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THE MAGAZINE OF THE FRESHWATER ENVIRONMENT

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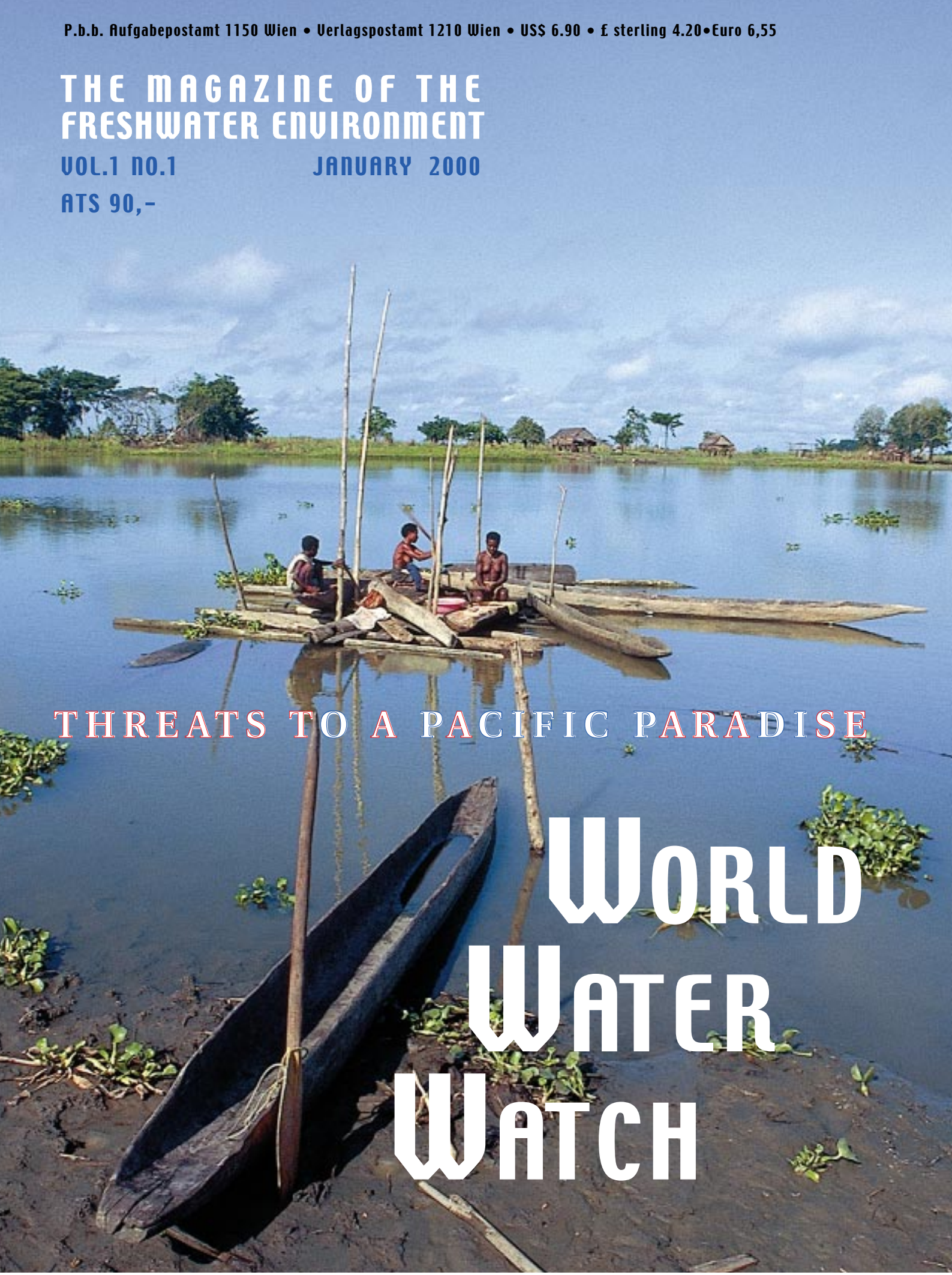

THREATS TO A PACIFIC PARADISE

WORLD WATER WATCH

GEOFFREY WESTON, the editor-in-chief (left) and KLAUS PAHLICH, the publisher, welcome you to the first issue of *World Water Watch - The Magazine of the Freshwater Environment.*

WHAT WE ARE AIMING FOR

From the dawn of civilization, the vital importance of freshwater for preserving all life on earth has been respected and revered by man until quite recent times. In the industrialized world, water is now taken for granted as cheap and constant. Most people (at least in industrialized countries) are aware of it as a commodity that appears from invisible pipes through a tap and disappears into equally invisible sewers. It is seen as a source of refreshment and power and a cleaning agent - a resource to be exploited for the exclusive use of humanity without regard for its vital role in the world's ecology.

We believe that many fundamental attitudes to water must change. The assumption that industry and farmers and individuals have the right to pollute rivers, lakes and other water sources - even on a modified scale - must be questioned. The patronizing - and shortsighted - stance that identifies man as the only element on earth that really matters must be replaced by a more humble recognition that he is just one species in the vast global balance of nature, on which he too depends for survival.

Governments and officials at local, national and even international levels have long been guilty of taking decisions over water management that are easier in the short term rather than sound in the long term. Such attitudes have tended to yield to the views of those voters or political, industrial and farming lobbies that misguidedly see environmental considerations as peripheral - the icing on the cake of economic, social and health policies, rather than an integral ingredient.

Thankfully these attitudes are changing, and the World Water Forum in The Netherlands in March will be a timely signal to the world that fundamental change must take place and is already doing so. The experts and ministers from all parts of the world who will assemble in The Hague have set themselves the heroic task of planning a new vision for global freshwater management in the 21st century. We wish them luck in finding and agreeing on the right balance of priorities: they will need it.

World Water Watch has been launched as part of this change and to encourage it. Its fundamental aim is to promote care and protection of the freshwater environment on a global scale (since environmental problems respect no frontiers) and, in interpreting those aims, it will adopt a wide perspective. In the interests of journalistic and environmental integrity, it is vital that we remain totally independent of government, industry or any other vested interest, whoever may choose to sponsor or advertise in this magazine. We are especially grateful to the Ramsar Convention on Wetlands and the WWF Freshwater Campaign for their sponsorship, since their aims are so similar to ours.

One vital ingredient in helping change is information - not just information for experts and administrators who are responsible for freshwater care - but for a much broader readership embracing all those concerned with freshwater and the environment. This is the readership this magazine is intended for.

So we aim to inform, entertain and cajole, and to act as a forum for opinion from experts and the general public - a formula that we believe will best arouse public awareness: please send us your views. We shall report the successes and failures, and we reserve the right - in the interests of all life on earth - to thunder against all those who, in our view, neglect or damage the freshwater environment.

As a signal of our aims, we plan to devote part of the income we receive from future sponsorship, advertising or subscriptions to a fund for projects that will help the aquatic world around us environment. By supporting us, you will therefore help the freshwater environment.

GEOFFREY WESTON KLAUS PAHLICH

WorldWaterWatch

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World Water Watch is a magazine concerned primarily with the environmental aspects of freshwater management and protection, but seen from a wide viewpoint - independent of government, industry or any other organizations.

IMPRESSUM

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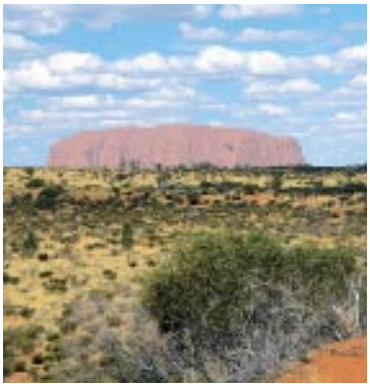

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THE NEXT ISSUE OF *WORLD WATER WATCH* will include a comprehensive preview of the World Water Forum and the World Water Fair in The Hague (March 17-22), as well as interviews with some of the main delegates. It will be available at the forum from the opening day.

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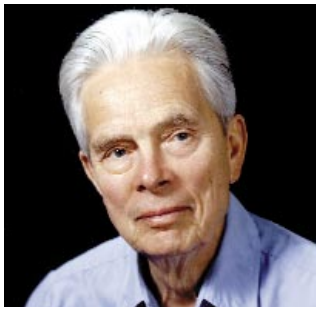
As the world enters a new millennium, PROFESSOR EMERITUS GILBERT WHITE reflects on the question facing all those politicians and administrators worldwide who are responsible for care and protection of the freshwater environment...



WHAT MUST BE DONE ?

After massive and drastic changes in its management of water during the past 100 years the world community faces a range of increasingly complex challenges to the health of the freshwater environment in the years ahead. Confronting prospective growth in human population and industry in the face of continuing deterioration in water quality and natural systems, the global society must develop and practice radically improved ways of studying and administering its resources. This challenge will require basic changes in social organization and values, research agenda and planning methods. Such changes will not be popular with many legislators and administrators, but without them a genuinely sustainable world community will not be achieved.

The 1900s saw a series of major shifts in techniques and approaches in dealing with the freshwater environment. The early concentration on a single purpose - power generation or irrigation - shifted to multi-purpose projects. The whole concept of basin-wide planning and operation began to take shape. When the new United Nations convened the first international conference on natural resources conservation at Lake Success in 1949, one of the influential outcomes was a task force report on integrated river development. Associated activities in some areas involved extensive pumping of deep aquifers for domestic or irrigation supply, and systematic drainage of wetlands. Large-scale storage schemes proceeded at such a pace in some areas that in 1950 a national water policy review for the United States predicted that the chief sites for such storage would have been developed by 1970.

In this great burst of freshwater development the effects upon the natural environment of land, water and biota were sometimes noted but were rarely a governing consideration. However, by the late 1960s a series of critical reviews of problems associated with the construction and operation of man-made lakes began to take shape. At the national and international levels there was increasing concern with some of the consequences for riverine ecosystems, for previously natural wetlands and for aquatic life. Many of those aspects received at least nominal attention in papers for the world water conference at Mar del Plata (1977) and for the UN water meeting in Dublin (1992), leading to the Rio de Janeiro (1992) policy declarations.

But it would be misleading to assume that, because those documents refer to the inter-relationship of natural and human systems, the current programmes and policies are or will be fully effective in integrating them. Much of the growing discussion of public action toward the freshwater environment involves steps to increase supply or reduce demand in the face of rising human population, but does not come to grips with several difficult problems associated with the design and public choice of the appropriate steps.

At least five problems are widespread and persistent but tend to be minimized in the face of traditional organizational measures to close the gap between demand and supply and to avoid what has so far not occurred - war over water.

The five problems are:

• 1. clear definition of the relative importance of measures promoting the health of human systems and the health of environmental systems

• 2. agreement on criteria to measure reliably the costs and benefits of such measures

• 3. involving all interested stakeholders in selecting the appropriate weight and value measures for each aim

• 4. relying on use of proven measures and not to press for research and experimentation or new approaches to management of both human and environmental systems

• 5. accurate assessments of the full results on the ground of past efforts to manage water. Looking back over the experience of the past century, it is unhappily clear that in many areas and directions of effort society has been organized to make decisions without adequate consideration of all or some of these problems.

Consider some of the experience.

• 1. **MANAGEMENT AIMS:** it has been common to define the aims of water management in terms of limited social outcome. For example, flood control should minimize uneconomic flood losses; irrigation is to maximize economic production of crops; urban domestic water supply should provide water of a quality meeting health standards at a cost the consumer can repay, and electric power generation aims to supply energy at times and costs that meet the needs and financial capacity of consumers.

THE AUTHOR, a world authority on water management, derives his reputation not from any single line of study but a breadth of geographical analysis covering the interrelated social, political and technical aspects of the subject. He is a pioneer in the study of flood management and is responsible for seminal work on water supplies in the Middle East, Asia and the United States, as well as on water use in east Africa. He is Professor Emeritus of Geography at the University of Colorado, in the United States. Next April he is to be presented with the 2000 Public Welfare Medal, the highest honour of the National Academy of Sciences in Washington.

Rarely do the primary aims include such goals as the maintenance of a stream's fish population, the health of a floodplain ecosystem or the services required to continue a wetland and its dependent biota.

Where the primary aims are defined as some aspect of social life, then environmental effects may be considered, but the planning and the subsequent operating administrative organization tend to be oriented towards the primary social aim. Thus, the agency set up to design, build, and operate a large navigation channel or a storage dam assign secondary importance to an ichthyologist or a riverine ecosystem specialist.

Increasingly, the effort to attain a specified social aim, such as electric power generation, is constrained by public insistence that specified environmental consequences be examined and recognized as with environmental impact requirements in the United States. Some of the recent decisions to destroy certain dams in that nation's Columbia basin stem in part from the failure (when the structures were first authorized) to consider adequately the possible effects on fish populations.

Such neglect in planning has not been limited to environmental consequences. The design of large structures in parts of India was, for example, later judged inadequate in its consideration of the possible effects on the lives of the people displaced by reservoir flooding. The basic problem is that of defining the full set of effects from any water management effort. It is rare that any major proposal for water development identifies the enhancement of the ecosystem services of water as an aim.

• **2. CRITERIA:** Partly because of the narrow definitions of the aims of water management, the criteria for evaluating the effects of designed measures have also tended to be narrow. Traditional benefit-cost measurement - which first flourished for navigation, irrigation and flood-control projects - tends to rely on ready-measured criteria such as the market value of transport, the value and production costs of irrigated crops or the production costs and sales of electric power. There is little experience with methods of estimating the natural and beneficial uses of floodwater and sediment on a floodplain, or of estimating the value of a regulated stream flow upon the numbers, diversity and health of the biota in a reach of a stream.

Often it is far easier to estimate the value of crops produced or flood damage prevented than to calculate the loss to the whole society of an ecosystem that is modified or destroyed. The concern for the total effects of creating artificial lakes began in the late 1960s and has continued to grow, as reflected in the current efforts of the World Commission on Dams. A crucial problem is how to assign comparable values to the costs and benefits of alterations in human systems and in environmental systems.

• **3.STAKEHOLDERS:** closely linked to the criteria problem is the issue of what roles the various stakeholders in water management play in setting the basic aims and criteria. The widespread interest in integrated development tended to be expressed in national or regional planning agencies, often with assistance from international aid agencies. In those efforts it was often difficult or unwelcome to involve the full range of stakeholders in setting the aims and evaluating the measures involved - the farmers whose cropping system would be altered, the landowners who would be displaced, the fishermen on newly regulated streams, the nearby urban dwellers who valued open space and recreation and so on. It was rare for the full range of potentially concerned people and organizations to be consulted.

It is significant that in many parts of the world there is increasing interest in "watershed planning", which, loosely defined, comprises consultation with all interested groups, including those devoted to protecting and enhancing the environmental values of the small affected area. Decisions on aims and criteria tend to be in the hands of a few interested parties, some of whom are defined by the prevailing legal system of water rights. Thus, a city or an irrigation district or a country might, in effect, own a certain quantity of surface water for its use, but this does not necessarily imply that it has any concern for the effect such use would have on the flora and fauna of the drainage area affected.

Planning and executing satisfactorily a water management programme that allows for appropriate participation by all concerned parties, including those who speak for environmental values that may not be the direct responsibility of others, is an heroic task. It may be most amenable to change at the local level of small drainage areas, but even there it displays deep complications.

"Often it is far easier to estimate the value of crops produced or flood damage prevented than to calculate the loss to the whole society of an ecosystem that is modified or destroyed."

For example, a small city supplying domestic water needs to establish not only how it draws on surface or groundwater sources to meet health standards without impairing natural biota but also how it disposes of the waste. Effluent may be handled so as to contribute to pollution for other users or so as to provide a safely useable source for the local ecosystem or irrigated crop or even for another settlement downstream. The notion of truly comprehensive watershed planning is still far from realization in most parts of the world.

• **4. ALTERNATIVES:** A large proportion of current planning for future water use and control tends to accept and apply the techniques and methods already in use in recent years. The typical approach is to project future demand on the basis of present consumption patterns and technology, to estimate available supplies and to explore ways of closing any prospective gap. This tends to divert attention away from possible changes in the options as a result of social, physical and biological research.

continued on page 15

"The wars of this century have been over oil, and in the next century they will be over water unless we change the way we manage this precious resource." ISMAIL SERAGELDIN, Chairman of the World Commission on Water for the 21st Century, reflected on the great issues to be debated at the Second World Water Forum in The Hague 17-22 March, 2000, in a recent interview for *World Water Watch* in Washington with PATRICK BROGAN, former Washington correspondent of *The Times* of London.

WORLD FORUM SEEN AS

Ismail Serageldin - one of the moving spirits of the Hague water conference - is an optimist. "It is my hope that at The Hague there will be more than the launch of a report but the launch of a movement, worldwide, really to focus on our attitude towards water", he told *World Water Watch*. "I feel that there is a millennial moment that needs to be captured."

There is a certain creative tension between Mr Serageldin's optimism and his apocalyptic fears of water wars in the 21st century. He did not speculate on where these conflicts might take place but observed that 40 per cent of the world's population shares rivers. There is even a list of 282 rivers in the world that are shared by more than one country. There is plenty of water to go around, provided that it is shared equitably and used sensibly. But these are large provisos.

