



WATER for HEALTH

TAKING CHARGE



World Health Organization – Geneva

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The World Health Organization 2001
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WATER for HEALTH



**TAKING
CHARGE**

The text "TAKING CHARGE" is written in a bold, yellow, sans-serif font. Behind the text is a faint, light blue watermark of the United Nations logo, which consists of a globe surrounded by olive branches. A medical symbol, resembling a caduceus, is superimposed over the globe.

FOREWORD



WORLD WATER DAY

Long before the advent of modern medical care, industrialized countries decreased their levels of water-related disease through good water management. Yet, even in these countries, outbreaks of water-borne disease continue to occur, sometimes with lethal consequences. In developing countries, preventable water-related disease blights the lives of the poor. Diseases resulting from bad hygiene rank among the leading causes of ill-health.

Much of this suffering is needless. Health provides an effective gateway for development and poverty alleviation. Improving water management is a powerful tool that can be used by individuals, communities and households to protect their own health.

3.4 million people, mostly children, die annually from water-related diseases. Most of these illnesses and deaths can be prevented through simple, inexpensive measures. For instance, trachoma remains the leading cause of preventable blindness, accounting for 146 million acute cases around the world. But the disease is almost unheard of in places where basic water supply, sanitation and hygiene prevail.

Safe water supply and adequate sanitation to protect health are among the basic human rights. Ensuring their availability would contribute immeasurably to health and productivity for development. "Business as usual" is no longer an option. We don't have enough time to just wait for large infrastructure investments to provide these basic services to all who need them. Several simple interventions are available, such as improving the quality of water in the home as well as improving hygiene education at the household level. Poor people can take charge of their own destinies and improve their lives by applying some of these measures. But they need to know what works and how such interventions can be exploited.

World Water Day, celebrated on 22nd March, became an annual event after the 1992 Earth Summit in Rio de Janeiro, Brazil, and brought home to millions of people the importance of cherishing a valuable resource which affects our very existence. The theme for 2001, Water and Health, highlights the opportunities for promoting health and development through safe water. People everywhere can use this day to raise awareness of the high level of disease and misery that results from bad and inadequate water sources. People can learn that they need not be victims, but can take matters into their own hands to create good, clean water for better health.

A handwritten signature in black ink, which reads "Gro H. Brundtland". The signature is written in a cursive, flowing style.

Gro Harlem Brundtland
Director-General



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Water is one of the earth's most precious and threatened resources.

Health is one of each person's most precious resources.

We need to enhance and protect them both.

Water for Health

WATER AND HEALTH:

Two precious resources linked to one another

From outer space, the earth looks like a "blue" planet because most of its surface is covered by water. But only 2.5% of that water is fresh, and most of that lies frozen and inaccessible in the icecaps and Greenland, leaving less than 1% of fresh water accessible in lakes, river channels and underground.

Hydrologists estimate that the average annual flow of all the world's fresh water ranges from 35 000 Km³ to 50 000 Km³. Due to a mix of geographical, environmental and financial factors, as well as to increased pollution from municipal and industrial waste, the leaching of fertilizers and pesticides used in agriculture, only about one-third of the world's potential fresh water can be used for human needs. As pollution increases, the amount of usable water decreases.

Water contributes much to health. Good health is the essence of development. However water's protective role is largely unseen and taken for granted in the wealthier countries. More attention is paid to its role in disease transmission than health protection. Water contributes to health directly within households through food and nutrition, and indirectly as a means of maintaining a healthy, diverse environment. These two precious resources — water and health — together could enhance prospects for development.



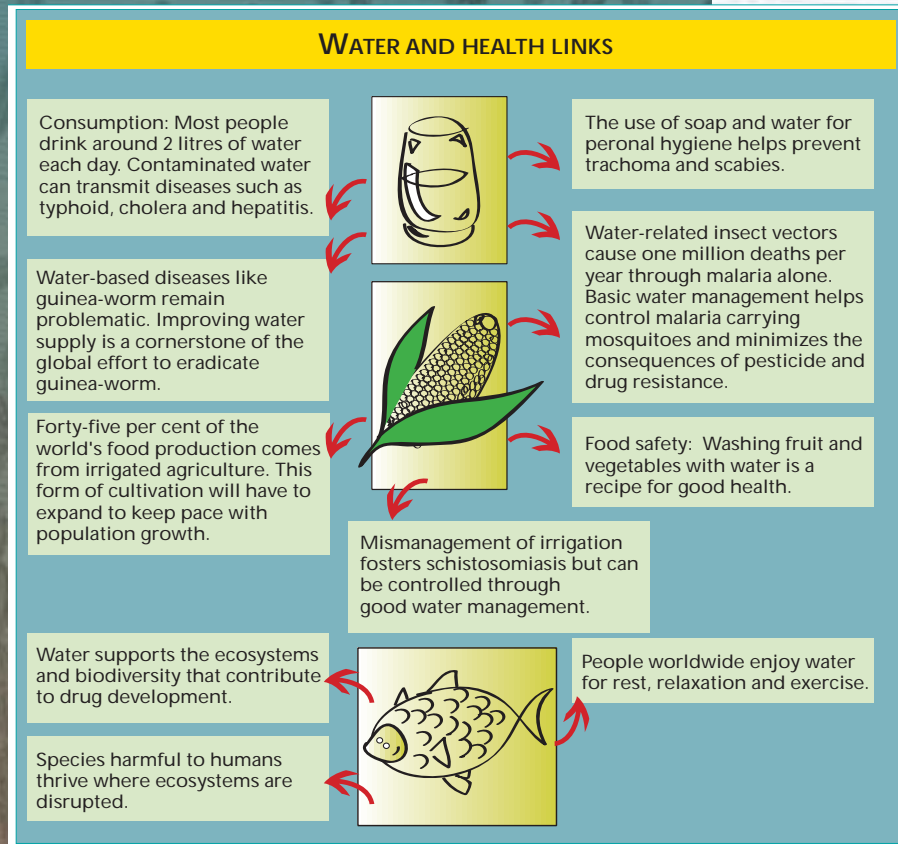
WATER & DEVELOPMENT: THE HEALTH CONNECTION

The poor are more susceptible to ill-health than are the well-off. They lack adequate

supplies of safe water and safe methods of disposing of their wastes. Lack of water and sanitation create ideal conditions under which faecal oral diseases thrive.

Study after study has shown that where a community improves its water supply, hygiene and/or sanitation then health improves. For example, diarrhoea can be reduced by 26% when basic water, hygiene and sanitation are supplied. Yet statistics tell a terrible story. Forty percent of the world's 6 billion people have no acceptable means of sanitation, and more than 1 billion people draw their water from unsafe sources.

The World Health Organization says diarrhoeal diseases remain a leading cause of illness and death in the developing world. Every year, about 2.2 million people die from diarrhoea; 90% of these deaths are among children, mostly in developing countries. A significant number of deaths are due to a single type of bacteria, *Shigella*, which causes dysentery or bloody diarrhoea. It is readily controlled by improving hygiene, water supply and sanitation. Although no vaccine exists and antibiotics may be inaccessible to many people, an effective intervention is available. The simple act of washing hands with soap and water reduces *Shigella* and other types of diarrhoea by up to 35%.



