economic good. Water has enjoyed an almost sacred nature throughout history; even in the midst of the 1991 Iraq conflict, the allied coalition spared water installations, though power stations were regarded as legitimate targets. Sacred or not, water is a commodity that few politicians would dare to treat in terms of economic value, and when they do, it is all too often the poor who must bear a disproportionate portion of the cost.

From a global perspective, there is indeed enough water to accommodate needs, if potential water stress is countered by sound economic controls and sensitive social adjustments. That said, it is important to bear in mind that fresh water is distributed unevenly across the globe, and it is the developing world that not only has least access to fresh water, but also has the fewest resources to promote efficient usage.

However, even in some of the most arid areas of the world water needs can be met as long as the political commitment and allocation of resources are made.

Water, war and humanitarian crises

According to a 1996 NATO/CCMS pilot study,[1] "Water shortage is generally seen as the environmental problem most likely to lead to violent conflict." If one looks at the interrelationship between demographic trends, patterns of water distribution and resource availability, the study's conclusion at least in the first instance seems compelling.

Currently 28 countries with a total population of 338 million are regarded as water-stressed. This figure may well increase to as many as 52 countries within two decades, and include at least 3 billion people out of a foreseen global population of approximately 8 billion. Virtually all these countries are and will continue to be identified as "developing" over the coming decade. However, conflicts over water may not necessarily be a prerogative of the developing world, for as noted in a recent World Bank assessment,[2] "...today, nearly 40% of the world's people live in more than 200 river basins that are shared by more than two countries. Even within (ed. developed or developing) countries, conflicts over water are bitter."

The relationship between wars and violent conflict and water is, however, far more complex than merely one of scarcity in a time of demographic change. Scarcity, per se, does not lead inevitably to conflict. As with avoiding war over natural resources, a far more complex nexus is woven around key technological, economic, political as well as demographic factors.

From that perspective, the interrelationship between water

Currently 28 countries with a total population of 338 million are regarded as water-stressed. This figure may well increase to as many as 52 countries within two decades.

and war has as much if not even more to do with a failure to address the consequences of failed socio-economic and political policies as it has to do with water scarcity. This sort of perspective has both domestic and inter-State dimensions. Domestically, there is growing concern that more and more States no longer have the capacity to resolve the contending interests that have emerged in modern, complex societies. A proliferation of non-State actors and a growing inability to moderate the worst excesses of so-called free-market forces mean among other things that the State's involvement in infrastructure and welfare will decline significantly.

A dramatic increase in waterborne and water-related diseases, including episodes of diarrhoea, typhoid, cholera, etc., will be the most immediate manifestation of the failure to deal with water. However, in the longer term, failed social policies, including the inability to provide adequate amounts of water to growing urban populations, will lead to disaffection and alienation. States will seek to constrain such tendencies by resorting to unusual levels of violence, which in turn will spiral into open conflict.

Externally, many assume that States will have less and less capacity to deal effectively with so-called transnational "regime management", including the use of and access to water. Instead, water issues, like other regime management issues, will be subject to a host of uncontrolled and contending interests, including those of the corporate sector, ethnic groupings, informal national authorities, religious extremists and criminalized sectors. Rather than order at the inter-State level, this vision suggests that issues affecting the management of water – be it pollution, exploration or desalinization – will be resolved not by the slow pace of diplomatic consensus-building, but by an assertion of power by a mish-mash of legitimate and non-legitimate State and non-State actors.

Whether from a domestic or external perspective, the theme of water and wars is one of complex interrelationships that go to the core of the ways that societies function and interact with other societies. Scarcity of water will not so much be the source of conflict as will be the inability of governments to reconcile contending interests at the intra- and inter-State levels. Nevertheless, the consequence of such complex interrelationships will mean that people affected by the collapse of traditional economic and political structures will find themselves faced by major water crises. In that latter sense, the ongoing crisis faced by Iraq after the Gulf war to maintain a sophisticated water system, dependent among other things upon electricity, during an international embargo, is an extreme though telling example of the interrelationship between water and government haplessness.

The crises that will affect large numbers of people in the future will involve various forms of mass migration as well as, *inter alia*, technological and pandemic catastrophes. Stranded minorities will increasingly flee to what are now called "stateless zones", with no authority responsible for or concerned with their basic needs. A good portion of these stranded minorities will be victims of conflict, including "ethnic cleansing", as well as refugees from the repression that will be the last resort of governments and States on the verge of collapse.

There will, too, be an estimated 200 million people over the next decade who will migrate for economic reasons from the developing to the developed world, many of whom will live on barren lands or will survive in the increasing squalor of urban ghettos.

1 "Environment and security in an international context: State of the art and perspectives", NATO/CCMS Pilot Study, *Ecologic*, Potsdam, 1996, p.15.
2 I. Serageldin, *Towards sustainable development of water resources*, World Bank, Washington, D.C., 1995, p.2.

Water under most circumstances can be provided; scarcity need not be a cause for war.

Among other foreseeable emergencies and disasters will be technological catastrophes. Unless there is a substantial change over the next decade in attitudes towards risk-reducing technology transfers and unless the newly industrialized countries themselves make a determined effort to provide for and enforce stricter health and safety practices, serious risk of technological catastrophes will be faced by countries such as Brazil, China and the Russian Federation, along with industrializing countries in South-East Asia, the Philippines and Mexico. Such catastrophes will leave people without the quality of water, food and environment needed to sustain life.

What these and other types of large-scale calamities have in common among other things is the crucial role that water will play in the survival of the affected and the increased difficulties associated with fulfilling such needs. There is certainly a need to provide assistance to displaced people in the context of the wider needs of host communities, and livelihood security (e.g., food security) and access to water are indivisible.

Yet, if one applies such strictures to future trends, the cost of providing adequate water systems takes the humanitarian and development communities to high levels of sustained commitment. Not only will the dimensions of involvement in water systems increase, but so, too, will the level of integrated development. In no sense can one fault the logic, but there must be a note of despair attached to the message, namely, that both resources and development commitments are on the wane at that very point when one is gaining a clearer idea about what needs to be done.

In the short term, immediate needs can be met both technically and from a societal perspective. There was a dynamic of uncontrolled privatization in Mogadishu in 1995 that was not only an effective substitute for conventional "centralized services", but which also stimulated the economy and provided the needs for the capital's estimated population of 1 million people. Technically, too, there are indeed well-tried means to reduce the risk of water contamination and to increase water efficiency. The more abiding issue is one of the consequences of economic decay. Even investment in education can reduce the impact of impure water.

The future in the context of the past

If water throughout ancient as well as modern history has been used as a weapon, there is less evidence that water has been or will be a direct cause of war or violent conflict. Even the water of the Nile river, frequently regarded as an all-too-obvious *casus belli*, has never been a source of conflict. As noted in a recent study for the European Union,[3] water stress "is not alone a sufficient condition for conflict over resources. It is assumed that other political conditions need to exist as regards the strength and weaknesses of social groups and their position vis-à-vis the associated State structures."

Water as an issue of potential violent conflict is part of a larger set of issues. Water under most circumstances can be provided; scarcity need not be a cause for war. The technical capacity to satisfy needs exists and can be applied. However, political will, long-term commitment and integrated planning and programming must all underpin the technician's skill.

3 T. Allan, A. Nicol, *Water resources, prevention of violent conflict and the coherence of EU policies in the Horn of Africa*, Saferworld and the School of Oriental and African Studies, London, June 1998, p.5.