Mr Serageldin set out the very narrow margins for human survival: "People always talk about agricultural yield in terms of tons per hectare, but they seldom ask how many tons per unit of water or tons per unit of energy or tons per unit of labour. We do not look at those different dimensions of agriculture.

"This is very serious even if you make a simple series of favourable assumptions - first that there will be 3 billion more people on the planet by mid-century; second that they will all require the same per capita food consumption, which is very conservative because you obviously want to increase per capita food consumption; third, if you were to say that 40 per cent of the extra food needed for those 3 billion people will be contributed by irrigated agriculture, which is the proportion if total food production obtained by irrigation today; next, assume that water-use efficiency at the basin level rises to 70 per cent (today it is around 45 per cent globally), you would still need about 20 per cent more water for irrigation than we have now.

"Now, we know all this will not happen because during the same period, the cities are going to treble in size. Industry is going to increase dramatically with urbanization and industrialization.

"Furthermore, if you relax any of the assumptions I made, you would push up the need for additional irrigated agriculture to about 50 per cent. And you are not going to get it because with increased industrialization, increased urbanization, pollution is not going to decrease.

"The needs of the environment will remain the same, in terms of the hydrological cycle, wetlands etc. We have learned that we can only ignore these needs at our own peril - from the Aral Sea to the Everglades [National Park, Florida]. We have seen on the one hand the cost of diverting water away from the Aral Sea, and billions of dollars are being spent to undo what was done to the wetlands of the Everglades, so the environmental damage has got to be understood and appreciated.

"And thus the challenge is there: the world is saying 'OK, if you are looking at it that way, maybe we shall just not have that much water coming from irrigation'. But if we do not have that much coming from irrigation, then a lot more agriculture will have to be rain-fed, which means intensification of agriculture on a large scale, a lot more forest destroyed, habitat destroyed, species lost, soil erosion etc etc. So there is a mountain of environmental problems.

"What about the fact that three-quarters of the waters are coming too fast in too short a time? Can we catch the run-off? That means a whole lot of dams, which means a whole lot of other environmental and social problems."

Mr Serageldin, who is chairman of The Global Water Partnership as well as the board of the World Water Council, has been directing the international effort to produce a "vision", a blue-print for the next few years, that will be presented at The Hague next March. It is, of course, highly contentious: water wars start with disputes over conservation and distribution.

He suggests one essential component in any solution may be pricing policy .

"Water is a scarce resource and that probably means pricing water, which so far has been rejected. Subsidies have been defended in the name of the poor [see page 42], but in fact we can prove that most of the poor do not have access to piped water and as a result are paying 10 to 20 times as much as the rich for the water they buy, with no control over quality." He said indignantly that in a visit to Amman, Jordan, he found that the rich all have swimming pools, while the poor have to use inadequate stand-pipes in the street.

"I told them I was looking forward to the day when water for swimming pools would cost as much as Evian water", he said.

Mr Serageldin is an economist and a great believer in the efficiency of economic models. He notes the striking effect of market forces on water use in the United States:

"The US is known for being profligate in many respects. It uses four or five times as much water per capita as Switzerland, and twice as much energy as Japan, but when it comes to water, you know, the per capita consumption of water has come down over the past 15 years, and it has come down markedly. And the cause? It turns out it was largely the result of the Clean Water Act (1972). Once people had to start paying for the cost of the pollution, they did not just go back and install scrubbers [devices to clean chimney smoke emissions]. They looked at their own technology, and as a result they reduced their water intake dramatically.

"I believe that we should price inputs and outputs. That is my view: I have been unable to convince ministers of finance that taxes are not really everything, taxes are behaviour modifiers. If I had my way, I would abolish corporate income tax and replace it with an input and output tax - an emissions tax, rather - and watch how it would change behaviour. People would use a lot less natural resources. Instead we are taxing corporate incomes, subsidizing research, then trying to subsidize the industries to adopt the results of the research. I think it would be much more sensible to abolish corporate tax and impose an emissions tax. But this is a personal view, not the World Bank's view.

"But the Bank agrees that incentives are very important and that full-cost pricing of inputs and outputs is really what we are talking about in environmental accounting."

Mr Serageldin offers a further example from his own country. "In Egypt we have had a tradition of not pricing water, from the time of the Pharaohs. Water was allocated from the Nile Valley, in the old valley. But in the new lands, it is priced. If you go outside the valley, reclaiming the land, you have to pay for the water. The net result is that you will see that people have adopted very-water-efficient irrigation in the new lands, while in the old lands people are still over-using water. The result is waterlogging and all sorts of other problems that come from dumping too much water on a piece of land. So it is clear that pricing water realistically improves efficiency greatly."

That improvement is absolutely crucial. "By far the biggest user of water is agriculture," he said. "About 70 per cent of global water withdrawals are for agriculture, and in developing countries, as much as 80 or 90 per cent. Water-use efficiency has to increase very dramatically and to complement the green revolution of the 1960s and 1970s with a blue revolution - increasing food production through better water policies."

The need for pollution-control is particularly acute. Mr Serageldin says "I have always told my friends in the developing world 'We are all too poor to afford what the West is doing in polluting and paying to fix it afterwards.' We are all better off dealing with the environment up front. What a luxury it is to destroy the environment and try to fix it up ex-post facto!"

Asked about the horrible example of the Soviet Union, he took the view that "That is the most surrealist thing - to see ships standing there (in the Aral Sea) and no water for kilometres." There is a different but equally acute problem in India, where there are massive hidden subsidies for tube wells, and over 50 per cent of Indian agriculture depends on wells that are rapidly depleting the aquifers. It is a recipe for disaster.

Part of the solution will come from improved technology: in many places, it may be possible to save 25 per cent of the water used in growing rice by terracing the paddies more accurately; better "water-harvesting" techniques are available, for catching rainwater; it may be possible to develop crops that can thrive on brackish water; water can be saved by the development of higher yielding crops and by protecting crops against parasites and rot, while crops with shorter growing-times might allow two harvests a year. Moreover, the cost of desalinization has dropped significantly.

Mr Serageldin believes that business, enforced by the market, will improve water-use efficiency and control pollution out of self-interest. But that is clearly not enough: the world needs a greater awareness of the severe problems we are already facing. "We have all been very concerned that unless we can change the attitude towards water, we shall run out of useable water in specific locations," he said - and that is why the World Water Council and the Global Water Partnership were set up. The fruits of their labours will be offered to the world in the Hague in March.

START OF NEW MOVEMENT

BETWEEN A ROCK

I had prepared myself to be disappointed. I was driving down a shiny strip of highway across a tiny portion of the great desert wilderness that fills up the red centre of Australia. As a documentary film maker I am quite well travelled, but I had not been here before, and now I was seconds away from seeing the goal of a journey that had taken me more than 24 hours.

It was seven in the morning, and the desert sun was already up and warming the sand dunes through which the road twisted . One final bend around the summit of a dune, and there it was - Uluru, the world's single largest rock monolith. To outsiders, who call it Ayers Rock, it is the defining symbol of the outback and, like the kangaroo and the koala, one of the defining emblems of the whole continent.

I was prepared for a let-down when I saw the real thing - like any object I had seen 1,000 times already in pictures. Yet it did not come with the sight that unfolded before me. I pulled over and stopped. It was truly amazing. There was something about its improbable scale when compared to the land around - a monotony of dunes and mulga flats. There was something about its shape and the way the sun picked out the finely etched bedding planes in the sandstone.

I had come to Uluru because I was making a TV series about the world's most spectacular and famous natural places. Instantly my fears that Uluru might not sustain a whole hour of television melted away. In one gaze across the rock, I knew that in its crevices and cracks, curves and bends was a fantastically rich story of geology, of indigenous culture, of archaeology, mythology, history and ultimately of the spirit of place. What I did not know was that the theme that would emerge to unite all these elements would be water.

Uluru looks out across one of the driest parts of one of the driest continents on earth. Before my trip, I obtained rainfall data gathered at Alice Springs, over 300 miles away to the East. Its accuracy was comic. Across the page were spread precise columns of zeros. Occasionally the eye would hit a cluster of figures denoting that rains had come. But I was struck how day after day, week after week and month after month nothing would fall. My mind conjured up an image of a lone and eternally optimistic meteorologist going out into the burning heat each day checking the rain gauge just in case some fickle cloud had shed a few measurable drops.

Historically, the millions of square miles of desert in the interior have been seen very differently by the two cultures that today live uneasily side by side in this land. The contrast between the indigenous and western view of the desert continues to exert a profound influence on its future. Especially when it comes to the use of water.

For aboriginal people, who have survived in this arid environment for at least 35,000 years, the desert is home. It provided them with everything they needed and they were uniquely adapted to it. They see their country as rich in resources - including water. All that is needed is for the country to be properly looked after.

To do this a complex series of sacred laws, enshrined in what they call Tjukurpa, tells them about the desert and its entire ecology - including the location of permanent and semi-permanent water holes. Water is the defining resource to aboriginal people who in this area call themselves Anangu. They know where to find it and how to get at it when it is hidden under the desert sand. Anangu see all the resources the desert has to offer as a totality, and they understand that they are as much a part of nature as the plants and animals that surround them.

But to the British, who first settled the country in 1788, the desert interior was a source of fear and uncertainty. It represented an impediment to progress - and therefore a challenge. How could they truly claim dominion over the country unless they had mapped, measured and evaluated the land? Driven on by these ideas, from the early nineteenth century exploration beyond the coastal fringes began. In the name of Queen and country, but also for personal aggrandizement, Victorian explorers risked their lives to stake their claim to be the first to cross the vast continent.

It was now that water began to be a defi-

Left: Ayers Rock from across the desert (about 40km distant)
All photos: Alex West

Opposite page: Kantju Gorge with the water hole at the bottom of a sheer rock wall hundreds of feet high. During rains a waterfall pours down this rock face, where the dark stain (right) remains.

AND A HARD PLACE

How water connects the past and the future at Ayers Rock

The British film director ALEX WEST went to Australia to make a film about one of the country's most enduring natural symbols - Uluru to the aborigines, Ayers Rock to outsiders. Little did he realize when he started that the overwhelming theme of the film would be water.

Right: classic sand dune country, with desert oaks on the horizon

Below: tourists climb the rock, holding on to the safety chain. Anangu would prefer visitors not to climb the sacred rock, but over 100,000 ignore their advice every year.

ning issue in the outback. Explorers specifically went in search of it. Until the 1850s the primary goal of interior exploration was to discover an inland sea. The existence of such a sea began as an expectation - after all, is it not true that all great continents have rivers that connect their interiors to their coastlines? It became an obsession.

In 1827 a picture of the inland sea was published on a map of the continent by T.J. Maslan, a retired officer of the East India Company. Maslan's sea was connnected to the coast by a great river runnning from the heart of the continent thousands of miles north west until it poured into the Indian Ocean. Without a hint of irony he christened this fiction “The Desired Blessing”.

Despite the fact Maslan never set foot in Australia, his map “verified” the existence of such a sea. It was not until after another 30 years of exploration, during which virtually no trace of water, let alone a sea, was discovered that the idea finally had to be grudgingly rejected.

The idea of the inland sea had been quashed by the time the first explorers entered the area close to Uluru in the early 1870s. Yet Ernest Giles and William Christie Gosse were still obsessed with water. For them it was a matter of life and death. As a typical entry from Giles's journal indicates.

“Wednesday 29th October (1873). I was not at all satisfied in my mind at the thought of our retreat from the bitter water creek, which now lay to the south of us. I was anxious to find out where it went to. I resolved to go there again, as we might still expect a bucket or two of water.

Right: Camp at Barbara Tjikatu's waterhole: Barbara is in the top centre of the picture, the author crouching on left.

Bottom right: Barbara's water hole. The film crew prepares to shoot.

The day was exceedingly warm, the thermometer again standing at 106 degrees in the shade, though the morning had been cloudy; it was late enough in the evening when we reached the old tank, and the quantity of water that had accumulated since we left - amounted to nearly a bukketful. I was greatly disapointed: I only asked three buckets, but there was scarcely one; it was evident the drainage was fast ceasing."

Giles was not the first to make it to Uluru. His rival Gosse got there ahead of him, and it was he who named the monolith Ayers Rock after the chief secretary of South Australia Sir Henry Ayers. Gosse was the first due to a happy accident also to do with water (or the lack of it).

Close to the rock is a huge salt lake called Lake Amadeus. It is the strongest visual evidence that once free-flowing water did exist in the heart of the desert . Today it is nothing but a huge salt pan over 100km long. Very occasionally there is enough rainfall to promote surface runoff into the lake basin. When this happens, it turns into a salty puddle, but it is never long before this water evaporates in the burning sun.

Gosse and Giles were the first white men to explore Uluru and its environs, but they lead a charge that today, 125 years later, some feel threatens to engulf the rock and its environment. Now well over 350,000 people visit the rock each year. These numbers have increased massively since the earliest organized trips in the 1950s. This year, Sydney hosts the Olympics, and thousands more are expected to visit the rock as part of their stay down under. Indeed the Olympic torch begins its journey to Sydney from the rock, placing it at the centre of the nation's Olympic consciousness.

Of course, as I drove my hired car through the desert I was a part of the invasion, and I was a willing member of the crowds.

After my first look at the rock, I took a walk around it to get a better feel for its nooks and crannies.

On this walk I came across a sacred waterhole at Kantju Gorge. It brought home to me, what the Anangu owners of the rock had known for millennia - that in the middle of this arid country, Uluru creates life by creating water. Kantju water hole sits tucked into the steep sides of the incision on the north-western side of the rock. It was formed by water cutting out a slightly less resistant band of sandstone

"THE ANANGU UNDERSTAND THAT THEY ARE AS MUCH A PART OF NATURE AS THE PLANTS AND ANIMALS THAT SURROUND THEM."

as it poured off the top surface of the rock.

The water comes as torrents that start after desert thunderstorms. Uluru is 867m high - high enough for cloud to precipitate out into rain when it hits its surface. Some rain water stays in pools on top of the rock, but most pours down the steepest slopes of its convex sides. The result - instant waterfalls that plunge spectacularly and stop just as suddenly.

As a result of these floods, Mutitjulu gorge was eroded away over time and the water hole at its base grew - a still pool of glistening water. Around it the bloodwood trees and other vegetation cluster soaking up the moisture. Dragonflies buzz silently across its still surface and frogs flick through the water. It is a superbly secluded spot. I marvelled at the tadpoles that swam about in the pool.

They will become shoemaker frogs, and they adapt remarkably to the dryness of the desert. When the drought comes, adult shoemakers will bury themselves in the mud at the base of the water holes, surrounded by a waterproof sack in which to retain moisture. They will remain animated in this state for years if need be before new rains see them wake from their suspension. Then they break free of their protective wetsuits and swim free to mate and breed. The tadpoles I saw were beginning this amazing lifecycle all over again.

But Kantju is not the most important water hole at the rock. The most reliable water supply is to be had at Mutitjulu on the southern side of the rock. According to the Tjukurpa, this waterhole is home to Wanampi the water serpent. Wanampi controls the water supply to the rock, and when it is very low Anangu will scramble up to a rock ledge above the waterhole and recite special words that ask Wanampi to regurgitate more water and refill the pool.

This sacred teaching shows how vital Mutitjulu is to the people, plants and animals of the rock. This water hole represents the best supply of water for many thousands of square miles. When it dries up, the drought it represents is very deep indeed.

Even then Anangu can find water. I was keen to film a sequence showing how they can locate and dig for water in what to a white man looks like dry sand. Sure enough, a few days later a party of Anangu, together with their children, some dogs, my film crew and my hosts from Uluru National Park spent hours driving through the bush to another water hole.

The great salt Lake Amadeus. There has been no perennial freshwater here for a million years.

When we arrived at the destination, it seemed less than impressive. We were miles from anywhere, but on an outcrop of bare rock was a circular depression in which groundwater came to the surface. It was not a pond, more a circle of grass which the women set to work tearing up. Slowly clear water filtered on to the soft silt and Barbara Tjikatu used the grass as a filter to separate the sediment from the water.

As we sat under the shade of a tree and ate a meal of barbecued kangaroo tail, Barbara explained something that other Anangu had been keen to impress on me - that to survive here the country had to be looked after properly and that the water hole was her special responsibility - since she was born here and it was a part of her personal Tjukurpa.

Barbara is old and does not see the waterhole often, but her palpable sense of concern for this tiny soak in the middle of the desert affected me. As an outsider to whom a puddle does not have any emotional impact, I became aware that without the land cruiser and all the modern technology at our disposal Barbara would have been the only one of us to survive here because she had the legacy of a collective wisdom that went back centuries.

As my trip went on - this sense of the collective wisdom of Anangu and our worrying lack of it grew.

Following a long and somewhat scary journey back to the tarmac road in the dark, I eventually returned to my room in the resort of Yulara. Yulara is an oasis of modern living in the desert. I showered and went down to dinner.