WATER MANAGEMENT TO REDUCE HEALTH RISKS

The transmission of disease is also rife among vulnerable communities because they live in environments receptive to the breeding of insect vectors that carry parasites such as malaria, filaria and trypanosomes. Most of these need water for part of their life-cycle. 300 million people suffer from malaria and in sub-Saharan Africa alone malaria kills an

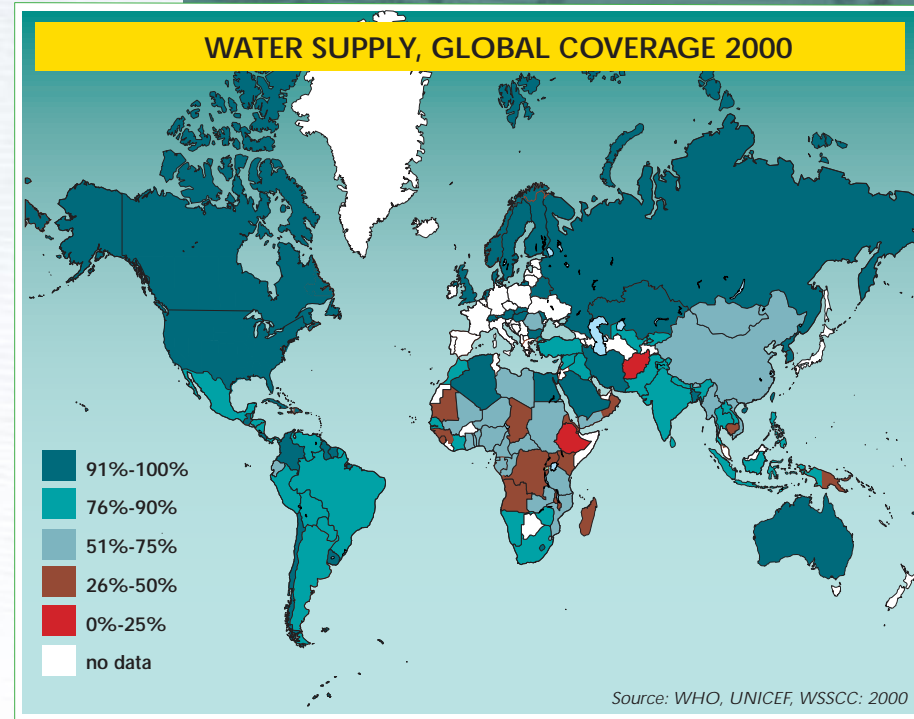
estimated 1 million people per year, the large majority are children under five. Other malaria hotspots are South and South-East Asia, and parts of South America.

Early diagnosis and treatment, as well as personal protection through the use of low-cost insecticide-treated mosquito nets continue to spearhead malaria control programmes. However, the ability to treat the disease effectively is being jeopardised as a result of growing problems of drug resistance and counterfeit drugs, while the use of mosquito nets meets with problems of affordability and social acceptability.

In many areas, particularly those with less intense transmission patterns, environmental management as part of integrated vector management can significantly reduce the spread of disease. Water management, which is key to this approach, should be based on a proper assessment and understanding of local vector ecology.

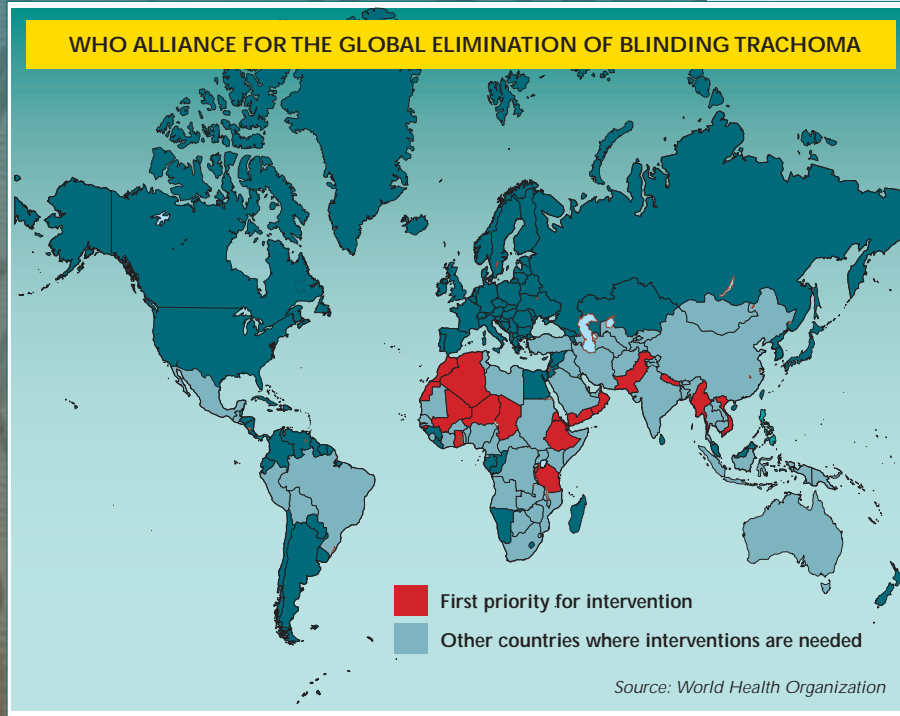
Many poor farmers in semi-arid areas may be dependent for their agricultural water supply on a small number of rich land-owners who can invest in the drilling of bore-holes. In the rice-growing areas of Tamil Nadu in southern India, such situations are not uncommon. Dependency on water provided by one rich farmer may create discrepancies between the time water can be purchased and the cropping cycle. Rice fields may thus be flooded for weeks and become important breeding places for *Culex* mosquitoes which can transmit Japanese encephalitis. Outbreaks of the disease kill at least 20% of people suffering clinical symptoms – mainly children. Twenty per cent of survivors are left with permanent damage to their central nervous system.

Growing water shortages for irrigation may contribute to the alleviation of the Japanese encephalitis problem. As farmers have to manage irrigation water as an increasingly scarce resource, the promotion of alternate wetting and drying practices of rice fields will contribute to a reduction in the vector population and, thus, in the risk of outbreaks.



SAVING SIGHT

Trachoma can be prevented by improving sanitation, reducing the breeding sites of flies and teaching children to wash their faces with clean water. Trachoma caused by microscopic *Chlamydia trachomatis* remains the leading cause of preventable blindness — with an estimated 6 million people suffering loss of sight and 146 million acute cases worldwide.



In Bamako, the capital of Mali, poor people pay as much as 45 times more per unit of water than do the rich, who get water piped into their homes, often at subsidized prices. In 1988, Cairncross and Kinnear estimated that 25% of the population living in cities in developing countries bought water from vendors, typically spending 10%-20% of household income.

WATER & HEALTH: THE POVERTY CONNECTION

Poor health and illness are dreaded by almost everyone. Needy people tend to live on what they earn on a daily basis and have no cash reserves to pay for a sudden illness. The loss of income and the inability to pay for the cost of treatment can push a family further into poverty and debt, thereby perpetuating the cycle of poverty.

"If you don't have money today, your disease will take you to your grave."

— An old man in Ghana, 1995

Poor communities are often forced to over exploit their natural resources in order to survive. Water sources are particularly vulnerable. In too many cases, they are abused to such an extent that they no longer can provide for a community's basic needs and end up posing serious health risks. However, opportunities for reversing this situa-

tion exist. What is required is that priority is given to water management and development and that communities play a major role in solving their own problem. This will entail the full involvement of communities in the planning and development of their own water systems.

Gross inequities in the reliability and quality of water supply services create a market for water-vendors and encourage use of unsafe local wells and springs in urban slums.

Similar inequities in access to safe water, especially in rural areas, force women in

developing countries to spend hours every day fetching water, causing an enormous drain on their energy, productive potential and health. The lack of good quality, reliable water puts people's health at risk and may force them to extract water from alternative, unsafe sources, exposing them to diseases such as diarrhoea or dysentery, cholera, typhoid and schistosomiasis. Traditional wells may become polluted with agrochemical residues as irrigated agriculture intensifies.

The gap between rich and poor becomes all too apparent in regard to the lack of water for drinking, irrigation and sanitation, and in their inability to maintain the integrity of ecosystems on which people depend. Time and again, poor people everywhere – in Bangladesh, Viet Nam, Kyrgyzstan, Malawi, etc. – cite lack of safe drinking-water as one of their most important problems.