Almost all those who come to Ayers Rock come to Yulara. The average visitor stays for 1.8 nights before heading off to their next destination. In that time they see sunset and sunrise at the rock - climb to the top (in the main ignoring Anangu requests not to) and sample the pleasures of the resort's pools, cafés and bars. Tourists are demanding folk - they want to experience the outback but they also expect the comforts of home and to this the resort panders like any five star hotel in a city.

The resort uses 1.5-2 m litres of water each day. This figure depends on the number of visitors. When the weather is hot, consumption rises. Yulara has been open since the early nineties, it's stylish amenities rely on technology: that evening I dined on Barramundi fish caught the day before off the north coast of Queensland, 1,500 miles away.

This is just one superficial example. Water is what plays the key role. Without water there would be no hope of having a resort in the desert, and that water comes from the same source as Barbara Tjikatu's waterhole deep under the ground.

The next day I met Dr Pauline English - a hydrologist who has done extensive research on the groundwater supplies of this section of central Australia. For Pauline, one of the keys to understanding the water resource and what we should do with it is nearby Lake Amadeus. We flew over the giant salt lake and had a spectacular view of its expanse.

Pauline explained how millions of years ago this was a freshwater lake - rich in aquatic and bird life. It was fed by rivers and streams, the former channels of which she has mapped under the earth using remote sensing.

This verifies the fact that the climate at that time was wetter, and it was only in the last million years that the onset of aridity has reduced the availability of surface water. In that time what water there is has come to be stored as ground water. It is this that we drank at Barbara Tjikatu's water hole, and it is this that I showered in at Yulara courtesy of modern boreholes that pump the water up from the groundwater aquifer up to 25 metres below the surface.

In the 20 or so years that the pumps have been bringing the groundwater from the aquifer to the surface, it has been impossible to estimate how much water there is with total accuracy. Steve Baskerville, who manages the state-of-the-art Yulara water treatment plant for Northern Territory Power and Water told me that the water will last for a good few years yet. But Pauline is less optimistic. She is aware of several key facts that affect the sustainability of the water resource. First the increase in visitor numbers, second increasing aridity and third the fact that recent radiometric dates for the groundwater suggest it fell as rain more than 80,000 years ago. That is before even the most radical scholars place the arrival of the first humans in the continent.

"Recent radiometric dates for groundwater suggest it fell as rain over 80,000 years ago"

All this suggests water is a finite resource that is getting smaller. With little or no rainfall to recharge the groundwater and ever increasing demand for what there is - the implication is clear - unless consumption rates fall or water is somehow recycled one day it will run out. The treatment plant at Yulara is sophisticated - and water is mined efficiently. However that does not change the fact that, apart from Pauline's investigations little is known about the amount of groundwater storage available.

As I prepared to leave the rock, and the remarkable country it forms a part of, I pondered on how alien I felt here. Sometimes that created a sense of unease - like driving at night through the outback, or the constant need to look out for poisonous snakes entwined in spinifex bushes. But more often it gave me a sense of wonder at this magnificent and harsh country and the amazing adaptability humans have developed in order to survive here. The more I felt this, the greater my sense of irony grew.

Technology had allowed me to get here and then live in comfort, but it could do nothing to conjure water out of thin air, should supplies run out. If this happens mass tourism would become a thing of the past - just a blip in the long history of the rock and its people - who respect water and know its true value in the dry heart of this dry continent.

WHAT MUST BE DONE?

continued from page 7

In recent years, there have been examples of highly significant new approaches. It was learned in Egypt that improving the quality and quantity of village water supply does not necessarily lead to better family health unless accompanied by education to improve patterns of household behaviour. It was demonstrated in India and Israel that agricultural practice can dramatically increase the crop yield in arid areas without supplemental water. Urban per capita consumption can be reduced through pricing, educational, and equipment programmes innovations.

Possibly promising lines for further research include de-salting technology, "zeroscape" (low-water-use) gardening in urban areas, alternative household water, effluent treatment and alternative rural agricultural practices. Treating all urban waste to nourish agriculture and produce an effluent meeting domestic health standards has also been looked at.

Relatively little attention has been paid to means of ensuring ecosystem services for different landscapes. These and other possible options growing out of further research need to be the focuses of water planning.

• **5. A MAJOR HANDICAP** to dealing with all of the foregoing problems is the lack of accurate, discerning appraisal of what has actually been the result of past water management. Library shelves and organization files are loaded with reports on what has been undertaken in terms of works completed, financial cost and revenue, people served, land irrigated, navigable channels, kilowatts marketed and land protected from flood. They are very thin on how this has affected the quality of life of the people or the relevant ecosystems. There is relatively little on how the livelihood and social life of communities has changed and the extent to which they are more or less sustainable. Such findings are crucial to judgments on the kinds of research most needed and what kinds of measures should be promoted or avoided.

The first attempt at making a canvass of all available ex-post evaluations of water management has just been completed at the University of Colorado by Wescoat and Halvorson for the World Commission on Dams. It should provide a beginning for a truly comprehensive appraisal, and it already gives a preliminary outline of the problems involved in such efforts. Access to reports that are comprehensive, integrative, and describe adaptive responses to early appraisals would be a major benefit. Available appraisals are particularly weak on addressing the effects of freshwater management on natural systems.

The lessons to be drawn from the past, rapidly-evolving experience should play important roles in the programmes for the years ahead. They should, as a minimum, include ways of dealing in a sustainable fashion with natural systems in terms of social aims, criteria for evaluation, involvement of stakeholders, assessment of past experience and research on new options. To do so effectively will require basic alteration by international aid agencies, legislative bodies and national and local administrators in the ways they calculate costs and benefits, assess service charges, design waste disposal and appoint staff competent to deal with the full effects of changes in freshwater systems.

ENCONTRO DAS ÀGUAS

WHERE THE WATERS MEET

The Austrian photographer and travel writer ANDREAS KOCH came to realize that his week's journey down the Amazon was equivalent to no more than dipping his toe into the world's biggest freshwater system, but the wonder that it inspired made him acutely aware that the rest of the world depends on its healthy survival.

Like a sad complaint, the call of a ship's horn carried over the vast river until it lost itself in the brooding air. It brought an angry response from monkeys hidden in the dense foliage. Then all life fell back into dull silence. There was an amazing amount of traffic on the Amazon - luxurious tourist yachts, huge seagoing vessels looking out of place, overcrowded double-decker steamboats and simple dugouts used by fishermen.

After my marriage to a Brazilian, I realized with quite a shock that my wife knew amazingly little about her beautiful country. Travelling for its own sake is not, by and large, a common thing among Brazilians. And if they do travel, the lure of foreign countries is much stronger than the curiosity to see their own beloved homeland. I came to understand that wanderlust is a European habit. It took all my persuasive skills to convince her that a visit to the Amazon region was essential, because it represents by far the most out-

Top: the light brown waters of the Rio Solimões join the dark flow of the Rio Negro to form the beginning of the Amazon.

All photos: Andreas Koch

Left: a steamboat awaits its horde of passengers.

standing feature of the country's landscape. For a week our guide João's knowledge and his little boat proved to be the perfect means to conduct our intrepid adventure.

Going up the Rio Solimões, we took a short-cut and were soon lost in a maze of sidearms and channels. The rich vegetation fell like an impenetrable curtain down to the opaque surface of the water. Countless herons stalked in the shallows, and kingfishers darted from low-hanging branches for their prey. Peaceful grassy stretches suddenly came to life when unnoticed alligators fled like grey flashes in the water. Mostly only a faint splash offered evidence that they exist here in abundance.

Farther on, the area became more cultivated. The *várzeas*, regularly flooded plains along the mineral-rich white waters from the Andes, are among the most fertile grounds in the Amazon basin. Houseboats lined the watercourse and on the black ashes of the burnt river banks the *caboclos* - Indo-European halfbreeds (the lowest social class except for the purebred Indians who lead a subsistence life as fishermen, woodcutters and smallscale farmers) - grow corn, beans, pumpkins and other plants.

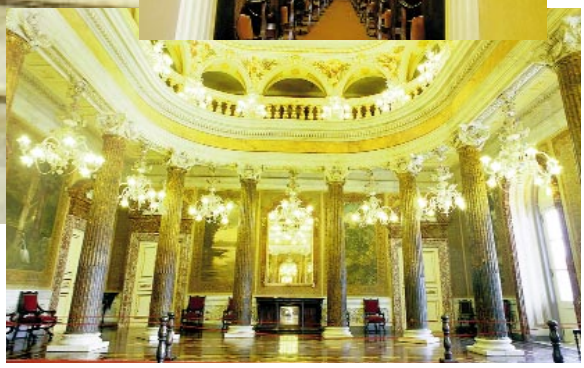
With my wife's help I tried to discuss the environmental madness of creating uncontrollable fires in the forest, just to harvest a handful of potatoes. But João merely shrugged his shoulders. "The wood here is of no value whatsoever. You can't sell it in the market, and it's not thick enough for construction purposes. Maybe one or two trees are exceptions, but you can forget the rest. Besides, the bigger the fire the greater the area cleared, and that means the less you have to be concerned about snakes in the clearing afterwards. If you don't do it this way, the area will be overgrown within a couple of months. And people need these potatoes a lot". You cannot argue with someone who has been hungry for most of his life.

For lunch we stopped at a floating restaurant. The locals had been drinking an ominous brew, which we had never tasted, having been put off by the stories of old women who munched roots, spitting the residue into large clay pots and leaving it there to ferment. Instead we decided to try the speciality of the house - piranha. Better to eat the fish before it eats you first. Frightening even when grilled, it nevertheless tasted absolutely delicious.

That night we spent with João's family in a large house, built on piles, down by the river. After

Typically Brazilian black-and-white wave-patterned paving on the Praça São Sebastião, in Manaus.

Piranha on a plate - "frightening even when grilled. Better to eat the fish before it eats you first."



***Manaus boasts the world's most extravagant opera house - the* Teatro Amazonas**

saying hello to all members of the tiny settlement, including some hairy brown tarantulas, João promised us a nightly *caça do jacaré* (alligator hunt). From a swampy river bank he cast the bright light of a big torch over the dense vegetation. Multiple pairs of yellow dots were glowing in the darkness.

Careful not to make too much noise, he floated his boat through the black water and moved steadily towards the shining eyes. Stepping out of the boat even more carefully, he moved through water that rose just above his knees. Suddenly he jumped forwards, there was loud splashing, and only seconds later he was back holding an alligator almost half his own size in his arms. In its panic, the poor creature was hissing desperately. With a broad grin João told us that it was still a youngster but that the bigger ones could not be caught so easily, at least not by a single man.

João caught a small alligator.

After the well-deserved applause, he put the poor thing back into the river. The animal was obviously as frightened as we were. Another thing we soon learnt was that mosquitos generally preferred the less acid water of the Rio Solimões and that they were immune to our expensive insect-repellents.

For the night the whole family gathered in the single room of the house, and all the windows and other openings were closed. After fixing our hammocks on hooks, João's father added some dry plants to the fire. Soon we were wrapped in eye-stinging smoke and somehow fell into a half-dazed sleep. Quite a difference to the night before in a clean bed in our cosy little hotel room, but now civilization was hours away.

"In July when the water is high I can go from my father's house to Manaus in about half an hour", João told me, "because then everything is like a big, big lake and you can drive by boat directly through the sunken forest."

The name Manaus has a special ring for me. I have read countless stories about this city surrounded by the world's biggest forest. Stories about fabulous wealth and grinding poverty, good and evil, madness and obsession. Founded by Portuguese explorers some 350 years ago, the city rose to unbelievable wealth in the nineteenth century through reckless exploitation of the surrounding natural environment - only to fall back into fever-stricken failure virtually overnight. It has regained some of its former importance in recent years through massive government support and a free-trade-zone.

Only since we made this trip have I fully understood the importance of the Amazon to this community in the jungle. Small roads and wide avenues desperately struggle to cope with the explosion of shops and stores aggressively pushing duty-free goods from South-East Asia. In contrast, there are shady *praças* (squares), where pigeons strut across the typically Brazilian black-and-white wave-patterned paving and the pattern of life suddenly seems peaceful. Newly renovated palaces, a French-inspired cast-iron market hall and the world's most extravagant opera house proudly manifest a heritage from the heyday of the rubber boom. A handful of white men living in a hostile environment, the rubber barons spent their fortunes on creating a copy of a traditional European or American metropolis. It is as incongruous as a Water World theme park in the middle of the Sahara desert.

Yet all this is surrounded by smelly industrial areas and the inevitable slums that stretch down to the waterfront. And not even the muddy floods of the earth's biggest freshwater vein can stop the spread of this pulsating metropolis. Although, incredibly, the high tide can reach 10 metres or more, piles, wharfs and docks mark only the beginning of a floating city. Huge tree trunks tied together carry huts, shops, hotels and bars where alcohol, prostitutes and drugs are easily accessi-

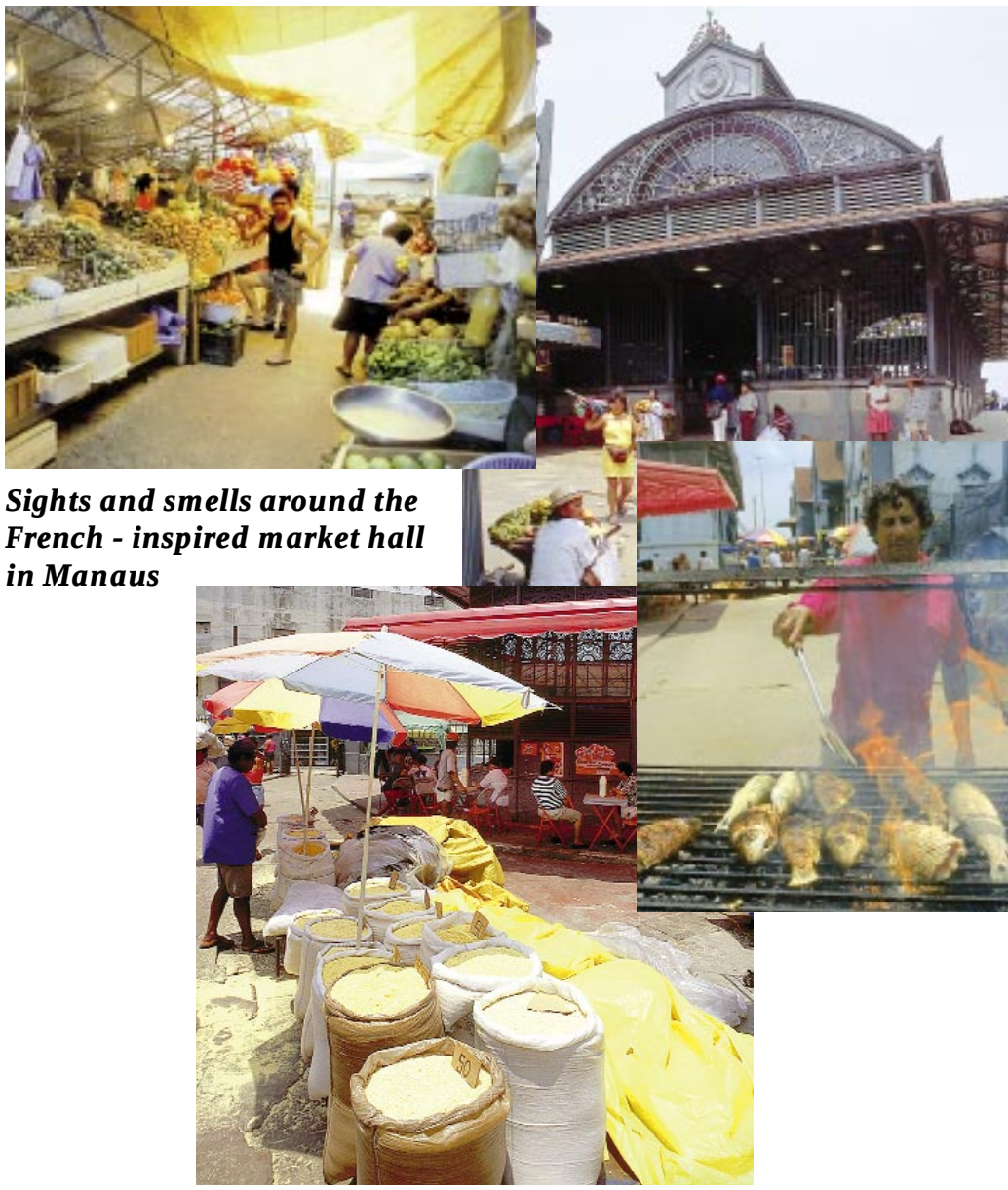
ble. There is even a floating petrol station for ships. Only floating traffic lights are missing.

The Amazon is not the longest but by far the biggest river on earth. In Manaus, about 1600 km from the mouth, the braided course of the Rio Negro is more than 11km wide. What we know as the Amazon is really a whole system of rivers, all with different names. Starting high up in the Peruvian Andes, the main sources are the Rio Ucayali and the Rio Marañón. After roughly 2,000 km, still in Peru, they join to form the Rio Solimões which then follows a course due eastwards towards the Atlantic Ocean. Some 2,500 km farther on the light brown Solimões, carrying tons of sediment from the mountains, meets the almost black waters of the Rio Negro, another main source, draining the rainforests to the north. The confluence, *Encontro das águas*, lies only a few kilometres east of Manaus and from there on the giant river is called Rio Amazon.

The humidity and heat were hard to bear. But a gentle breeze out on the river soon dried all the spots of perspiration on my T-shirt and kept the little bloodthirsty flying things away. João, leaning lazily on the rail under the sunshade was lost in silent thought. All of a sudden he raised his arm and pointed to a spot in the distance.

"Olha! Olha! O boto cor-de-rosa!" he shouted.

My poor Portuguese was not quite up to this, but, although there was clearly something to see, I could not see anything unusual. After several minutes and some lengthy explanation I was able to distinguish a tiny black dot parting the waves before it was gone again. It was the dorsal fin of an Amazon river dolphin *(Inia geoffrensis)*. These freshwater mammals, distantly related to their cousins out in the sea, have adapted to their unique environment in many ways. Most obvious is its rose-red colour, easily discernable in the murky water. Playful as dolphins are, they are common visitors to the *Encontro dos Rios*.



Sights and smells around the French - inspired market hall in Manaus

Every second the Amazon drains the forest of 120 billion litres of moisture.

Due to the sheer volume of water carried by the Solimoes and the Rio Negro, different in colour and temperature, the two streams do not blend immediately. So for the first few kilometres the River Amazon is strictly divided into a milky light-brown righthand stream and a clear but tea-coloured lefthand stream. That is what the dolphins like. Darting in and out from one side to the other gives them a lot of fun - a game they can play for hours or even days.

The rainforest is still a great mystery, only slowly revealing its secrets to scientists. It seems to grow and expand relentlessly as every patch labouriously cleared is overgrown again within a very short time. Only recently was it discovered that as a whole the jungle remains in a fragile state of equilibrum. The percentage of dead and decaying plants equals the amount of newborn flora, thus keeping all the nutrients and minerals in a steady lifecycle. The shallow layer of humus covering the geologically ancient rocks was eroded and washed out aeons ago. It is thus unable to preserve all the necessary nutritive substances.

Every second the Amazon drains the forest of approximately 120 billion litres of moisture. And with it go precious nutrients and other vital components. Much of that loss is compensated

by the milky waters of the Rio Solimões and its tributaries carrying rich minerals from the younger rocks of the Andes. But a simple calculation makes it clear that this can never be enough.

It is interesting that other main sources of fertilizer lie in dry or semi-arid areas close to the Caribbean coast far to the north and in the dusty stretches of the dry Sertão to the south, shifted by wind and atmospheric movement to the Amazon basin.

The hot equatorial sun powers a huge system of vaporization and rain. Intricate measurements revealed an astonishing fact: in the forests of the Amazon basin, a world abundant with life and water, rain is truly a very precious thing. Every drop of rain is vaporized and falls as rain at least four times before it finally leaves the jungle having been thorougly cleaned. As the resources are limited, there is a constant struggle for them. This results in the initial impression of uncontrollable

Gigantic green plate-like leaves of Victoria regia float on a pond off the Rio Negro: the diameter of a single leaf can reach 2 metres.

Top right: freshwater dolphins have adapted to their environment in many ways.

Right: the calm waters of the Rio Negro.

growth so common to the inexpert eye. Fast growth optimizes the chances of access to the rain first. But if other competitors are too big , then it pays to hop on top of them and take root, as, for example, epiphytes and bromelias readily demonstrate.

Gigantic green plate-like leaves of Victoria regia covered the surface of a pond off the Rio Negro. Named after Queen Victoria, this biggest genus of all water lilies definitely shows regal dimensions. The diameter of a single leaf can reach 2 metres. Fringed by huge trees, the little stretch of water was the only open space in the forest.

Down in the shadow of the green roof, the air was still, and the human body seemed to melt just by being there. Flies and mosquitos gave us a warm welcome when we started our jungle tour and remained persistent companions ever afterwards.

For one 3-hour stretch we stumbled behind João through the dense undergrowth. Once in a while he gave short explanations about trees and plants, what they were good for or which to beware of - welcome respites in our exhausting adventure. The forest thinned out and a small stream crossed our path. Clear, dark-brown water swept over well polished boulders, rushed down little crevasses, gathered in a deep pool and finally spilled in a glittering cascade, the Cachoeira da Arara, over a ledge to a river bay.

Lying in the refreshingly cool water soon let us forget all the minor mishaps of our journey. Ironically we had been travelling for days on our planet's biggest freshwater system without daring to jump into the water since we did not know what treasures or dangers it hid. I was finally swimming in one of the world's greatest natural treasure chests - or at least a tiny part of it.

Many people live in the Amazon basin. Even more make a living in or from its forests, but we all depend on an ecological balance to support the world's water resources, especially the Amazon on account of its size. Greed, hunger and ignorance are constant threats . No insurance company can replace its loss, and we are only just beginning to understand its true value. The Amazon is not only an unforgettable sight: it is vital for the future of life itself.

On the black ashes of the burnt river banks the* caboclos *- Indo-European people - grow corn, beans, pumpkins and other plants.

Left: "the dark brown waters swept over well polished boulders, rushed down little crevasses, gathered in a deep pool and finally spilled in a glittering cascade, the* Cachoeira da Arara*, over a ledge to a river bay."

Below: trees and thick undergrowth tumble into the edge of the water. The Amazonian jungle remains in a fragile state of equilibrium.

SPONSORED BY THE RAMSAR CONVENTION ON WETLANDS

DISPELLING MYTHS AND PRESENTING SOLUTIONS

Thoughts on the freshwater crisis, wetlands and the Ramsar Convention

By Dr BILL PHILLIPS, Deputy Secretary General, Ramsar Convention on Wetlands

In this first issue of a much-needed international forum on freshwater environmental management, it is very pleasing that a place at the table has been provided for the Convention on Wetlands. Otherwise known as the Ramsar Convention (from the small Iranian city where 18 nations signed this, the first multilateral environment, treaty in 1971), the Convention on Wetlands is fast emerging as one of the primary tools available to humankind dealing with the world freshwater crisis and growing poverty, as well as conserving biodiversity.

Before looking more closely at what the modern Ramsar Convention has to offer this debate, let us first dispel some of the myths and put to rest some of the misinformation still being circulated about wetlands and the Convention.

Dispelling the myths

1.*"Wetlands are only a small and insignificant part of the global ecosystem."* - WRONG. Under the Ramsar Convention, wetlands embrace the full range of freshwater ecosystems associated with rivers and streams, (lakes, peat swamp forests, marshes, alpine meadows, wet grasslands etc.), peatlands in all forms, and even subterranean karst and other hydrological systems. The Convention also considers coastal systems such as coral reefs, sea grass communities and intertidal areas (mangroves, saltmarshes and mudflats) as wetlands, and when all of these wetland types are considered together they represent more than 10% of the planet's surface area.

2. "Wetlands are wastelands." - WRONG. Believe it or not, this image continues to prevail in some sectors of society despite all that we now know about the functions that wetlands perform and the benefits they provide. Fortunately many countries are now reversing uninformed decisions made in the past when wetlands were being "reclaimed". We now know the folly of this euphemism for destruction - which was predicated on the understanding that wetlands were indeed wastelands. These days we are aware that wetlands are the natural filters of our waterways, that they help to protect us from floods and help to feed and support us in everything from fish production to ecotourism. It is this understanding that now results in countries such as the USA and China taking concerted and large-scale efforts to reinstate wetlands as part of their national water management strategies or economic gain and for broad social agendas.

The Ramsar Convention promotes wise use of wetlands. Their destruction (top) denies humanity of the vital functions and benefits they provide (below).

Photos: WWF/Marek Libersky, Ramsar/R.Leguen

3. "Wetlands are just another 'user' in the water management equation and should be treated as competitors with the consumption sectors." - WRONG. Amazing as it may seem, this continues to be a much-promoted view in many water management discussions. Fortunately, an increasing number of water managers now recognise that wetlands are like the oil in a motor car - without it the system doesn't function - and that in addressing sustainable water use we must give the natural providers of water pre-eminence and priority access. More and more countries are now adopting water management strategies and principles that recognise that wetlands are part of the maintenance and supply system for water, and they are restoring wetlands or creating artificial wetlands, to bring "health" and resilience back into degraded waterways.

4. "The Ramsar Convention is about waterbird conservation and that's all" - WRONG. Yet another myth. The Ramsar Convention had as a strong part of its roots the conservation of habitats for migratory waterbirds, but the visionary architects of the treaty also recognised the hydrological, ecological and social values of wetlands and enshrined the concept of "wise use" in the text. In 1971, this term "wise use" was ahead of its time: many people will recognise it by the later and more frequently used synonym "sustainable use", and more and more of our energies are directed towards promoting attitudes and activities that do not lead to loss of the natural capital of the planet. It is also not widely known that signatories of the Ramsar Convention have accepted , through Article 5, an obligation to work cooperatively with those neighbouring countries with which they share wetlands and water resources. This obligation presents an existing "tool" for promoting international cooperation in the management of our freshwater resources.

What can the Ramsar Convention do for you?

Throughout its nearly 30 years of operation, the Ramsar Convention has assembled a number of "tools" to help to promote its three central themes of action - wise use, the List of Wetlands of International Importance, and international cooperation. In May 1999, at its 7th Conference of the Contracting Parties, the signatory governments of the Convention, recognising the need for more urgent action, adopted several further "tools", which have now been put together with the previously-adopted guidelines to form the Ramsar "toolkit". The "toolkit" (outlined below) provides frameworks and guidance for actions at all levels - international, regional, national, river basin and local. It covers policy and law through to inventory and site management as well as communication, education, public awareness and community empowerment. Its assembly has been based on the experiences (both good and bad) of experts and practitioners from around the globe and is a ready-made part of how we need to manage water resources in this new century

In the context of freshwater management, some of the "tools" in the Ramsar "toolkit"stand out as vital. These are:

Handbook 4, on Integrating wetland conservation and wise use into river basin management, provides a template for our sustainable use of rivers into the future. It assumes that we understand that impoundments, straightening and channelising rivers is not the long-term solution to freshwater management - that we must respect, protect and as necessary reinstate the natural designs of our rivers, including their wetlands. The reward is a return to living rivers which can again be productive in every way - from providing water for humans and wildlife, to producing food and supporting livelihoods and thus alleviating poverty.

Handbooks 5 and 6, on local people's participation in management and on communication, also address vital aspects of managing freshwater. Through ignorance we have arrived at the doorstep of a global crisis, and it is time to shift the decision-making function from central governments to locally-based consultative processes that allow traditional knowledge and practices to be considered and encourage balanced solutions to be agreed by those most affected, the local stakeholders.

Handbook 7 provides a strategic framework for the development of the List of Wetlands of International Importance -an icon of the Ramsar Convention. At present there are just over 1,000 sites designated as Wetlands of International Importance, and the Convention has the ambitious target of doubling this to 2,000 by the time of the 9th global Ramsar conference in 2005. At face value, this may seem irrelevant to freshwater management, but this is not the case. The vision for the Ramsar List is "to develop and maintain an international network of wetlands which are important for the conservation of global biological diversity and for sustaining human life through the ecological and hydrological functions they perform".

Freshwater policy-makers, decision-makers and practitioners need to note this vision very carefully, because in this statement the governments of the world are saying that we have to recognise and protect our wetlands for their "ecological and hydrological functions". The Ramsar network can be, and needs to be, a key part of our efforts to repair the ailing freshwater infrastructure. If we recognise wetland areas as vital parts of maintaining healthy rivers - these same areas must surely also be of national, regional and possibly international importance and should be recognised as such.

Finally, there is **Handbook 9** on international cooperation, and again, in this context these guidelines provide a formula and framework for countries that share water resources working together to achieve the long-term sustainability of these resources. Whether it be through multi-party river basin commissions, training assistance, knowledge sharing, or a range of other actions - the Ramsar Convention can, and does, provide a vehicle for international cooperation.

Where to from here?

The world is rapidly heading for, and in some places is already experiencing, a freshwater crisis. It is time to recognise that wetlands provide an important weapon for us to use in addressing this problem. If this recognition, and the frameworks and 'toolkit' for action promoted by the Ramsar Convention, can be a prominent part of the integrated approaches that are clearly needed, then we will have made one very large step towards managing this precious resource wisely. In so doing we will have also helped to address some of the myriad other problems confronting us - food security, poverty, unprecedented flooding, loss of biological diversity... the list goes on. Wetland conservation and wise use make good sense. It's not just about protecting wildlife habitats; rather it's about ensuring the viability of an essential part of the global water equation.

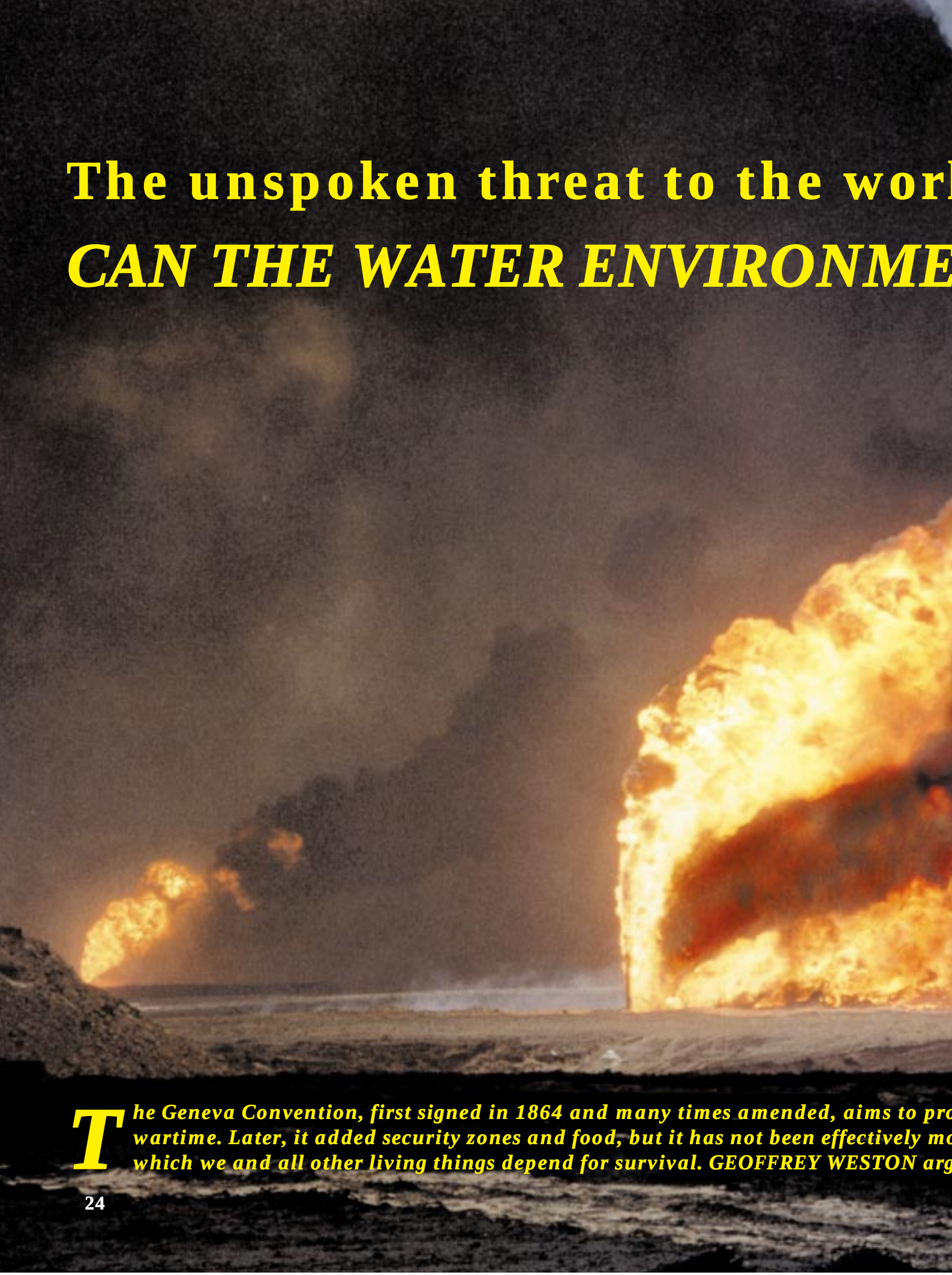
The Ramsar Convention 'toolkit' for the conservation and wise use of wetlands

including Guidelines adopted by the 7th Conference of the Parties, San José, Costa Rica, 1999