Good water, good health and better living are worthy goals in and of themselves. But, basic services for the needy are also a moral and human-rights obligation. This view is too often overlooked by those in control of the developmental purse-strings and by the poor themselves. Because deprived people are frequently unaware that they have a right to properly functioning basic services – to good water and to good health – they have been unable to obtain them.

LOST OPPORTUNITIES

Where women and children spend hours each day walking to streams and other sources to collect water for their families, they have little time or energy left to pursue an education and other gainful activities. The heavy loads they carry may cause skeletal deformation and accelerate the deterioration of joints.

Everyone benefits from good sanitation. But girls are among those who benefit the most. Girls often miss out on an education because they have to help with the household chores and, when money is scarce, it's usually the boys who get chosen to go to school. An important reason why girls drop out of school in developing countries – mainly in Africa and Asia – is because of lack of sanitation facilities.

Almost 70% of the 1.3 billion people living in extreme poverty are women. Women – especially poor women – are often trapped in a cycle of ill-health exacerbated by childbearing and hard physical labour.

Eliza Fenlas, a mother of three who lives in Inhambane, one of Mozambique's driest provinces, spends five hours a day trekking 24 kilometres to fetch 20 litres of water. She looks forward with joy and anticipation to the day when her area will benefit from a safe water programme. She says a well nearby will make a big difference in her life. She will have more time for household chores and farming. She will have more water available for washing. She is hopeful that the safe water will put an end to her seven-year-old son's chronic diarrhoea.

Source: UNICEF

The right to the highest attainable standard of health is a fundamental human right which embraces a wide range of socio-economic factors that promote conditions in which people can lead a healthy life, and extends to the underlying determinants of health, such as access to safe and potable water and adequate sanitation, and a healthy environment.



Faecal contamination of water is an important cause of ill health. Improving sanitation is a priority.

Studies show that school attendance by girls increases when separate latrines for girls and boys are installed. In a school in Bangladesh, where UNICEF began promoting separate facilities in 1992, girls' school attendance has risen by an average of 11% a year.

The unreliability of rural water supplies in parts of India stimulated people to store water in their houses to bridge periods when the supply ran dry. This resulted in dengue outbreaks, because the stored water provided breeding places for *Aedes* mosquitoes.

GOOD WATER SUPPLY, SANITATION, HYGIENE AND WATER MANAGEMENT CONTRIBUTE TO PREVENTING:

Anaemia, Arsenicosis, Ascariasis, Campylobacteriosis, Cholera, Cyanobacterial poisoning, Dengue, Diarrhoea, Dysentery, Fluorosis, Guinea-worm disease, Japanese encephalitis, Infectious hepatitis, Impetigo, Lead poisoning, Malaria, Malnutrition, Methaemoglobinaemia, Ringworm (Tinea), Scabies, Schistosomiasis, Trachoma and Typhoid Fever.

NUTRITION, FOOD SECURITY AND IRRIGATION

Malnutrition affects nearly 20% or almost 800 million people in the developing world (WHO 2000). Malnutrition plays a major role in their ill-health, making them particularly susceptible to infectious diseases carried by unsafe food and water, which results in further malnutrition. Great progress has been made in feeding the world. Over the past 30 years, food production and distribution have more or less kept up with the growing population. The two factors responsible for this improvement are irrigation and high-yielding varieties of crops. Food production needs to increase further to feed a growing world population; while famine, owing in part to water shortage, is already affecting large parts of the world (particularly Africa). 40% of the world's food now comes from irrigated land and this requires ample supplies of water. For example, 1 000 tons of water are needed to grow one ton of wheat. Solutions include more efficient use of water, recycling and sustainable use of dams and irrigation systems.

WHY WE NEED TO ACT

Water and health – everyone stands to gain

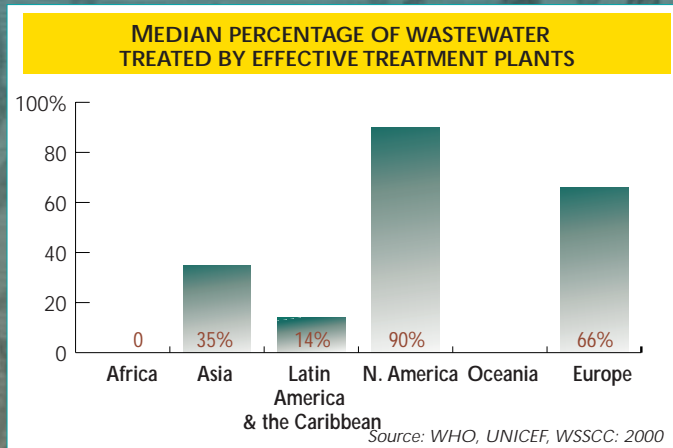
The treatment of wastewater often is a haphazard affair. In developing regions of the world, treatment is applied in only a minority of systems. Even in the industrialized countries of North America and Europe, for example, sewage is not universally treated.

Problems of unsafe water and inadequate sanitation systems are most acute in developing countries. Although in a smaller proportion, people in industrialized countries also get sick from contaminated water and untreated sewage. Despite the fact that developed countries normally have the means to deal with these problems, they often don't for reasons of complacency, lack of political will, cost and so on. Public pressure to remedy serious health and environmental problems may be instrumental in initiating change.

PRESSURES ARE GETTING WORSE

Unsustainable approaches : Some of the technologies adopted in the wealthier countries to make life easier and more comfortable for their inhabitants can cause problems. The move from latrines and septic tanks to flush toilets in major cities propels municipal sewage, often with limited treatment, into rivers and coastal areas.





The lack of wastewater treatment is a health hazard.

In Indonesia, the transmission of malaria was drastically reduced when farmers synchronized their rice-production system to allow rice paddies to dry out completely during certain periods. Then again, in Sri Lanka, the breeding of malaria mosquitos was suppressed in small rivers and irrigation canals by regularly flushing them out.

If all goes well, the waste may be diluted and treated by natural processes. But, it also may accumulate in fish and shellfish which, if eaten, can make people sick.

Furthermore, the contaminated water may endanger the health of swimmers at beach-side resorts. Governments increasingly are forced to balance the costs of cleaning up sewage-polluted water against the loss of revenue that may result from ill-health, lost tourism and problems incurred by fisheries.

Urbanization: Cities are growing at an incredible rate worldwide. The current urban population of 2.8 billion people will increase to 3.8 billion in 2015 and to 4.5 billion in 2025. Megacities create tremendous demand for water and act as dense sources of pollution. This challenges the ability of those in charge of water management to provide for the needs of all inhabitants.

Population: With population growth, demand for the world's finite supply of fresh water is rising, putting strains even on the industrialized countries. Global population projections suggest that the world population of over 6 billion in 2000 will increase 20% to over 7 billion by 2015, and to 7.8 billion by 2025, a 30% rise. Enormous strains will be put on existing services, and substantial increases in the provision of water and sanitation will be needed to meet the needs of the swelling population. As populations grow and demands for water and other services expand, pollution levels will rise, while more water will be needed in agriculture to feed and nourish the large population.

Interdependence: Health is often not systematically considered by those who plan water development projects. Consequently, local communities, many of whom do not even stand to gain from the project, end up carrying the increased risk of illness from newly introduced water-related diseases. There are far too many examples of poorly-designed development schemes which have brought malaria or schistosomiasis into areas where it previously did not exist. Health concerns are rarely included in agricultural development policies. It has been shown that where health is taken into account, the eventual efficiency of water projects is greatly enhanced.

Fresh water: The world's supply of fresh water is limited. Water sources are

vulnerable, too often ill-managed and inequitably distributed between the rich and the poor. The poor are also disadvantaged in that too many of them live in water-deficient countries, mostly in Asia, the Middle East and sub-Saharan Africa. This creates particular problems for people in rural parts of Africa where, on average, less than 50% of people have access to both improved drinking-water and sanitation.