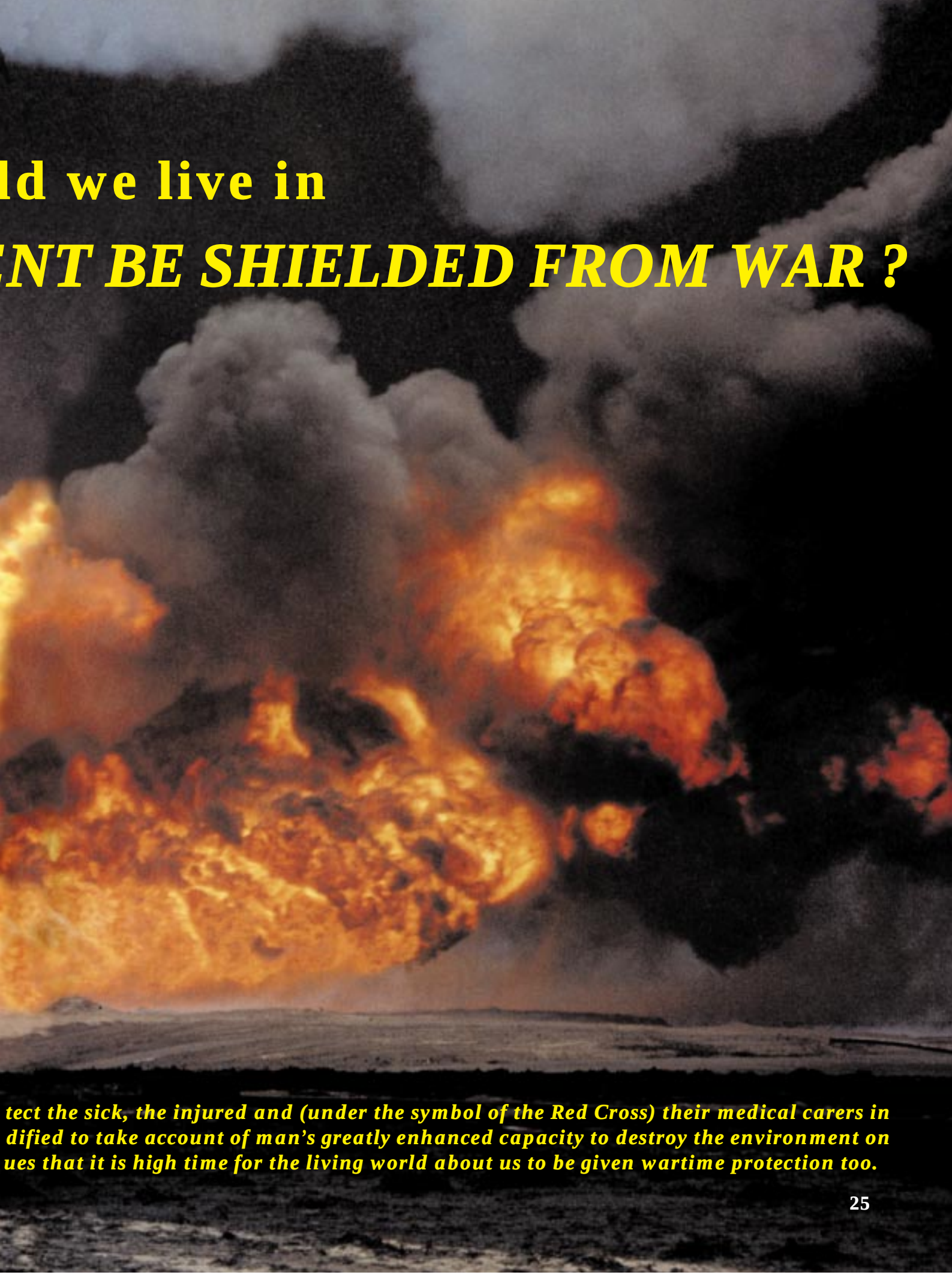
Wise use of wetlands	*Wetlands of International Importance - designation and management*	*International cooperation*
Handbook 1 Wise use of wetlands **Handbook 2** Developing and implementing National Wetland Policies **Handbook 3** Reviewing laws and institutions to promote the conservation and wise use of wetlands **Handbook 4** Integrating wetlands conservation and wise use into river basin management **Handbook 5** Establishing and strengthening local communities' and indigenous people's participation in the management of wetlands **Handbook 6** Promoting the conservation and wise use of wetlands through communication, education and public awareness - The Outreach Programme of the Convention on Wetlands	**Handbook 7** Strategie framework and guidelines for the future development of the List of Wetlands of International Importance **Handbook 8** Frameworks for managing Wetlands of International Importance and other wetlands - including: I. Guidelines on management planning for Ramsar sites and other wetlands; II. Guidelines for describing and maintaining the ecological character of Listed sites; III. Framework for designing a wetland monitoring programme; IV. Guidelines for operation of the Montreux Record (of sites where changes in ecological character have occured, are occuring, or likely to occur); V. Wetland Risk Assessment Framework	**Handbook 9** Guidlines for international cooperation under the Ramsar Convention on Wetlands - which covers: I. Management of shared wetlands and river basins; II. Management of shared wetland-dependent species; III. Partnerships between Conventions and agencies; IV. Sharing knowledge and expertise; V. Development assistance; VI. Foreign investment and business sector codes of conduct

The unspoken threat to the worl

CAN THE WATER ENVIRONME



The Geneva Convention, first signed in 1864 and many times amended, aims to pro wartime. Later, it added security zones and food, but it has not been effectively m which we and all other living things depend for survival. GEOFFREY WESTON arg

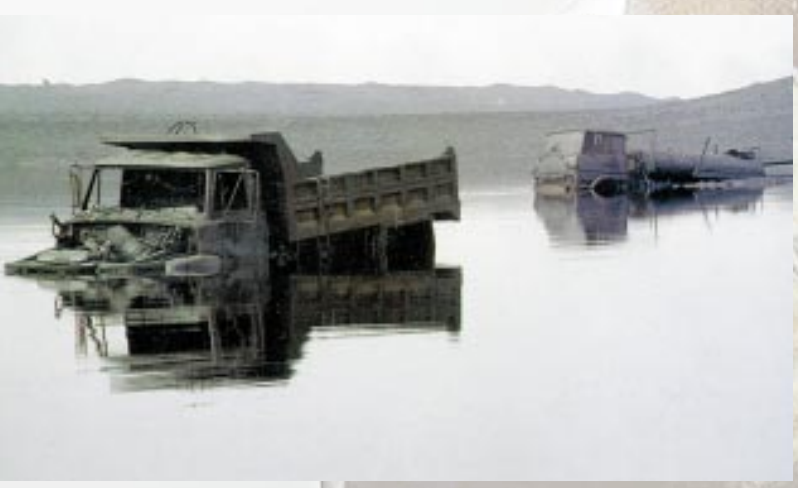


ld we live in

NT BE SHIELDED FROM WAR ?

tect the sick, the injured and (under the symbol of the Red Cross) their medical carers in
dified to take account of man's greatly enhanced capacity to destroy the environment on
ues that it is high time for the living world about us to be given wartime protection too.

If only the peoples of the world and their leaders could be presented in advance with a comprehensive bill for every war ! As they were not, one of history's great unanswerable questions must remain "How many wars would never have started?". The profit-and-loss accounts of wars are commonly measured by politicians in terms of political or territorial gains and losses, by arms manufacturers in terms of the success or failure of their products, by generals on the success of their military strategies but by ordinary people in the numbers of loved ones lost or maimed, homes and livelihood destroyed, lives shattered.



Above: Where camels once grazed, Iraqi vehicles are submerged in lakes of oil.

Right: General view of a damaged road bridge in downtown Nis, 250 km south of Belgrade, The bridge was hit by NATO aircraft. *(AP Photo/str)*

The importance of humanitarian considerations is beyond question. But there is another price to pay for war - one that is not immediately self-evident but in the end is just as important. It is the price paid by the natural world in which we live and on which we all ultimately depend for our survival. This world has no effective protection from war through international treaty but is increasingly threatened by the scale and ruthlessness of modern warfare.

The chattering classes rabbit on about wildlife protection, global warming and pollution from industry. Their attention is diverted when the freshwater environment, unmonitored and defenceless in war, is threatened by military action. I leave it to scientists to pinpoint the time when the impact of war on this environment became critical. For me, Iraq's invasion of Kuwait in 1990 is a good-enough watershed.

This highly traumatic event transformed attitudes to the environment almost overnight. An official Kuwaiti report saw it as "the greatest premeditated and manmade environmental catastrophe that man has ever experienced". In the words of one environmental official I talked to in Riyadh, Saudi Arabia, "We entered a new era environmentally with the Gulf War". Inevitably the full ecological impact of the invasion played a subsidiary role that only later came to the surface. By then it was out of the headlines and therefore deleted from politicians' immediate priorities, but the effects will be felt for many more years to come.

The scorched-earth tactics of Saddam Hussein's retreating army resulted in what was arguably the worst act of aggression that man had ever inflicted on the world he lives in. No fewer than 1,073 oil wells were wired with explosives by the Iraqi troops. In the end, 613 wells were set on fire, while 76 wells failed to catch fire but were gushing oil. Another 285 wells in the neutral zone shared with Saudi Arabia were damaged. To put the Kuwaiti experience into perspective, the largest number of oil fires previously known in any one area at one time was five, which occurred by accident in Libya in 1965.

A large quantity of crude oil was pumped by Iraqi soldiers into a trench along the Kuwaiti-Saudi Arabian border as a deterrant to the allied troops. The aim was either to torch it or discharge it into the Bay of Kuwait in the event of an amphibious attack, which never transpired. Once the oil wells were on fire, they continued to burn at some 6m barrels a day (about 10 per cent of the world's daily oil consumption), together with 100m cu metres of gas.

The polluting smoke and fumes from this hellish conflagration mostly reached heights of 1,000ft-10,000ft but in some weather conditions rose to 22,000ft. It swished around like a giant tail at the mercy of the wind, reaching areas 800 miles from Kuwait. Six months later, the polluting cloud was still obscuring the sun in Riyadh hundreds of miles away, while air travellers arriving at or leaving Kuwait airport today can still see clearly the nearby oil lakes that despite massive reclamation measures have defied human efforts at a final cleanup. Some 10,000 people were directly involved in putting out the Kuwaiti fires - a

process that took 8 months despite all the skills that money could buy.

The eventual toll on human health alone will not be known for many more years. But the air-borne pollutants emitted by the fires amounted to more than 60 per cent of the world's total emissions of soot and 2 per cent of the world's emissions from all sources. Lethal quantities of sulphur dioxide and nitrogen oxide were also released.

The oil lakes created by all this devastation contained up to 40m barrels of oil and sludge. About half of this amount was pumped away, and most of the rest has either evaporated or remains as sludge. Eventually, rain is likely to force the remaining oil into the aquifers, some experts say, causing another major pollution problem that will cost countless billions of dollars to solve.

Oil is obviously a major resource (and therefore target) in war but also a major polluting element - neither factors being of any relevance to those well-meaning negotiators who sat down to thrash out the original Geneva Convention. It continues to be a major worry to environmentalists concerned with the effects of the still recent and unresolved conflicts in former Yugoslavia. Today Croatia can perhaps offer the best evidence of environmental damage in the region.

Black smoke rises from a burning oil refinery in Novi Sad, some 80 km north of Belgrade, after NATO missiles targeted it.
(AP Photo/ Jaroslav Pap)

Left: Kuwait after the oil fires: the entire country was blanketed in a layer of sticky, black soot.

After the end of hostilities in Croatia, the authorities in Zagreb organized an international conference on the impact of war on the environment. Delegates learnt that war-created environmental pollution had damaged rivers, lakes, underground aquifers, the sea, soil and air, while flora and fauna were destroyed. Some Croatian experts who foresaw the dangers took whatever preventive measures they could, such as cutting the reserves of toxic chemicals and fuel to the minimum. But the damage was still extensive, and the conference began talking about "ecocide" and "ecoterrorism".

Attacks on the oil refinery at Sisak caused 133 tons of oil or oil derivatives to be burned or spilled into surrounding areas. Some flowed into the River Sava, which enters the Danube in Belgrade. At the height of the war, the mineral-oil level in Belgrade at the confluence of the two rivers was 175 times the permitted safety level. But the Danube basin covers 13 countries, a reminder that environmental damage respects no frontiers and is rarely confined to the warring countries.

Destruction of the power plant and heating installations in Osijek caused 7,000 tons of heavy oils to be burned or spilled, affecting 60,000sq metres of surrounding land. Many industrial and municipal wastewater installations were destroyed during the war, and in some cases local authorities were forced to dump waste into the nearest rivers or the sea. One of the most serious environmental consequences of the war was the distribution of PCB, toxic cancer-forming chemicals used in the hydraulic devices of heavy armaments and transformers. Toxic materials from thousands of damaged arms seeped into the soil around Vukovar and entered tributaries of the Sava and Danube. Croatian forests were also damaged by phospherous.

A team of scientists led by the World Wide Fund for Nature investigated the impact of war on Yugoslavia following

hostilities between NATO and Yugoslav forces over Kosovo. Their initial findings in Belgrade, Novi Sad and Pancevo, published last July, inevitably reflected those reached in Croatia. The team found there has been widespread pollution of water directly and through the soil from oil, gas and chemicals, including cancer-forming chemicals. Water was found to contain toxic substances that were many times above the permitted level and would inflict a wide range of harmful effects on the health of the population over a wide area.

This is some of the environmental toll from just three theatres of war. Even there the catalogue of devastation seems endless. Man's capacity to destroy the world he lives in has grown far beyond the vision of the Geneva Convention - the blunt instrument devised to inject a basic civilizing element into warfare. The vastly improved accuracy of modern weapons has not been accompanied by any serious plan to use this advantage to protect the world in the longer term. One problem has been the long lapse of time that is needed for an accurate assessment of the impact of war on the environment. It is much too early to take toll of the aquatic damage in Kosovo and East Timor.

"The patronizing stance that identifies man as the only element in nature that really matters must be dropped and replaced by a more humble recognition that he is just one living species in the vast global balance of nature."

Right: Kuwait children on their way to school wear masks as protection against the pollution.

Below: an Australian army corporal greets a little girl and her mother in front of an image representing Jesus Christ in Dili, East Timor.

Photo by Gary Ramage/REUTERS

There are a number of international provisions that offer indirect protection to the environment, as well as laws against environmental modification, but these moves tend to look at man's perceived right to a healthy environment, as though other living things that make up the ecological balance on which we still depend do not have those rights. Meanwhile, expert observers after the Gulf War noted the difficulty of interpreting existing laws and applying them to the realities of modern warfare.

But, some will argue, any serious attempt to reach an agreement on environmental protection during war will not stop unprincipled tyrants like Saddam Hussein or Slobodan Milosevic from flouting it. True, but by placing the environment under the same Red Cross umbrella as war-wounded, medics and innocent women and children, it will at least be a political card that in time will be much harder to ignore when hot war moves into the realm of diplomatic horse trading. It is no secret that environmental mismanagement by man can itself lead to war, but no legal framework compiled by the international community to shield the environment from war will be effective in protecting man until there is a fresh and widespread change of attitude.

The patronizing stance that identifies man as the only element in nature that really matters must be dropped and replaced by a more humble recognition that he is just one living species in the vast global balance of nature. However difficult it will be to devise a framework for an effective agreement, it is high time that the world's military, political and environmental leaders sat down together to lay the foundations before it is too late.

The author is editor of World Water Watch, *was a Middle East editor of* The Times *of London and has specialized in the Gulf countries for more than 20 years. He was also the founder editor of* Danube Watch – The Magazine of the Environmental Programme for the Danube River Basin.

COMPREHENSIVE PLAN FOR ITALY'S LONGEST RIVER

What is described as a much needed improvement programme for Italy's longest river, the Po, involving expenditure of $12.8bn over 20 years is scheduled to start in 2000. Known as PAI (the initials stand for the Italian words for hydro-geological plan), the project will for the first time tackle the 652km long river as one organic unit instead of the piecemeal approach adopted in previous years and will serve as a model for similar programmes planned for other major Italian waterways.

The object of the exercise is to increase the water flow where desirable and to strengthen the banks to enable them to withstand landslides in the upper reaches.

The PAI plan, drawn up by the institutional committee set up by the various Po river basin authorities, marks a departure from past practice when action was taken mainly on an ad hoc basis. As well as being Italy's longest river, the Po is the most densely populated and yet since 1989 only $1.76bn has been spent on management and maintenance. In drawing up the plan, experts have established that 49 per cent of the Po's 3,175 riparian municipalities are exposed to risk - ranging from high to very high, 48 per cent to medium-to-high risk, while only 3 per cent are free from risk.

The plan will include new forestry policies, the expansion of areas of spontaneous vegetation and improved management of wetlands and water meadows. This will result in changing certain traditional areas of the landscape with their characteristic vistas of Lombardy poplars. Unlike the willow, the poplar has shallow roots and when the river is in flood, the tree is uprooted and borne along downstream causing damage to structures such as bridges and human habitations.

Rising at Monviso near Turin in the west, the Po flows eastwards past major centres such as Pavia, Piacenza, Mantua and Ferrara, and empties into the Adriatic. Its rate of flow is 1,464 cubic metres a second. A total of 15,764,600 inhabitants live along its banks, the greatest density being in the Lambro region to the south of the Milan conurbation with 1,478 inhabitants per sq km. Industry is responsible for the greatest pollution with a share of 52 per cent, followed by agriculture with 33 per cent and the remaining 33 per cent from the population at large.

On January 6, The European Commission decided to take further legal steps against Italy for not respecting the Urban Waste Water Treatment Directive in Milan, which should have been met by the end of 1998. The city still discharges its untreated waste water into the Lambro-Olona River, a trubutary of the Po, and is a major cause of the main river's pollution.

PETER MUCCINI

RECYCLED EFFLUENT HELPS EMIRATES' BIRD HABITAT

In much of the world, preserving wetland nature reserves is primarily a matter of protecting natural habitat. The United Arab Emirates, in south-eastern Arabia, has been obliged to take a different approach.

The UAE, with a total area of less than 90,000 sq km, has a highly arid climate with rainfall that is, at best spasmodic. Largely dependent on desalinated water, the country has been obliged to tackle seriously the question of recycling water, in order to conserve declining reserves of artesian fresh water.

As a by-product of recycling, the country now has one of Arabia's most important wetland reserves, an area of saline lakes at Al Wathba, 40 km. east of Abu Dhabi, which have become a major centre for migrant and resident waterfowl. Managed by Abu Dhabi's Environmental Research and Wildlife Development Agency (ERWDA), the Al Wathba Lake Nature Reserve attracts thousands of migrant waders and other waterfowl during the winter, and has also been the site for the first recorded breeding anywhere on the mainland of the Arabian Peninsula of the Greater Flamingo *Phoenicopterus ruber*.

The key to its success is the use of recycled water from the adjacent Mafraq Sewage Treatment Plant, which treats wastewater from Abu Dhabi city. A substantial quantity of this is used to irrigate fodder fields at the nearby Al Wathba Camel Track.

These fields lie on infilled *sabkha* (salt-flats). To prevent the fodder being killed by rising salts, the water, then highly salty, is pumped out from under the fields. Once all discharged into the sea at Musaffah, 10 km away, some is now pumped into another area of *sabkha*, which was formerly flooded only after winter rainfall.

Recognizing that the new lake was attractive to migrant birds, local conservationists, with the support of senior government officials, also arranged for treated effluent to be released directly into the lake. This provided nutrients upon which organisms like brine shrimps could feed, thereby increasing the attractiveness of the lake to the birds.

The discharge channel from the sewage treatment plant also provided an ideal habitat for the natural generation of reedbeds and tamarisk woodland. In consequence, Al Wathba Lake now offers suitable habitat for a wider range of birds, and over 200 species have been recorded at the site.

Future plans for Al Wathba Lake include development as a centre for environmental awareness. One key theme will be the way in which a careful use of resources, even recycled sewage effluent, can contribute to the enhancement of the environment. Another will be partnership between government, industry and non-governmental organisations on environmental issues. Much of the planning for the reserve was undertaken by ERWDA in collaboration with international oil major BP-Amoco, which has extensive UAE interests.

The only fresh water that reaches Al Wathba Lake is provided by occasional rainfall. The lake's success as a reserve is wholly dependent on first generation treated and recycled effluent and on the re-use of recycled effluent that has already been used for irrigation. Little is wasted, and Al Wathba's proponents claim that the multiple re-use of water resources at the lake offers lessons in water conservation and in habitat enhancement for desert areas throughout the region.

PETER HELLYER

SPONSORED BY THE WWF LIVING WATERS CAMPAIGN

WWF'S LIVING WATERS CAMPAIGN URGES ACTION TO ENSURE WATER FOR ALL

The world's freshwater ecosystems are being degraded at an alarming rate. Many species that depend on freshwater habitats have disappeared while others are on the brink of extinction. Signs also point to an increasing global shortage of water for essential uses such as drinking, sanitation and food production.

WWF's 1999 Living Planet Report noted a continuing decline in more than half of the world's freshwater species, from frogs and salamanders to cranes and turtles. In Costa Rica, the disappearance of the golden toad and other amphibians has been attributed to climatic changes.

The findings and the ever-increasing human demand for freshwater point to the urgency of the WWF Living Waters Campaign, launched last year to ensure that adequate freshwater is available, both now and in the future, for people and nature. "The Living Waters Campaign is part of our contribution to a larger goal of conservation and sustainable use of natural resources", says Dr Claude Martin, Director General of WWF International. "We need to ensure that we leave our children a Living Planet, as well as satisfy our immediate and future needs for water."

Conserving freshwater ecosystems is a priority for WWF. In keeping with WWF's mission, a sound freshwater strategy involves incorporating ecological as well as human realities, promoting conservation of ecosystems, emphasizing watershed management and reducing adverse impacts of factors such as trade, privatization, and globalization on freshwater ecosystems.

The Living Waters Campaign will therefore:

- Engage in the international water debate and influence agenda setting
- Initiate projects at the watershed level to demonstrate viable, appropriate solutions
- Build and strengthen partnerships
- Increase the area of protected and well-managed ecosystems

Actions include restoring wetlands so that floods are controlled and river basins maintain capacity to retain water, conserving wetlands and ensuring enhanced sources of drinking water, wile replacing forest cover to maintain generation of groundwater. In addition, increasing the freshwater conservation area is expected to slow down the dramatic decline in freshwater species and their habitats and improve quality and quantity of water for people.

Freshwater ecosystems are seriously threatened worldwide despite their widely recognized benefits. ***Photo: Cam Hill***

Concern for freshwater is not just a matter of how much water there actually is but also of managing water resources and freshwater ecosystems in an efficient way. New thinking is required at every level - from individuals to companies, governments and the international community - to address existing and emerging challenges in sustainably managing water resources and freshwater biodiversity. The Campaign will initiate actions in partnership with governments, companies, non-governmental organizations and others, that demonstrate new and alternative approaches to water management which will benefit people and nature in the long-term.

FRESHWATER: A CRISIS FOR PEOPLE AND NATURE

WWF is aware of peoples' needs for safe and reliable freshwater sources. Conserving freshwater habitats such as lakes, rivers, springs, marshes and ponds is undoubtedly one of the most efficient and cost-effective means of guaranteeing that these services will be available in future years. If we act now to protect these resources we can help avert a global catastrophe in terms of human suffering and loss of essential natural services. The Campaign is part of WWF's concerted international effort to leave a Living Planet for future generations.

Like the air we breathe, having access to freshwater is taken for granted every day by millions of people. But this may soon change.

The freshwater issue is not a mater of how much water there is, but of managing water resources and freshwater ecosystems in an efficient way.

According to United Nations agencies, one-third of the world's population live in countries that are experiencing moderate to high water stress, part of which is due to increased demands from a growing population. By the year 2025, two-thirds of the world's population could be facing serious problems with water availability.

At the same time, freshwater ecosystems such as lakes, rivers and marshes are disappearing or being altered at an alarming rate. Some countries have already destroyed 50-80 per cent of their natural wetlands. In just a few decades, the populations of many freshwater-dependent species have fallen to critical levels.

A Looming Crisis

All signs point to an impending freshwater crisis. Less than 1 per cent of the world's water is readily available for direct human uses, for example in agriculture and industry, and for drinking and domestic purposes. Currently we are using about half of the world's freshwater resources: this is set to rise with increasing population and economic development.

Groundwater reserves - many of which are shared by one or more country - are already being intensively tapped. Some 200 of the world's major rivers flow through more than one country. The potential for international conflict over such shared water resources is high. Mechanisms to ensure the equitable sharing of resources among the stakeholders concerned exist for only a relatively small number of these international rivers.

Essential for human survival, freshwater ecosystems house large numbers of animal and plant species. These species and their associated ecosystems represent a substantial part of the Earth's biological diversity. Yet, there is growing evidence of widespread decline in the status of freshwater species. A recent World Bank Environment report suggests that 25-30 per cent of freshwater fishes are vulnerable, endangered or extinct. Of seven freshwater dolphins, three are endangered and another vulnerable. Likewise, of 23 crocodile species, 10 are threatened; of 143 species of tortoises, turtles and terrapins, 82 are threatened or near-threatened, most being freshwater turtles.

Valuable Ecosystems

Recent studies draw attention to the economic value of freshwater ecosystems such as wetlands and lakes and rivers. At an average value of US$14,785 and $8,496 per hectare, respectively, these habitats are estimated to be several times more valuable per unit area than terrestrial ecosystems such as forests, grassland and rangelands.

WWF's promotion of sound conservation principles reinforces actions already under way, such as the Convention on Biological Diversity.

Photo: Lee Harper

Despite these widely recognized benefits, freshwater ecosystems are seriously threatened worldwide. In just 30 years, the Aral Sea - formerly the fourth largest lake in the world - has shrunk to less than half its size, and has become as salty as the ocean. The diversion of water for agricultural irrigation, combined with water extraction for power generation, led to severely reduced inflows. As the lake's water level dropped, evaporation rates increased leaving an area of almost 4m hectares of polluted soils that has since been blown on to surrounding lands, causing widespread economic losses and human suffering. The once economic fisheries of the Aral Sea have also been destroyed.

Conserve Now for Tomorrow

Conserving freshwater biodiversity and habitats is vital to support human life and development. If these precious ecosystems are not looked after, basic human needs cannot be met and further social and economic development will be retarded.

New strategies and initiatives must be developed if people and nature are to benefit from this natural resource in the next century.

WWF is aware of peoples' needs for safe and reliable freshwater sources.

"Some countries have destroyed 50-80 per cent of their natural wetlands."

Essential roles

Few people realize the range of products derived from freshwater habitats - food such as fish, rice and cranberries, medicinal plants, peat for fuel and gardens, poles for building materials, and grasses and reeds for mats and basket making. Essential for human survival, freshwater ecosystems also house large numbers of animal and plant species. Freshwater (wild capture) fisheries alone produced about 12 million tonnes in 1992, while freshwater fish farming generated about the same amount. Together, these account for about one-quarter of the planet's fishery yields.

Freshwater ecosystems provide a range of useful services, especially by absorbing rainfall and gradually releasing this in time, preventing mass flooding. They also act as highly efficient sewage treatment works, absorbing chemicals, filtering pollutants and sediments, breaking down suspended solids and neutralizing harmful bacteria, a natural cleansing process that, if removed, would require expensive storage, filtration and cleansing operations.

Conserving freshwater habitats such as lakes, rivers, springs, marshes and ponds is undoubtedly one of the most efficient and cost-effective means of guaranteeing that these services will be available in future years. If we act now to protect these resources we can help avert a global catastrophe in terms of human suffering and loss of essential natural services.

WWF's Living Waters Campaign is a concerted effort to promote sound principles of conservation and sustainable use, addressing human needs by integrating water resources and ecosystem management. This initiative will reinforce actions already under way through, for example, the Ramsar Convention on Wetlands of International Importance and the Convention on Biological Diversity, drawing on assistance from government agencies, from local communities, the private sector, donor organizations, the United Nations, and conservation organizations worldwide. The Campaign is part of WWF's concerted international effort to leave a Living Planet for future generations.

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GREENING THE SYDNEY OLYMPICS

CLEANING WATER BY COPYING NATURE

Some of the latest technology and thinking for protecting the aquatic environment are being used to improve the environmental credentials of this year's Olympic Games in Sydney, Australia. By KEITH HAYWARD, editor of *Water 21 - Magazine of the International Water Association*.

The Olympic Games are not good for the environment. Construction materials for new facilities and infrastructure, many millions of air miles travelled by competitors and visitors and a mass of waste are just some examples of the impact these huge events have.

This fact was recognized by the Australian city of Sydney when it made what was to be the winning bid for the 2000 games. As part of its bid, the city pledged to make the event the 'Green Games' and sought to take account of the environment wherever possible.

The main site for the games is 14 km to the west of the city centre, at Homebush Bay. This 760 hectare site will include the main Olympic facilities, a new Sydney showground, already complete, as well as parkland and woodland.

Come September, around 500,000 people are expected to visit the games each day. There will also be 15,000 or so athletes and officials housed in the purpose-built Olympic village at Homebush Bay. All will need water - for drinking and flushing toilets, for example. Water will also be needed for watering grass and plants across the main site. Then there is the waste water that will be produced.

One drawback is that buildings and paved areas prevent rainwater from soaking into the ground. Water runs off instead into watercourses or drainage systems, washing pollutants with it, primarily litter in the case of the Olympic site. This will be most pronounced at Olympic Plaza, a 9 hectare expanse of paved area able to cope with crowds of up to 300,000 people.

These water-related concerns are among the issues that have been taken into account in the development of Homebush Bay, and have been addressed with a combination of technology, engineering and some modern thinking about how water can be managed.

Rainwater from across the site will be channelled through pipes to underground traps that will remove litter and solid material such as gravel. These traps are shaped something like vertical cylinders. Water enters tangentially; the speed of the flow makes it spin around inside the trap, separating out the polluting material; then the water runs out through another pipe.

The cleaned water will then go to one of two specially-constructed ponds on the site. Reeds have been planted on the fringes of these ponds, and the ponds have been designed so that water will flow through the reed beds as it passes through the ponds. Such constructed wetlands are gaining wider acceptance as a means of removing pollution by mimicking nature. Physical, chemical and biological processes taking place in and around the reed roots will together remove pollutants from the water.

There is also a disused quarry at Homebush Bay, since part of the area being used for the Olympics used to house the state brickworks. This brick pit has been given a new role as a central component of the water management scheme for the site. While purified rainwater is a resource that can be put to good use, it naturally arrives in sudden bursts. To overcome this problem, it will be transferred to the brick pit, which is now being used as a reservoir.

Even without a green commitment, it would be necessary to treat the waste water produced during the Olympics. This could simply involve piping the

waste water into the city's sewer system. But, like the stormwater, the waste water has the potential to be put to a more beneficial use.

The first step is to treat the waste water, so a waste water reclamation plant is being constructed. Special steps are being taken to ensure that two key pollutants are removed. Nitrogen will be removed from the waste water by including an extra final stage in the treatment process in which microbiological activity will break down nitrogen-containing compounds. The other key pollutant, phosphorus, will be removed by chemical treatment. The treatment plant will also be equipped with ultraviolet disinfection, in which ultraviolet lamps will reduce the level of microbiological contamination without the need to add disinfectants such as chlorine.

Not only will waste water from the site be reclaimed: the plan is in fact to extract sewage from the city's sewer system. In a novel concept known as "sewer mining", additional waste water will be taken from a nearby sewer and treated in the reclamation plant. In contrast to the stormwater, flow in the sewer is relatively constant, so that a steady supply can be guaranteed. The treated waste water, both from on site and the sewer, will then be transferred to the brick pit.

Stormwater and wastewater have therefore both been turned from potential pollution sources to potential water resources. The other aspect of the water management scheme at Homebush Bay is therefore how to exploit these resources and, in turn, reduce the amount of clean water that will need to be taken from the city's supply system.

One of the specially constructed ponds, built to treat rainwater from the Olympic site.

Before the water can be reused, it will first need to be treated. As well as more conventional techniques, the treatment scheme will include use of ozone, a powerful disinfectant that does not remain in the water after treatment, and membranes with pores small enough to lower the salt content of the water. This process will result in water of high enough quality to drink, although only the state Health Department could declare the water fit to drink.

This treated water will finally be fed into a network of pipes dedicated to distributing reclaimed water. The site, including the various stadia and the Olympic Village, has been constructed so that it will be possible to use the water for flushing toilets, landscape irrigation and outdoor uses such as washing down paved areas and washing cars.

Reclaimed water will not actually be supplied to the Olympic Village during the games, only to the rest of the site. This is a concession to public misgivings over the safety of reusing waste water.

The village will be supplied with reclaimed water after the games, when it will be turned over to housing. Reclaimed water will be provided at a lower price than normal supplies, to encourage residents to use it. The village will have other green credentials too: with 5,200 residents it is being hailed as the world's largest solar-powered suburb.

These are ways that technology is helping to reduce the environmental impact of the games, at least as far as water is concerned. But there are other water-related environmental measures that are being taken. For example, the area is home to Sydney's largest remaining mangrove forests and the city's second largest salt-marsh. An extensive restoration pro-

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Study shows water can be purified with waste heat

Around the world cities are growing and, as demand for water rises, pressure on the aquatic environment is increasing. Studies in Florida, USA, however, are showing how a new approach may go at least some way towards reducing this pressure.

The idea is to integrate municipal treatment of waste, waste water and water to produce pure water in an energy-efficient way. Modern waste plants use the waste as a fuel for generating electricity by producing steam to drive turbines. Although heat is recovered from the steam, a significant amount of heat is not recovered.

Dr Joan Rose of the University of South Florida and Paul Hauch of Kisinger Campo & Associates are proposing that the waste steam should be used to heat wastewater after it has been treated. This heating will both destroy micro-organisms in the water and make the water evaporate. This evaporation will further purify the water, which can then be condensed and collected.