Climate change: The 21st century could see a rise in disease if predictions of climate change come true. If nothing is done to reduce the emissions of carbon dioxide and other greenhouse gases which are believed to lead to global warming, scientists warn that global temperatures might increase by 1 to 3.5 degrees centigrade by the year 2100. Scientists believe that the climate changes would increase the number of deaths and illnesses due to infectious diseases. For instance, mosquitos may extend their range to new geographical areas, leading to more cases of malaria. Climate change also would threaten hundreds of millions of people, who currently are not at risk, with dengue (another mosquito-borne disease), and floods and drought would impact on food production.

Natural disasters : Floods are the second most frequent cause of natural disaster, after windstorms. However, drought is the largest cause of death because it often leads to famine. Floods affect more regions and more people than any other phenomenon. The consequences of flooding, especially in poor communities, can be horrific. This



Floods and drought are amongst the most frequent natural disasters that contribute to ill-health and most frequently affect the poor.

MAJOR FLOODS AND STORMS

Floods devastate people and structures

YEAR	LOCATION	DEATHS
1421	Holland	100,000
1530	Holland	400,000
1642	China	300,000
1887	Yellow river, China	900,000
1900	Galveston, Texas, USA	5,000
1911	Yangtze River, China	100,000
1931	Yangtze River, China	145,000
1935	Yangtze River, China	142,000
1938	Yellow river, China	870,000
1949	Yangtze River, China	5,700
1953	Holland	2,000
1954	Yangtze River, China	30,000
1959	Japan	5,098
1960	Bangladesh	10,000
1963	Vaiont, Italy	1,800
1979	Morvi, India	15,000
1991	Bangladesh	139,000
1991	Philippines	6,000
1991	Huai River, China	2,900
1998	Central America	18,000
1998	Yangtze River, China	3,000
1998	India and Bangladesh	2,425

Source: White 1999: World Water Vision: 2000

was seen in the disastrous floods that occurred in the aftermath of the powerful cyclones that struck Madagascar and Mozambique in February 2000. Many people died, hundreds of thousands of people were made homeless, epidemics of malaria and cholera broke out, rich farmland was rendered useless and economic development received a severe setback.

The after-effects of a major flood usually linger on for many years. Flood-stricken communities have to come to terms with the drownings and injuries sustained by their loved-ones, with the loss of their homes and belongings. The breakdown of water and sanitation services increases vulnerability to waterborne diseases. Flood damage sustained by water supply, irrigation and other water infrastructure is a major setback to health and economic development. Environmental pollution leads to more ill-health. For instance, leptospirosis, a bacterial disease which affects both humans and animals, can reach epidemic proportions during severe flooding because of the widespread contamination of surface water, soil and plants.

CONTAMINATED WATER CAUSES 54 DEATHS IN MILWAUKEE

Cryptosporidium parvum was not recognized as a human pathogen until late in the 1970s. In the early spring of 1993, the residents of Milwaukee, Wisconsin, fell victim to the largest documented outbreak of waterborne disease in the USA. More than 400 000 people fell ill with acute watery diarrhoea caused by *Cryptosporidium* infection. The infection, which causes abdominal cramping, nausea, vomiting and fever was transmitted through the public water-supply system. Milwaukee gets its water from Lake Michigan. Apparently, one of the city's water treatment plants failed to filter out the dangerous parasite in the untreated water. Two years after this outbreak, investigators concluded that the infection, which can have fatal consequences for immunodeficient people, had killed 54 — most of whom had AIDS.



Cryptosporidium

Source: MacKenzie et. al., 1994

WHERE WE NEED TO ACT

It is estimated that it would cost about US\$ 23 billion per year to achieve the international development target of halving the percentage of people unserved with improved water sources globally (currently at 18%) and improved sanitation services (currently at 40%) by the year 2015. But governments presently spend US\$ 16 billion a year in building new infrastructure. The additional US\$ 7 billion a year needed to supply good water and sanitation to some who lack it is less than one tenth of what Europe spends on alcoholic drinks each year, about the same as Europe spends on ice cream and half of what the United States spends each year on pet food. Compared to what governments expend on military weapons, the cost of providing people with the means to improve their health is small.

WATER AND HEALTH FOR THE RURAL POOR

Managing water supply can be difficult in rural areas. Of the 1.1 billion people without access to improved water sources worldwide, around 84% live in rural areas. Drinking-water quality is especially difficult to control and even in the most developed countries, small community water supplies frequently fail on basic microbiological quality. Rural communities have a different relationship to water than do urban dwellers. Water dominates every aspect of their lives. People in the countryside live off the land



To achieve the international development target of halving the proportion of people without access to improved water or sanitation by 2015, an additional 1.6 billion people will require access to water supply and about 2.2 billion will require access to sanitation facilities.

ARSENIC CONTAMINATED DRINKING-WATER – A PUBLIC HEALTH EMERGENCY

- Arsenic exposure in Bangladesh is widespread and involves thousands of wells.
- Estimates indicate that at least 100 000 cases of skin lesions caused by arsenic have occurred and there may be many more.
- If exposure continues, skin lesions will continue to occur.
- Skin lesions are unpleasant and may be debilitating.
- Skin lesions are occurring in children aged 10 years and younger.
- Large numbers of cancers are predicted to occur in the future, including fatal internal cancers.
- The cause is known: each day of continued exposure increases the risk of morbidity and death.
- Sustained drinking of water containing 500µ/l of arsenic may result in 1 in 10 people dying from arsenic-related cancers.
- Unlike other major health problems experienced in Bangladesh, arsenic-caused diseases can be eradicated at relatively low cost.

Source: Bulletin of the World Health Organization, volume 78, (9): page 1097 (2000).

and depend on water to grow their crops. Scarce water supplies are used sparingly for household needs. Water is the source of their livelihood and, when unclean or mismanaged, the source of ill-health and continued poverty.

Water contains many trace elements and minerals, which may be benign, beneficial or toxic. Everything depends on how much. While some minerals may be beneficial in low concentrations, most can be toxic in excess. Only a few chemicals – for instance, arsenic and fluoride – are thought to be major public health issues. The problems they and nitrate cause are most common in rural areas.

ARSENIC IN DRINKING-WATER

One of the worst examples of a do-good project gone wrong is occurring in Bangladesh. About two decades ago, millions of small wells began to be drilled in an effort to provide safe water to the population. At the time, all attention was focused on preventing diarrhoeal disease which ravaged the population. No one, until the 1980s, identified naturally-occurring arsenic as a health hazard.

A recent study published in the Bulletin of the World Health Organization suggests that Bangladesh is grappling with the largest mass poisoning in history, potentially affecting between 35 and 77 million of the country's 125 million population, threatening them with potential epidemics of cancers and other fatal diseases.

Attacking the problem in Bangladesh is not easy. There are millions of wells and those that are dangerous are mixed in with those that are safe. There are several technical solutions but no single universal method. Well-to-well testing is needed.

FLUORIDE

Fluoride is present in all waters. Low amounts of this element can be good for teeth. But, excessive amounts of fluoride in drinking-water can be toxic.

People with teeth discolored by fluoride are found worldwide, and crippling skeletal effects are prominent in at least eight countries. It is estimated that 30 million people

suffer from chronic fluorosis in China where the custom of burning fluoride-rich coal in the household may further aggravate the problem.

These issues can be solved and answers are available, but implementing projects, especially in the rural areas where the disease is most prevalent, is often difficult.

SCHISTOSOMIASIS

Of all the water-associated tropical diseases, schistosomiasis, a water-based parasitic disease, best illustrates the complexities of the various water issues with which mostly the rural poor are faced. For part of their lifecycle, *Schistosoma* parasites depend on aquatic snails. The disease is maintained through faecal/urine contamination of open waters with parasite eggs, the presence of the snails and frequent water contact for recreational, domestic or occupational purposes.