The approach has already been tested by Rose and Hauch in a pilot study carried out on behalf of Gumaco, a company that supplies evaporation systems used, for example, to process fruit juices and believes the technology could be used in water purification.

The pilot study used three evaporation stages each at different temperatures (approximately 93, 51 and 38 degrees C). The ability of these stages to destroy and remove micro-organisms was tested using known quantities of a virus, a bacterium and microscopic fluorescent latex beads, the latter used to represent particles and organisms such as Cryptosporidium.

No viruses, bacteria or beads were found in any of the samples taken of the treated water, confirming the capacity of the process to produce pure water. Rose and Hauch also predict that the concept of combining waste, wastewater and water treatment can be economically viable.

KEITH HAYWARD

VITAL ROLE OF THE INDIVIDUAL

ORGANIC FOOD MORE DESTRUCTIVE THAN SEWAGE

PETER MUCCINI, writing from England, outlines ways in which - in the developed world at least - everyone can help to safeguard water resources.

In 1893 farmers at Giverny, a village north-west of Paris, were disturbed by reports that a famous painter was creating a water garden in their neighbourhood featuring all sorts of weird and wonderful exotic aquatic plants. There were fears that this vegetation might contaminate local waterways and possibly poison the soil and the livestock living on it. The authorities, however, gave Claude Monet the go-ahead and he created several ponds on his property using the water from the Rhu, a brook running into the Epte, a tributary of the Seine.

More than half a million people visit Monet's magnificent garden during the seven months of the year when it is open to the public Inspired by the Japanese prints Monet admired so much, the layout is full of asymmetries and curves. There are weeping willows, bamboo groves and water lilies blooming throughout the summer, a vista that can be enjoyed from beechwood bridges adorned with wisteria. The setting provided inspiration to Monet for 20 years for a host of paintings which are among the best loved in the history of art.

It would be wrong, however, to dismiss the original hostility to the water garden at Giverny as ignorance and superstition on the part of the local peasantry. It is equally mistaken to believe that the only threat to rivers, lakes and other waterways comes from industrial waste or the chemical residues of intensive farming. Individuals with seemingly innocent and praiseworthy pursuits such as gardening can also cause risk. Monet was aware of this and employed several gardeners to ensure that the water from his ponds did not find its way back into the stream from which it was taken, thus avoiding the transfer of any harmful material into the Epte and subsequently the Seine. The dimensions of the water garden at Giverny are still kept strictly within the limits that Monet imposed in his original design.

Alien vegetation, no matter how decorative, can present a menace to the ecology of the environment into which it is introduced unless it is kept under strict control. In Britain the Institute of Freshwater Ecology has sounded the alarm by reporting

Claude Monet's garden in Giverny, France, is famous for inspiring many of the great painter's works, but few people realize that, at the same time, he did his best to avoid polluting local freshwater resources.

streams and ponds are being choked by foreign plants sold through garden centres. One strain, *Crassula helmsii* , can double its biomass in 8 days and eventually form huge mats on the surface that rob lakes, ponds and canals of their oxygen with subsequent lethal effects on animal life.

Dr Hugh Dawson of the Institute's station at Wareham in Dorset, in the south-west of England, told *World Water Watch* that unsuspecting private gardeners are mostly to blame for the situation.

"They start a small pond in their gardens and put these plants in it", he explained. "Then they get tired of it or perhaps they do away with it because it presents a danger for small children who might fall in and drown, but they do not have the heart to kill the goldfish. So they carefully gather up the fish together with pieces of vegetation and other material such as dragonfly larvae and put them into a larger local pond on common land near by, and that is where the problem starts."

Dr Dawson cites one pond in his locality in the New Forest which sounds like a science-fiction nightmare.

"About 15 years ago somebody put some greenery in it ,and now there are three hectares of *Crassula helmsii* 3ft (1metre) deep all over, monopolizing the pond and presenting a threat to others in the neighbourhood", he explained. "We are currently spraying the pond to eradicate the vegetation before it spreads. This is an expensive process and since the herbicide is non-selective, harm is done to animal life around the pond."

Dr. Jonathan Newman of the Aquatic Plant Centre in Reading, Berkshire, has further horror stories to tell. He said the problem has developed over the last 15 years with the growing use of water as an amenity in household gardens, Garden centres have cashed in on the trend by importing plants from equatorial regions of the planet that are much showier than domestic varieties but potentially deadly in their effect.

"These invasive plants reproduce by fragmentation," Dr Newman pointed out. "So any fragment - even one only 4mm long carried on a bird's foot - is a viable new plant, and if ponds are connected to water courses these fragments can escape and grow to huge dimensions in a comparatively short period of time. This vegetation is also unsuitable as a food for local insects like water beetles and it blocks out the sunlight so that submerged native vegetation dies, causing damage to the fish population."

Dr Newman reckons that plants like imported pennywort *(Hydrocotyle ranunculoides)* and parrot's feather *(Myriophyllus aquaticus)* costing a couple of dollars can, if allowed to escape, cost

nearly $80,000 to control within 18 months. The message to keen gardeners is clear: if you wish to safeguard water resources, make sure that your imported plants are kept under strict control. Better still: stick to domestic varieties. They might not be as spectacular, but they are safe.

At present there is no government regulation on the import of these plants into Britain. However, in the US state of Florida and in Perth, in western Australia, the authorities have a list of banned plants which is strictly enforced. In Florida, rigorous controls were imposed after it was found that the pretty, lilac-hued water hyacinth, first imported from South America in the late 1800s, began to clog up lakes and canals and slow stretches of river. In Perth the villain was the floating pennywort, which has choked extensive reaches of Swan River.

Dr Newman believes there is a need for a public-education campaign on the dangers of spreading these plants and the well-meaning practice of giving friends a few samples to plant should cease.

Not all weeds, however, present a serious threat to water resources. One individual who is kept busy maintaining a river is Thomas Byng, Earl of Strafford, who until recently sat in the House of Lords, the upper chamber of the British legislature. The Strafford family owns 2.5km of the River Itchen, in Hampshire, and the Earl has been caring for it for 18 years. He is now engaged full time and single handed on the task, which consists of scything weeds along the riverbank during the growing season from April to September. It means five cuttings but the Earl insists the job is not as hard as it sounds.

"The weeds and reeds simply fall into the river and are carried away," he explains. "They are caught by a boom downstream, and then they are removed and disposed of."

"Some predictions suggest that without managing demand by the year 2020 we shall need almost a third as much water again per person."

The Earl does this service for the local angling club, and his only reward is from the annual subscription fees of the anglers, which also go towards other maintenance work. As a result of his labours anglers are assured of having easy access to the river to fish for brown trout and grayling. The Earl's efforts may also have improved the animal life on the Itchen. Water voles, once plentiful along the river, had been driven away by escaped mink who took up residence in holes in the river bank. With the area kept clear it was possible to hunt down most of the mink, and the voles returned together with otters, which now keep the mink at bay.

Throughout the world individuals (as opposed to organizations) are conscious of the need to safeguard water resources. In the watershed region of the Catskill Mountains in New York State there are 300 dairy farms from which pollution in the form of phosphorous and nitrogen from manure in barnyards and fields and residues of man-made fertilizers could contaminate drinking water supplies. Farmers collaborate to create a series of barriers such as ditches to trap any outflow. Similar precautions are taken in Wisconsin, where spring rains could bear away manure and petroleum wastes. Here the matter of prevention is crucial because Wisconsin has 825,000 private wells of drinking water and there is enough of this precious resource to cover the entire state to a depth of 30 ft (more than 9metres).

The householder certainly has a crucial role to play in the protection and conservation of water resources. Typical daily consumption of water in the developed world is upwards of 149 litres per individual. Some predictions suggest that without managing demand by the year 2020 we will need almost a third as much water again per person. Individual consumers have to learn some surprising facts that - as well as choking weeds, animal and chemical waste - water supplies must be protected from apparently harmless substances. According to the British Environment Agency these include milk, fruit juice, alcohol, cream, yoghurt and other organic drinks or foodstuffs. When they enter a surface drain they can be up to a thousand times more destructive than raw sewage or chemical waste even in small amounts and can wipe out river populations through oxygen starvation.

As well as steering clear of alien plants, gardeners must not be over lavish in their use of water. Lawns should not be trimmed too short to enable them to retain more moisture and there are many attractive, colourful plants that do not require large quantities of water such as lavender, climbing roses, rosemary, poppies and cornflowers.

GREENING THE SYDNEY OLYMPICS

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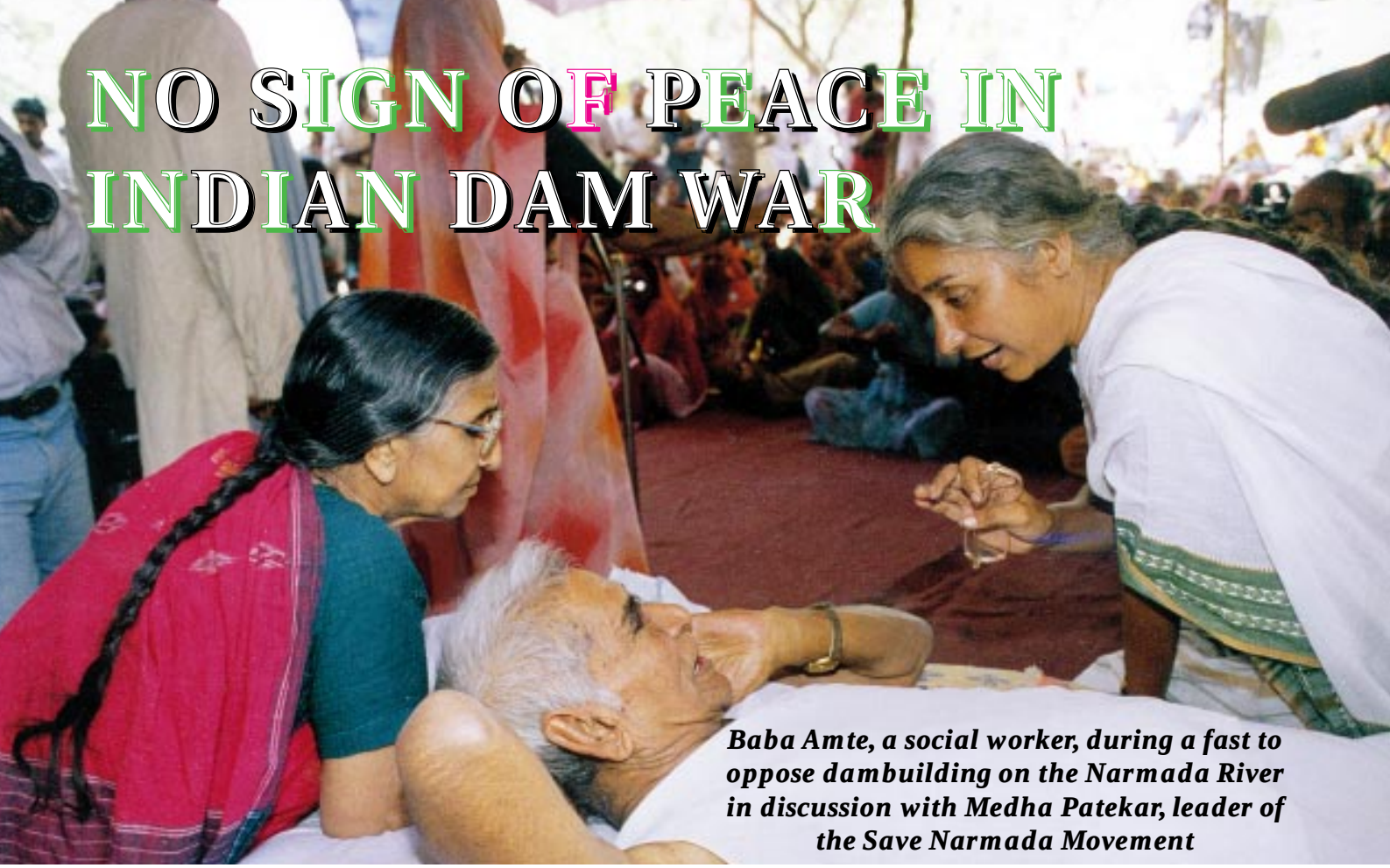
gramme has been undertaken to ensure they survive. A waterbird refuge is also being created on the eastern side of the site.

Another aspect is that the brick pit, central to the water management scheme at Homebush Bay, was found to be home to one of only 12 known breeding colonies of the green and golden bell frog in the Sydney area. Following study of the frog population, new breeding habitats are being created within and outside the pit, with special frog underpasses, built to allow the frogs to migrate within the general site.

Probably the most important environmental aspect of the 2000 Games though is something that no one visiting the site is likely to notice. Development of the site has provided an opportunity to tackle a huge legacy of contaminated land. A 2-year site investigation, started in 1990 and believed to be the largest in Australia, found that some 9m cu metres of landfill had been spread over 220 hectares in several landfills dating from the 1950s. Domestic waste, asbestos, pesticides, heavy metals, oil products and chemical and foundry wastes were found, up to 18 metres thick in places.

The waste has since been consolidated to reduce the area over which it is spread. The containment sites have been capped with clay to reduce the amount of rain percolating through the waste and thereby dispersing pollutants into the water table, and collection systems have been installed to catch any leachate that does arise. In fact the waste has been landscaped and trees planted on it, helping to improve the appearance of the site.

NO SIGN OF PEACE IN INDIAN DAM WAR



Baba Amte, a social worker, during a fast to oppose dambuilding on the Narmada River in discussion with Medha Patekar, leader of the Save Narmada Movement

Since independence in 1947, India has built more than 3,300 dams. The inflamed debate over the prospect of more of them in the Narmada valley is now in its fifteenth year, and the most vehement protesters threaten to drown themselves in the slowly rising waters. S. P. SAGAR reports from Delhi that the tide seems to be turning against high dams.

Dams are good. Dams are bad. Dams bring prosperity. Dams bring disasters. Such are the diametrically opposite views.The debate rages on.

The current global spotlight is on the dams proposed on the River Narmada in central India. But the key controversy is about the largest dam of the valley - the Sardar Sarovar project, being built by the Government of Gujarat state. The affected people are overwhelmingly opposed to it, fearing submergence, which has already begun. They are led by diehard activists. A head-on clash seems inevitable, as neither side is willing to give way.

The core issue is whether the dam work be stopped forthwith or be allowed to continue - whether a fresh tribunal should be appointed to review the project or whether it is unwarranted. The Supreme Court, the highest court in the land, is now handling the matter. A verdict is expected on February 8.

Passions are running high.The dam opponents have threatened to sacrifice themselves in watery graves if the dam height is increased farther and submergence occurs. The Government, on the other hand, remains adamant about letting the project go on. Supporting the Government are hordes of local people eager for water to drink and for irrigation. They have started agitating at the site to protest against delays in completion of the project.

The anti-Narmada struggle is now in its fifteenth year. But the setbacks and repressions have neither weakened the agitation nor the spirit of the agitators They are led by a non-government organization, the Narmada Bachao Andolan (Save Narmada Movement), of which the moving spirit is a woman called Medha Patekar. The support of the noted social worker Baba Amte and, more recently, by the Booker prize-winnning author Arundhati Roy besides a host of others from India and abroad, has further sharpened the edge of the movement. "It is a fight for social justice", says Vimalbhai, the convenor of the NGO National Alliance of People's Movements, a sister organization.

India has built 3,303 major and medium-size dams since 1947, the year it acquired self-rule. Some 700 large dams are still under construction. Thirty big dams, 135 medium-size dams and 300 small dams are to be constructed in the Narmada valley alone. The Government's pet theory is that dams, major and medium-sized, are vital for economic growth in a countrythat is largely poor. The common logic is that big dams would bring bulk irrigation, bulk power, bulk drinking water supplies and, no less important, would check floods.

But the dam detractors do not accept this argument. They say the gross contribution of the large dams to gains in food grain production is only 9.8 per cent. The net contribution is even less - 5 per cent. On the other hand, the land lost due to submergence, due to dam and canal work, water logging and salination totals 15.5 per cent, according to Himanshu Thakkar (a graduate engineer from the Indian Institute of Technology, Mumbai), coordinator of the South-Asia Network of dams, rivers and people, quoting profusely government and World Bank figures.

He also discounts the theory that dams control floods. He cites the case of Bihar, a chronically flood-ravaged state in eastern India. Scores of big dams have been built over India's rivers - the mighty Ganga and Sone, the turbulent Damodar, the Kosi, Kamala Balan and others - with massive embankments raised around the edges. Yet, the acreage of the flood-prone areas in the state has gone up from 2.8 m hectares in 1952 to 6.89 m hectares in 1998, two and a half times more.

India spent a massive $36.8 billion (at 1996-97 prices) on building large dams until the end of its eighth five-year plan period (1992-97), or 68 per cent of its total irrigation and flood control budget of $53.8 billion earmarked for that period. This is apart from the trauma local people suffered from being thrown out of their homes and torn from their cultural roots. "What good are the dams then?" Mr Thakkar asks.