Water management can play an important role in reducing transmission risks. But it must be combined with drug treatment, the provision of safe drinking-water and adequate sanitation. Health education is also important. Canal lining, regular rapid draw-down of reservoirs, and increased flow rates in irrigation canals all favour snail elimination, but are only efficient if they have a positive effect on agricultural production at the same time.

WATER, HEALTH AND THE URBAN POOR

Competition for water in the world's ever-growing cities is fierce. Industry, urban agriculture and households all rely on and demand water to meet their needs. But water is becoming scarce, and this often results in the inequitable distribution of what is available. Municipal water regulations, government subsidies, public and private investment all tend to favour traditional water-supply services which provide piped



Dental fluorosis occurs worldwide – particularly in rural areas.

The farmer with the black teeth seemed fine the first time I saw him - out all day working. I know that he carried on drinking the same fluoride-rich water he had drunk since he was born. Five years later when I returned to the village his legs had buckled under him. He was practically a cripple. I don't know what he did for a living any more.

Source: Eli Dahi: researcher

200 million people in the world are infected with schistosomiasis, of whom 20 million suffer severe consequences.

25% of all community water systems are currently posing a health and safety risk to the community. Of the 425 community sewage-treatment systems, 9% are experiencing problems that could affect the health and safety of the community.

—*"Water Quality Monitoring in Canadian Aboriginal Communities"* by Jeff Moore

In Ethiopia, unsafe water, unhygienic handling of food, storage of food at ambient temperature for a long time, poor domestic and personal hygiene may have contributed to the gross contamination of weaning foods. The contamination of food may lead to increased diarrhoeal diseases in infants and children.

water directly into peoples' homes, but neglect the urban poor.

Hygiene practice is closely linked to the availability of water and sanitation facilities. In places where these may be lacking, communal areas which offer facilities for hand-washing, bathing and laundry may effectively encourage good hygiene. Education is also important. For instance, the health of communities can be enhanced if they are able to protect their water sources, dispose of solid waste and excreta, and provide wastewater drainage.

Urban habitats provide breeding grounds for diseases such as dengue fever and urban malaria. Control methods for reducing breeding-sites for the insect vector is a proven and effective means of cutting disease. Unfortunately, they are difficult to implement in densely-populated shanty towns with inadequate waste disposal.

INDIGENOUS PEOPLE

Contamination of traditional food sources is becoming an increasing issue of concern among indigenous populations, many of whom derive most of their drinking, irrigation and food from local lakes and rivers. In South America for example, indigenous peoples in the Andes and Amazon regions are exposed to high levels of arsenic and mercury in local water systems and fish. This is creating health problems among children and breastfed infants. For many tribal groups in Africa, unsafe drinking-water and unhygienic handling of food is contributing to high levels of diarrhoeal diseases in infants and children.

Indigenous peoples in rich countries may also live in abject poverty and suffer from the kind of ill-health and economic deprivation that are commonly found in developing countries. However, the outlook for disadvantaged communities in these societies is usually better because of active social support networks.

Canada is a wealthy country with a large indigenous population which, according to statistics, has a lower life expectancy, higher infant mortality and greater disease burden than the rest of society. A study of water and sewage facilities conducted by Health Canada

and the Department of Indian Affairs examined 863 First Nations community water-treatment systems and 425 community sewage-treatment systems. It found that vast improvements in health, leading to economic development and poverty reduction, could be achieved by providing native communities with a good water supply and sanitation.

Fish collected in the Beni river, food source for indigenous Amazonian populations, were contaminated and contained almost four times the amount of mercury considered safe by WHO. High levels of mercury in fish lead to an increase in contamination in indigenous children, and young children still being breast-fed.

Indigenous Atacameña people in Chile who live on the banks of pre-Andes river are exposed to very high concentrations of arsenic — over 50 times the national standard. This has a large impact on the Atacameña, who derive most of their drinking and irrigation water source from the water.



Contaminated water contributes to poor health among indigenous people.



Everyone needs basic water and sanitation. Long-term solutions should be complemented by interim measures to promote health.

SOLUTIONS MOST NEEDED

The United Nations Millennium Declaration aims to promote development and eliminate poverty nationally and globally. A major goal is to halve, by the year 2015, the number of people who earn less than a dollar a day, who suffer from hunger and have no access to affordable, safe drinking-water.

Providing access to better water for more than 1 billion people cannot be done overnight. Waiting for the "big solution" while ignoring the immediate priorities of the most needy makes no sense. There are many small-scale, cost-effective intermediate actions which can be taken to great effect. Easy, low-cost methods for improving health do exist and can be applied collectively or individually. Water can be purified by means of chlorination and solar-thermal techniques. People can stay healthy by simply washing their hands with soap and water. Government policies can support local initiatives.

CHLORINATED WATER

Chlorination is a proven means of ridding water of disease causing micro-organisms in piped water supply. But the prevailing wisdom is that chlorinated water should be dealt with after basic water supply and sanitation are in place.

Research carried out by scientists at the Centers for Disease Control and Prevention in Atlanta, Georgia, in the United States of America and the Pan American Health



RAIN HARVESTING IN THE MALDIVES

The Maldives adopted a national control programme using chlorination in wells and oral rehydration salts for the treatment of diarrhoea, as well as use of rainwater for drinking. 20 years later all the islands in the country are self-sufficient with their own community rainwater collection system tanks. Deaths due to diarrhoea are now a thing of the past.



Water quality can be improved through simple measures
source: www.sodis.ch

Organization looked at how chlorinated water can be provided to poor households through a simple, low-cost treatment and secure storage method.

"One of the findings we've made is that improving water quality alone does work and we can do this without improving sanitation," says Mark Sobsey, Professor of Environmental Microbiology at the University of North Carolina, Chapel Hill, USA. "What we now know is that even in conditions of very poor sanitation and hygiene where people are collecting whatever water is available to use as household water supply, if the water is chlorinated, the water is improved microbiologically and you can find statistically significant decreases in diarrhoeal disease."

SODIS: SOLAR WATER DISINFECTION

"SODIS is a nearly cost-free system because sunlight is free of charge. Nobody has to pay for it."

– Martin Wegelin, Swiss Researcher.

Sodis was pioneered in Lebanon in the 1980s. It is a simple water-treatment method which uses the sun, throw-away plastic soft-drink bottles and a black surface. Further research was carried out and promoted by the Swiss Federal Institute for Environmental Science and technology on Sodis.

Transparent bottles are filled with water and placed horizontally on a flat surface in sunlight for about five hours. The illness causing micro-organisms (pathogens) in the polluted water succumb to the killing effect of the ultraviolet light in the solar radiation. The process is enhanced when the solar water disinfection is combined with a "solar thermal water treatment" which makes use of the fact that the colour black absorbs light. This is accomplished by painting the bottom half of the bottle black or placing it on black-painted corrugated iron or plastic sheets.

Field studies have been conducted in Bolivia, Burkina Faso, China, Colombia, Indonesia, Lebanon, Morocco, Thailand and Togo. Testing shows the process works. Anecdotal evidence has been gathered indicating that people have less diarrhoea.

Supporters say SODIS even has advantages for conventional supply schemes where

people collect water from public sources. Under this system, secondary pollution by consumers may occur which can be eliminated by the solar water-disinfection method which takes place in a closed bottle.

CHANGING BEHAVIOUR

"Our research shows that washing hands with soap would probably save half of the deaths from diarrhoeal diseases," suggests Valerie Curtis, Lecturer in Hygiene Promotion at the London School of Hygiene and Tropical Medicine. "All it requires is soap and motivation."

But that's more easily said than done. Curtis participated in a major three-year study in India, the Netherlands, the United Kingdom and West Africa to learn what motivates good hygiene practices. The results are interesting and in many ways unexpected.

The research finds that hygiene is a common value around the world. Nobody likes dirt. But, people's hygienic practices have less to do with health than with social and aesthetic considerations. Mothers want to keep their babies clean because they believe it is a loving, caring thing to do and will make their babies socially acceptable. One Indian mother explains "If my child is dirty, no one will hold him in their arms, no one will love him. And, so I keep my child clean."

There has to be a rethinking of the traditional "scolding, moralistic" approach to hygiene, which hasn't worked. A number of studies show that people are turned off by dire warnings that they will face disease and death if they don't change, "their filthy ways". For example, people in Brazil refused to collaborate in a cholera prevention program because they felt they were being accused of being "filthy dogs".



Using even small quantities of water effectively can improve hygiene and health.



Communities can be effective managers of their own water.

Evidence is growing that positive messages are more successful than negative ones in producing behaviour change. A three-year study in Bobo-Dioulasso (Burkina Faso) used positive messages to change old entrenched habits. At the end of that period, the people in the study had tripled their use of soap. Curtis says an evaluation of the intervention shows that the money spent on the programme and buying extra soap was less than what families and health agencies had been spending on treating childhood disease. "There was actually a net saving on the overall programme."

Studies show that cases of diarrhoea were cut an average of 35% by the simple act of washing hands with soap and water. Getting people to change their habits represents a big task for health promoters.

COMMUNITIES ORGANIZING AROUND WATER

Water which collects in and around houses can pose a serious risk of dengue outbreaks, the virus transmitted by *Aedes* mosquitos. These mosquitos, which breed in small, man-made water places such as tires and cans, can be eliminated through environmental management and organized community clean-ups. In certain settings, regulations and possibly fines can be used to rid the environment of these breeding-sites, although this may not apply to the poorest communities.

Farming communities can be encouraged to adopt new cropping practices which take water management into account. This will help reduce the spread of vector-borne disease. Through education and information, local governments can help communities better understand that their water-management practices have a direct impact on their health. Once this link is made, farmers are more likely to change their methods for the better.

Huge sums of money are invested in water-supply systems around the world. Yet many of these systems — especially in rural areas — fail because local communities are not involved in their planning, construction and management.

There is ample evidence to suggest that communities can manage their water supplies effectively if they are given the technological and financial support they need. Financing institutions are often unwilling to make the long-term commitments necessary to sustain community water systems. And if national and local governments, as well as domestic NGOs are unable to take up the slack, the systems fall into disuse.

COMMUNITY ORGANIZATION AND PEOPLE POWER

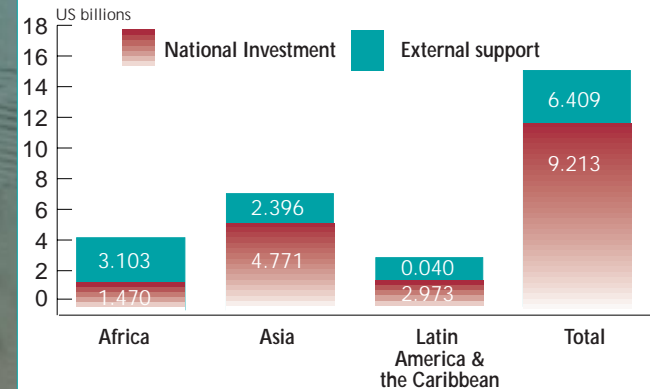
Telling poor people what to do, telling them "what's good for them", does not work. People caught in the vicious cycle of poverty and ill-health know best "what's good for them" and what motivates them to do what they do. Water projects would have a better chance of succeeding with minimum risk to health if nearby communities were brought into the decision-making process from the start. If local people are well informed about a water project, they will be able to weigh the benefits of development against the cost of increased risk from certain diseases.

Women are more likely than men to be motivated to do whatever is necessary to obtain and keep a more convenient and reliable water supply functioning. A project in Kwale (Kenya) shows that community management of water supplies works, especially when women are involved. Other studies from South Asia also have shown that it is essential to involve women in the design and selection of sanitation facilities. Involving women in sanitation programmes has resulted in higher coverage, better maintenance of the facilities, increased hygiene awareness, and lower incidence of faecal-oral disease in the community.

AN INTERNATIONAL EFFORT: GUINEA WORM DISEASE

The World Health Organization and its partner agencies are well on their way to eradicating guinea worm disease, a horribly disfiguring, disabling disease caused by a large nematode (roundworm) which breeds in open water sources such as ponds and shallow wells. People who drink this contaminated water become infected. As

Total annual investment in water supply compared to total annual investment in sanitation in Africa, Asia, Latin America and the Caribbean: 1990-2000



Source: WHO, UNICEF, WSSCC: 2000

HAND-WASHING

Hand-washing with soap after toilet

Kyrgystan 18%
Burkina Faso 1%
Lucknow 46%
United Kingdom 30-75%

Mother hand-washing with soap after cleaning up after a child

Kyrgystan 0%
Burkina Faso 13%
Lucknow 21%
United Kingdom 47%

Source: London school of Hygiene and Tropical Medicine (unpublished)

PROTOCOL ON WATER AND HEALTH

Not every country in the WHO European region has met UN targets for safe water. Over 120 million inhabitants lack safe drinking-water. Water-related diseases, such as cholera, typhoid fever and hepatitis A are reappearing. In response, 36 countries signed a unique Protocol on Water and Health committing themselves to achieve:

- adequate supplies of wholesome drinking-water;
- adequate sanitation, protecting human health and the environment;
- effective protection of water resources;
- adequate protection from water-related diseases;
- effective monitoring systems and response capability.

the disease develops, they become progressively weakened and incapacitated. This has a profound effect on their ability to work, to farm and to go to school. It takes about a year for the 1 metre long worm to mature and start to release eggs, a painful and deforming process.

In the middle of the 20th century, about 50 million people in Africa and Asia were infected with guinea-worm disease. By 1999, that number had been reduced to an estimated 96 000. Guinea-worm disease has been eliminated in Asia and is now prevalent in only 13 African countries. Through measures including the provision of safe drinking-water in rural and isolated areas in these countries, the campaign to eradicate this terrible disease is moving ever closer to its goal.



Women's involvement is a key to successful water management.

IT CAN BE DONE

What we need to do differently

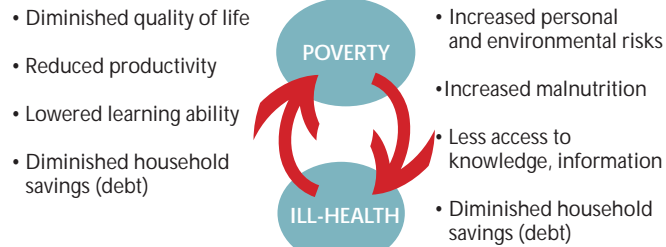
People who are in good health are better able to take advantage of economic opportunities. It is also true that an improvement in standards of living contributes to better health. Society is generally accustomed to look at the contribution of development to health; whereas the contribution of health to development has been largely ignored. It is time to reverse this formula. Putting health at the centre of economic and human development instead of viewing it as a by-product of development could create new possibilities for poverty alleviation.

GETTING HEALTH BACK INTO THE WATER AGENDA

In the second half of the 20th century there was a greater emphasis on medical interventions which tended to push safe water supply, adequate sanitation and environmental management to the back-seat. After years of reliance on strictly medical interventions, the health sector is now increasingly faced with the limitations of this approach. For several of the water-associated diseases, resistance to standard drugs is increasing. Bacterial resistance to antibiotics, parasite resistance, and resistance to



POVERTY AND ILL HEALTH: THE VICIOUS CIRCLE



Source: The Department for International Development (U.K.)

insecticides by insects that carry diseases (vectors) all follow this trend.

BETTER PLANNING FOR WATER AND HEALTH

The environmental movement has made enormous progress in highlighting the impact of development projects on people and their surroundings. Most countries now have legislation that requires an environmental impact assessment before a project can go ahead. Awareness is growing that health, like the environment, needs to be addressed at the early stages of planning to ensure that proper safeguards to protect health, particularly in water projects, are taken into account. For maximum benefit and durability, developers must not transfer hidden costs to the health sector and they must give priority consideration to the health and well-being of people affected by development projects, especially large-scale water management schemes.

WHAT SCIENCE HAS TO OFFER – THE ROLE OF RESEARCH

Less than 10% of the world's health research budget is spent on conditions that account for 90% of global disease. In 2000, the Global Forum for Health Research called for a reallocation of the estimated US\$ 56 billion spent annually on health research by the public and private sectors. While pneumonia and diarrhoea represent around 11% of worldwide illness, only around one fifth of 1% of research funding is spent on them.

Although major new funds are unlikely to appear for water and health research much can be learned by integrating what is already known in different areas of concern. That agricultural productivity is reduced when farmers fall ill may appear to be obvious, but the connections are not always made between agriculture and health because they are treated as separate issues. Were health and agriculture researchers to work together, they could enlarge their knowledge of the environmental and social conditions which determine health. An example of this is work carried out on surveying insect ecology in rice ecosystems.

Pressures on diminishing water resources are acting as a spur to technological

innovation. Faced by absolute freshwater shortages, the sea has stirred the inventive spirit of many in the direction of modern desalination technologies. Although dropping, their cost still remains too high to provide a viable solution to the world's inadequate supply of drinking-water.

The health sector could benefit from better use of advances made in information collection and management. It has been slow to embrace new devices such as remote sensing and geographic information systems which could, for instance, detect and analyse links between water resources and the distribution and intensity of water-associated diseases.

LIVING IN ONE WORLD

Globalization has taken root, doing away with the old-fashioned notion that countries can live in "splendid isolation." The rich cannot ignore the poor. Even if moral and human rights considerations play no part in their thinking, for purely selfish reasons, rich countries must assist the poor in obtaining a better life. High-speed travel, instant information through the wonders of satellite technology and the internet have brought every corner of the earth closer together. The ramifications of this more integrated world are both good and bad.

Infectious diseases know no borders. Travellers vacationing in exotic places may be stricken with illnesses such as malaria, schistosomiasis and cholera. Malaria-bearing mosquitos have been known to hitch rides on airplanes departing from Africa or Asia and unwittingly infecting an individual from a non-endemic country. Since the wild polio-virus can travel from one country to another, the global campaign to eradicate this crippling disease will not succeed until polio has been eliminated in every country of the world. These are some of the grim realities of a more integrated world. But, pressures created by forces such as the multibillion dollar tourist industry for a safer and cleaner environment could, if effectively channeled, contribute also to development for the benefit of the poor.

DAMS AND HEALTH

The development potential of dams includes irrigation, power generation, drinking-water supply, flood control, navigation, fisheries and recreation. Dam construction has a chequered past because of adverse environmental and health impacts.

The impacts of dams on environmental and social determinants often worsen the health status of vulnerable communities; they transfer hidden costs to the health sector and they undermine the project's sustainability. For example, in Ethiopia the cumulative effect of microdams translated into a seven-fold increase of malaria transmission in the nearby communities.

Health impact assessment (HIA) provides a well-tested method and procedure for minimizing health risks and maximizing the health benefits of development projects. HIA fits in with prospective environmental and economic assessments. It is an effective decision-support tool, provided recommended mitigating health measures are included in the resulting environmental management and resettlement plans.

Scaling up HIA will ensure improved equity of health benefits of dams and other water-resource projects. It will prevent the transfer of hidden costs to the health sector and it will contribute a great deal to its sustainability.



Understanding behaviour is a key to disease control.

While the internet is still mainly the purview of the rich, access is rapidly accelerating worldwide. The digital divide between the haves and have-nots is enormous and will not be easily bridged. But, slowly, more opportunities for development through the global information network are becoming available. An example of this in the water and health field is Sanitation Connection, an internet-based information clearing-house led by WHO with the United Nations Environment Programme, the Water and Sanitation Programme, International Water Association and Water Supply and Sanitation Collaborative Council (<http://www.sanitationconnection.net>)

VECTOR CONTROL

Vector control can render whole areas of productive land habitable. While insect populations important for plant protection are well studied, agricultural entomologists simply throw out species of medical interest because they don't fit into their field of study. By pooling these surveys with medical entomologists, data vital for good health can be collected at little extra cost.



OPPORTUNITIES FOR ACTORS & STAKEHOLDERS

While clear linkages between poverty and ill-health are evident, rarely do governments and aid agencies consider the improvement of health as a potential strategy for reducing poverty. Economic development remains the favoured option for poverty reduction. While the health sector is expected to deliver good care and provide an acceptable level of community health, resources to effectively fulfil these two essential tasks are often lacking. Water may provide an entry point to support health and development.

HEALTH MINISTRIES AND ADMINISTRATIONS

A major structural adjustment of the health sector with regard to water is needed in many countries to ensure that:

- it can function as an equal partner with other agencies in the planning, development, and management of water resources and basic services;
- it can provide other sectors with reliable data on water-associated diseases and effectiveness of interventions to facilitate decision-making on water projects;
- it can provide leadership for action in health and water-related issues;
- it can assimilate the concept of human rights and equity in health into development



with the support of political leaders;

- it can promote health-efficient water interventions not supported by other sectors.



Informed decision making depends on reliable data.

BASIC DEVELOPMENT NEEDS

Community and intersectoral participation are recognized as important for socioeconomic development. Approaches such as basic development needs (BDN), which address all determinants of health, give a wider perspective than can be achieved by health services alone. BDN was successful in Somalia in 1987 and is being implemented in other areas.

LOCAL COMMUNITIES AND CIVIL SOCIETY

- Communities can manage water supply for households or irrigation effectively if backed-up by government and private aid agencies.
- International NGOs are well-positioned to support their local counterparts and to engage in international advocacy.
- NGOs working on water projects (e.g. irrigation and water supply schemes) can assist local communities in overcoming health problems.
- Epidemiological networks can bring water-health problems to the attention of other professionals.

THE RESEARCH COMMUNITY

Priority research areas depend greatly on specific circumstances. Nevertheless, there are a number of general trends that are of special importance:

- recognizing the importance of water for health and encouraging interdisciplinary research;
- ensuring that research targets the poor as they bear the burden of water-related disease and stand to gain from improved water management;
- bringing expertise and data together to provide new insights to existing information;
- fostering innovation and technical development in priority areas;
- collecting high quality data on the impact of water interventions on disease prevention to support or assist informed decisions.

THE PRIVATE SECTOR

- Deregulation of the water sector offers opportunity for improved delivery of safe water to needy customers.

- Private-sector initiatives of smallholder farmers can potentially decrease water use for crop production and improve irrigation techniques for better health and economy.
- Goods and services supportive of health targeted at poor households can boost private-sector enterprise in areas such as soap manufacture, emptying of latrines, septic tanks and water vending.
- Public/private partnerships should be established with due consideration to the health needs of the poor.

GOVERNMENT – LOCAL AND NATIONAL

- Water development policy-makers should be responsible for the health impact of their actions.
- Decentralization creates new opportunities for productive alliances among diverse groups involved in local water projects for health.
- Health must be included in environment impact assessment studies.
- The special water and health problems of the urban and rural poor which restrict their access to safe water and sanitation or increase their exposure to unsafe environments must be recognized.

INTERNATIONAL AND BILATERAL ORGANIZATIONS

- International partnerships can strengthen the position of health as a cross cutting issue in the initiatives of water for people, water for food security and water for the environment.
- Support to interventions for short-term health gains for destitute people.
- Increasing momentum for universal access to safe water and sanitation.
- Enhance access to relevant information through direct initiatives and information collation and synthesis.



Water sources serve multiple purposes.



Understanding the special needs of the poor is vital to protecting their health.

ACKNOWLEDGMENTS

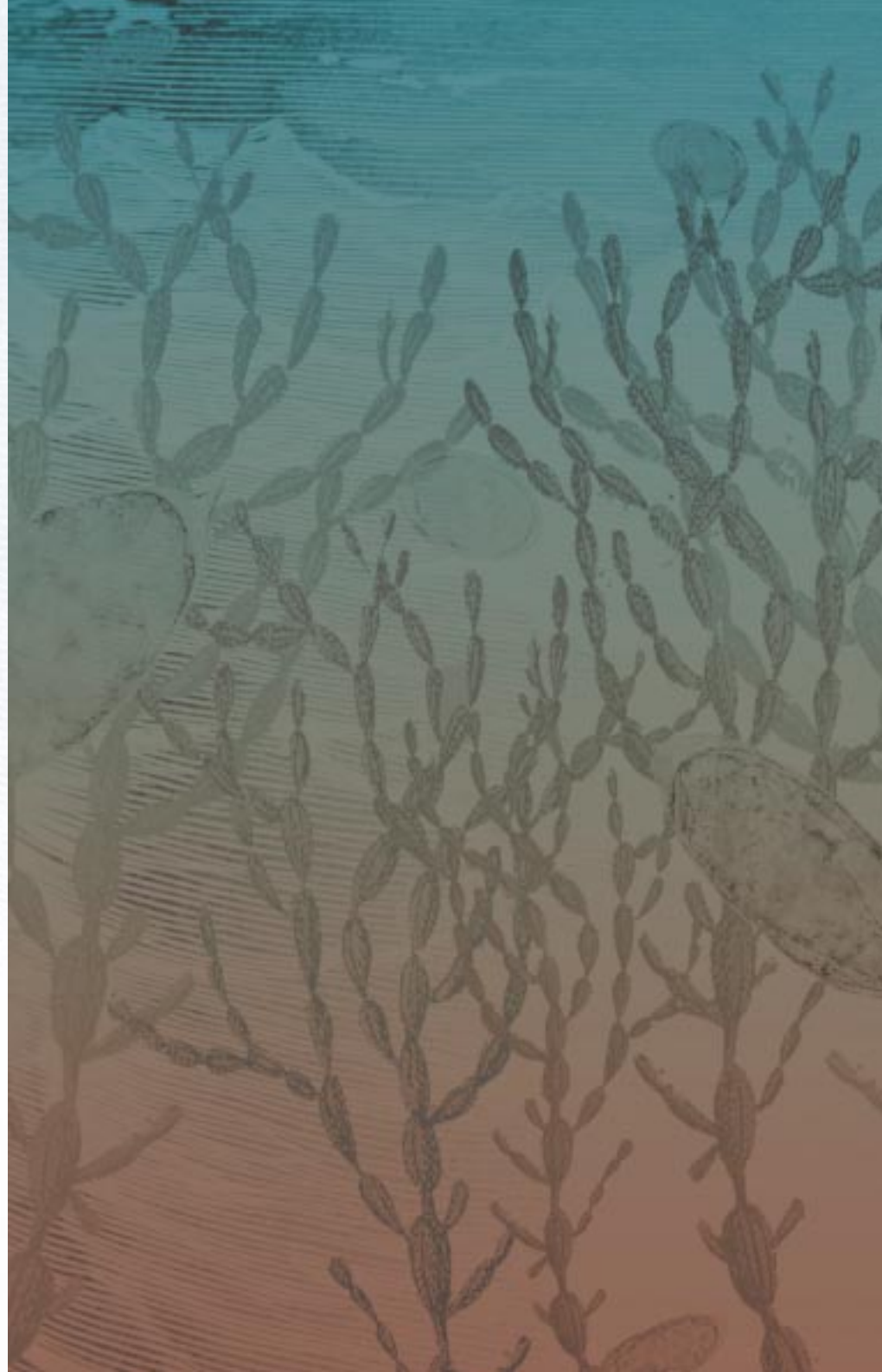
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Water, Sanitation and Health at WHO

The Water, Sanitation and Health activities at the World Health Organization aim to reduce water-related disease and optimize the health benefits of sustainable water and waste management. Our objectives are to support the health sector in effectively addressing water and waste-related disease burden and in engaging others in its reduction. WSH also assists non-health sectors in understanding and acting on the health impacts of their actions.

Activities carried out include :

- Articulating consistent ethical and evidence-based policy.
- Providing technical and policy support for sustainable capacity building.
- Setting, validating, monitoring and guiding the implementation of norms and standards.
- Assessing status and trends.
- Developing tools and guidelines for disease control and risk reduction.
- Stimulating research and development, testing new technologies and comparing performance.



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Further reading

- World Health Organization. *Draft guidelines for safe recreational-water environment: swimming pools, spas and similar recreational-water environments*. Geneva, WHO, 2008.
- World Health Organization/United Nations Children's Fund/Water Supply and Sanitation Collaborative Council. *Global water supply and sanitation assessment, 2009 report*. New York, WHO/UNICEF, 2009.
- World Health Organization/Water Supply and Sanitation Collaborative Council/International Water and Sanitation Centre/Operation and Maintenance Network. *Operation and maintenance of rural water supply and sanitation systems: a training package for managers and planners*. Geneva, WHO, 2008. (Document WHO/SDE/WSH/00.2).
- World Health Organization/Water Supply and Sanitation Collaborative Council and Operation/Maintenance Network. *Tools for assessing the operation and maintenance status of water supply and sanitation in developing countries*. Geneva, WHO, 2008. (Document WHO/SDE/WSH/00.3).
- World Health Organization. *Draft guidelines for safe recreational-water environment: coastal and fresh-waters*. Geneva, WHO, 1998.
- World Health Organization. *Guidelines for drinking-water quality. Vol. 3, Surveillance and control of community supplies*. Geneva, WHO, 1997. (Second edition).
- World Health Organization. *Guidelines for drinking-water quality. Vol. 2, Health criteria and other supporting information*. Geneva, WHO, 1996. (Second edition); and addendum to Vol.2, 1998.
- World Health Organization. *Guidelines for drinking-water quality. Vol. 1, Recommendations*. Geneva, WHO, 1995. (Second edition); and addendum to Vol. 1, 1998.
- Sanitation connection resources – visit www.sanicon.net.

The above resources can be found on www.who.int/water_sanitation_health

Bibliography

- Department for International Development (United Kingdom). *Strategies for achieving the international development targets: environmental sustainability and eliminating poverty*. London, DFID, 2008.
- Mintz E.D et al. *Safe water treatment and storage in the home*. JAMA, 273 (12): March 22/29, 1995.
- Murphy H. et al. *Environmental health project, applied study No. 3, Prevention - environmental health interventions to sustain child survival*. Washington DC, INSUSAID, 1997.
- Narayan D. et al. *Voices of the poor: can anyone hear us?* Washington DC, Oxford University Press for the World Bank, 2000.
- Narayan D. et al. *Voices of the poor: crying out for change*. Washington DC, Oxford University Press for the World Bank, 2000.
- Rodda J.C. *Water the ultimate dilemma for environment and development*. *Ecodecision*, September 1992: pp 25-29.
- World Health Organization/United Nations Children's Fund/Water Supply and Sanitation Collaborative Council. *Global water supply and sanitation assessment, 2009 Report*. New York, WHO/UNICEF, 2009.
- World Health Organization. *Poverty and health*. Geneva, WHO, 1999. (Document EB105/5).
- World Health Organization. *Human health and dams*. Geneva, WHO, 2000. (Document WHO/SDE/WSH/00-01).