But India does need hydel (hydroelectric) power, especially when its huge potential is largely untapped. Its total installed electrical power capacity is currrently no more than 90,000 MW, derived from primarily coal-based plants that unleash carbon dioxide and add to global warming. Due to lack of resources and other constraints, India cannot go for nuclear or gas-based plants.

"The people should be the sole judge to decide - not the Government, nor the agriculturists, nor the industrialists nor the city dwellers".

Moreover, the electricity demand pattern is very variable - high during evenings and low for most part of the day. But coal-based plants cannot be switched on and off , to synchronize with the load pattern, because the boilers take a long time to heat up. The hydel plants can meet this exigency. This is another justification for high dams.

However, there is no hydel project in India that has not been delayed endlessly on account of demonstrations and controversies, causing enormous cost overrruns. The Koel Karo project in eastern India had to be abandoned because of tribal demonstrations even after a lot of money had been sunk in the project. The mega Tehri dam project on the River Bhagirathi in the Himalayas has already stuck midway. Maheshwari dam in the Narmada valley is yet to take off. Then there is the Almatti dam in Karnataka, which, like the Kaveri dam, has kicked off a major inter-state water dispute over water-sharing.

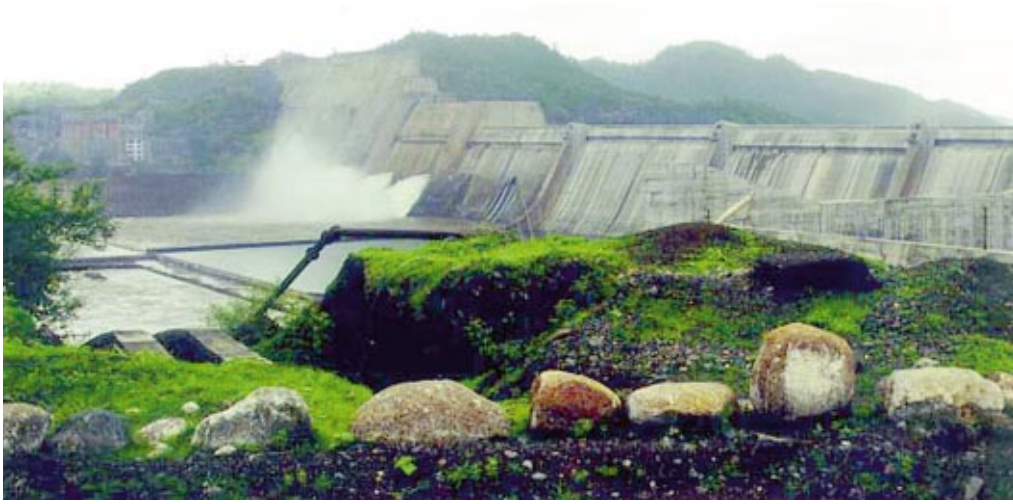
It seems the tide is turning against high

Protests have taken many forms: from bottom, demonstrators in a flooded hut, a flotilla of boats, Medha Patekar addressing her followers, a demonstration in the United States and confrontation with police in Delhi.

dams. Even the traditional supporters – industry and business, are having second thoughts. The environment chief of the Confederation of Indian Industry, K.P. Nyati, said: "The era of large dams is over". His objections are that dams - the artificial barriers to the river flow - distribute the benefits of the river water, a natural resource, inequitably between the people of the upstream and those downstream. They result in biodiversity losses, lead to unsustainable use of the groundwater and losses to ecology and environment. Where people oppose, there is no reason why the Government should not listen.

Mr Nyati's view is that "the people should be the sole judge to decide (to have the dam or not), not the Government, nor the agriculturists, nor the industrialists nor the city dwellers."

A widely held view that big dams are a renewable source of energy and are environmentally benign has also been challenged. The World Wide Fund for Nature says the problems resulting from neutrification (rich nutrients stimulating excessive plant growth) lead to deterioration in water quality, sedimentation, landslides and the production of carbon dioxide and methane - both greenhouse gases (which cause global warming).



Object of hate: the unfinished Sardar Sarovar dam

But many academicians still feel large dams are necessary. S.C. Agarwal, senior water technologist of Indias's premier economic research organization, the Indian Council of Applied Economic Research, says that if the dams are properly designed and technically sound and the rehabilitation aspects are taken care of, dams do serve the purposes they are meant for. The controversy in India has mainly arisen because of a "very very poor record of rehabilitation". This is also the problem of Narmada although the new rehabilitation package "appears to be good". Mr Agarwal takes the view that " no basic change in large dam construction policy is called for".

Environment is still a matter of little or no concern for the Indian masses who are largely illiterate. India is also such a large country that people in one part do not become involved in issues in another part unless they are directly concerned. This is the case of Narmada. It has failed to involve the masses. Besides, the pro-dams propaganda alleging that demonstrations are backed by foreign interests, is blunting the edge of the movement.

"There is an international movement against big dams... Unfortunately some local counterparts of this anti-dam movement are working in India without perhaps realizing that they are acting against our national interests", India's former power minister Y.K. Alagh reported in a memorandum to K.R.Narayanan, India's President, on behalf of Bhagirath, an organization called the International Movement for Development.

The Sardar Sarovar dam envisages a height of 146.5 metres, a reservoir of 4.72 m sq feet capacity, a 75,000 km long canal network, and a hydel capacity of 1450 MW. It promises irrigational water to Gujarat and the neighbouring states of Rajasthan, Maharashtra and Madhya Pradesh. Early this year the Supreme Court ordered the height to be raised from 80.5 metres to 88.5 metres.

The Gujarat Government wants the dam to be raised to at least 110 metres, because only then would the project yield even partial benefits. Besides, once construction has begun, it would hit two birds with one stone: the locals would themselves vacate the project area (fearing submergence) while foreign investments might start flowing in, assured that the project would be completed. This is the Government's strategy, according to the spokesman of the struggle, Sanjay Sangvai.

There is no sign that the activists will compromise on the issue. Nor are there signs that the Government will give up the project. Even if Gujarat says it would improve the resettlement package, activists would not believe it, for they say there is no land left for resettlement, so there is no point in proceeding with the project.

Arundathi Roy: prize-winnings donated

According to the International Rivers Network, a US-based organization that supports local communities working to protect their rivers and watersheds, "by building this dam [the Sardar Sarovar Dam], the Government of India has condemned thousands of its people to a life not worth living. Its actions have ripped apart the Narmada Valley and destroyed the river-based culture that has thrived there." Some 500,000 people face eviction from their lands there. Such is the strength of feeling that worldwide protests have taken place from Washington DC, in the United States to Sydney, Australia.

Arundhat Roy's book* The Greater Common Good *is a devastating indictment of modern development techniques, and she attacks the Sardar Sarovar dam in particular. She argues that giant dams take over countryside resources and last year donated her £20,000 Booker prize-winnings to the Narmada capaign.s

COLOMBIANS MARCH 700KM TO PROTEST AGAINST DAM

Last month, 167 members of the Embera-Katío indigenous group walked the 700km from Tierralta to Bogotá to protest against the flooding of their lands for the $780m Urrá dam, in Colombia. The Emberas are demanding that their Government stop filling the reservoir immediately and negotiate with them. The Minister for the Environment Juan Mayr refused to meet the protesters, who have therefore staged a sit-in outside his ministry ever since.

Meanwhile another 120 have been occupying part of their lands earmarked for flooding by the reservoir. The Emberas plan to remain on their lands until their demands are met. On November 18, Urrá S.A.began filling the reservoir despite the lack of adequate consultation, according to reports from the United-States-based International Rivers Network. This action violated the Constitutional Court's suspension of the project until the Emberas gave their consent.

The march took place to focus national and international attention on the struggle of the ethnic group to protect their rights to livelihood, self-determination and sustainable management of their resources. The dam was financed by the government-owned Nordic Investment Bank, the Canadian Export Development Corporation, Nordbanken and the Colombian Government.Construction was carried out by Skanska of Sweden and the Russian firm Energomachiexport.

"The international agencies involved in financing and building this dam must take action now to ensure that the rights of the Embera-Katío to their land and their resources are respected", said Monti Aguirre, Latin America campaigner for International Rivers Network. "It is inexcusable for these institutions, which include Canadian and Norwegian government agencies, to fund such a project and then walk away from their responsibilities."

The dam would flood 470 hectares of Embera-Katío territory, flood plantain fields and disrupt navigation, while the Lorica wetlands are drying out and fish are abandoning breeding grounds.

Efforts to negotiate with the Government have long been ignored, and have instead met with violence, four of the protesters having been killed by masked men. The government-controlled press has called for the protesters to be killed, but under pressure the Government, still ignoring the court ruling, has issued an order limiting the filling of the reservoir to a level lower than that occupied by the Emberas. An appeal has been lodged with the Organization of American States International Committee on Human Rights.

THE SHAPE OF THINGS TO COME

WATER FAIRS AND EXHIBITIONS

GLOBE

International Trade Fair and Conference on Business and Environment

22.03.2000 - 24.03.2000

Products: Waste Processing, Waste Water Processing, Disposal of Toxic Waste, Information Systems, Recycling, Water supply

Trade + Convention Centre
Vancouver/Canada
Organizer: GLOBE Foundation

A W L Tech

Traide Fair for Waste Water, Water and Waste Disposal

29.03.2000 - 31.03.2000 every 2 years

Products: Waste Processing, Education, Professional Analytic Equipment, Industrial Safety, Literature, Noise Minimizing, Air Cleaning, Measuring Technique, Promotion, Service Offer, Water

Messe Sinsheim
Sinsheim/Germany
Organizer: P.E. Schall GmbH Messeunternehmen

AQUA TECH

International Water Technologies & Equipment Exhibition

08.03.2000 - 11.03.2000 annual

Products: Training, Water Processing, Water Treatment, Water Protection

Hannover Messe Building
Istanbul/Turkey
Organizer: Royal Dutch Jaarbeurs
FGS Fuarcilik A. S.

WATER

Special Exhibition for Water Supply and Water Clearence Technologies

15.03.2000 - 19.03.2000 annual

Products: Water Supply, Water filters

Lenexpo Exhibition Centre
St.Petersburg/The Russian Federation
Organizer: LENEXPO VAO

SO MUCH EFFORT FOR SO LITTLE ?

A $500,000 campaign - launched with funds from the European Union - to persuade the citizens of Zaragoza to conserve domestic water resulted in a saving of just 0.34 per cent in consumption. But in Spain, industry and farming account for 94 per cent of water consumption, so was it all worth while? GILES TREMLETT went there for *World Water Watch* to find out .

The Spanish city of Zaragoza sits on the mighty River Ebro, which flows all the way from the country's green and rainy north-west to the picturesque Delta del Ebro on the eastern Mediterranean coast. Unlike other Spanish rivers, the Ebro is not prone to drying up, and the 700,000 inhabitants of Zaragoza are amongst the few Spaniards who are rarely, if ever, forced to ration water when one of the country's periodic droughts set in. The city may have polluted the river with the waste from its paper mills, but it pulls its drinking water from further upstream and transfers it in abundant quantities via the grandly-named Imperial Canal of Aragon to people's taps.

This was, therefore, as unlikely a place as any in Spain in which to launch a year-long campaign dedicated to persuading ordinary "Zaragozanos" that it would be a good thing to save water. But campaigns, and campaign funds, do not always follow logic. The "Zaragoza. A Water-Saving City" campaign was the result of the enthusiasm of a small group of ecologists based at the city's "Fundacion Ecologia y Desarollo". From its offices behind the city's imposing Nuestra Senora del Pilar Cathedral, the foundation brought together a sufficient mixture of enterprise and political influence to raise the money it needed to fund the campaign.

Half of the 87 m pesetas ($500,000) spent during the campaign came from the European Union's LIFE programme, which is devoted to environmental projects. The other half was raised from the city's conservative council, the regional government of Aragon and from a local savings bank, Ibercaja. Some local plumbing supply companies also chipped in a small amount.

Was this money well-spent? Marisa Fernandez, the campaign co-ordinator at the Fundacion, said the figures speak for themselves. According to the Zaragoza City Council, which owns the city's water-supply company outright, domestic water consumption in the city had fallen 5.6 per cent by the end of the campaign in October 1998. That meant a saving of nearly 1.2 billion litres of water, more than 10 per cent above the campaign target. In financial terms it was a saving of some 200 m pesetas ($1.25m), or a return of 150 per cent on the original investment. At first sight, then, the campaign was an extraordinary success. Two thirds of the city's schools took part in an "awareness" campaign, in which they learnt about ways to save water at home and, class by class, contributed drawings to what ended up as a colourful and ingenious *Water Book* that ran to six thick volumes.

Public awareness of water saving measures was raised by television advertising, public exhibitions and leaflets. While the people of Zaragoza were reminded that water could be saved by such simple measures as turning off the tap while shaving or washing up, the campaign's organizers decided to concentrate on technological solutions.

Shower heads, tap nozzles and cistern water-savers were publicized. The city's plumbers and suppliers of plumbing products were also called in. On the whole, they were pleased to take part in a campaign that, at the end of the day, promised more work for them from those who wanted their plumbing changed. A very practical message hammered home during the campaign was that saving water also meant saving money. But the low level of the city's combined water and rubbish service bills, which average less than 13,600 pesetas ($80) per household per year, made it difficult to "sell" the devices as ways of making huge financial savings.

"We have discovered that people really learn by example", explained Marisa Fernandez. In terms of raising public awareness about water saving, the campaign was a success, as figures from a telephone-polling company showed. Whereas before the campaign only one in three households said they used water-saving measures, this had doubled to two out of three by the end of the year. Sixty per cent of people had previously admitted to having no knowledge of water-saving measures, with this figure reduced to 28 per cent at the end of the year.

But the technological change wanted by the Fundacion happened only in part. Only 4,000 homes installed water-saving devices during the year, although a number of housing developers decided to incorporate them into new-buildings. The long-term success of the campaign, therefore, is uncertain. Water-saving campaigns that concentrate on changing habits often see those habits discarded as soon as the campaign slips into history.

Spain has the highest per capita consumption of water in Europe.

At the foundation, they are aware of this problem and are raising funding to continue the campaign and spread it to industry, gardens and public spaces. "And maybe, if we are brave, one day we will have a go at agriculture," said Marisa Fernandez. A look at the figures for water consumption in Zaragoza and the rest of Spain, however, raises questions about whether, in reality, this campaign has achieved anything of real significance.

Spain has the highest per capita consumption of water in Europe. But that water is not used by people in their homes. Eighty per cent of it goes to agriculture and 14 per cent to industry. Only 6 per cent goes to domestic use.

That means that the Zaragoza campaign achieved, in real terms, a saving of just 0.34 per cent of per capita consumption.

And with the funding drying up at the end of the campaign, legitimate questions can be raised about whether that saving will be continuous.

The same saving could have been achieved, for example, by a minor improvement in the efficiency of Zaragoza's water distribution system. The city has one of Europe's worst water efficiency rates, at 52 per cent. In other words, 48 per cent of the water it receives from the Ebro is lost on its way to people's homes or to the city's industries. "They have to pump 355 litres per day per inhabitant so that 150 litres get there," explained Eva Fernandez, the campaign's press officer. In other words the same saving achieved by the campaign could have been saved by

improving efficiency by less than 2 per cent.

A similar level of saving to that achieved by "Zaragoza. Water Saving City" could also have been achieved by reducing agricultural consumption of water in, for example, Aragon, by just 0.5 per cent. But neither Aragon, which is one of the 17 semi-autonomous regions into which Spain is divided, nor Zaragoza, the region's capital, appear to be thinking that hard about saving water. The emphasis, instead, is on finding more and better water.

Dam expansion projects are being planned in the Pyrenees to increase the supply of water to farmers and improve "The quality of the water that reaches taps in the big city. "Quantity is not a problem in the city, but quality is. The water here is very hard, with lots of lime", Marisa Fernandez admited. "But that does not mean that we need to start flushing our toilets with Pyrennean mountain water." And this, it seems, is where the campaign was really heading. This was basically a political campaign, trying to raise consciousness about water and turn "Zaragozanos" on to the ecologist's agenda.

The so-called* Book of Water, *built up with a series of posters and drawings prepared in local schools was one of the Zaragoza campaign's most successful elements: it eventually ran to six volumes.

"What was important to us was raising people's consciousness," said Marisa Fernandez. "The majority of the region's inhabitants live in the city, and all social mobilizations start here." The campaign may not have been directed at the farmers and businesses who waste most of Aragon's water, but it was directed at 700,000 people - or nearly two-thirds of the region's population - whose votes and protests count most amongst those who administer the region's water. "You have to start close to home, with the water that comes out of people's taps", explained Marisa Fernandez.

The Zaragoza campaign has acted as one of the inspirations for a similar, LIFE-funded, campaign being run in a Madrid suburb by the World Wide Fund for Nature Spanish branch, WWF-ADENA. The project supervisor Alberto Fernandez said criticism of the relatively small amount of water saved in Zaragoza is misdirected.

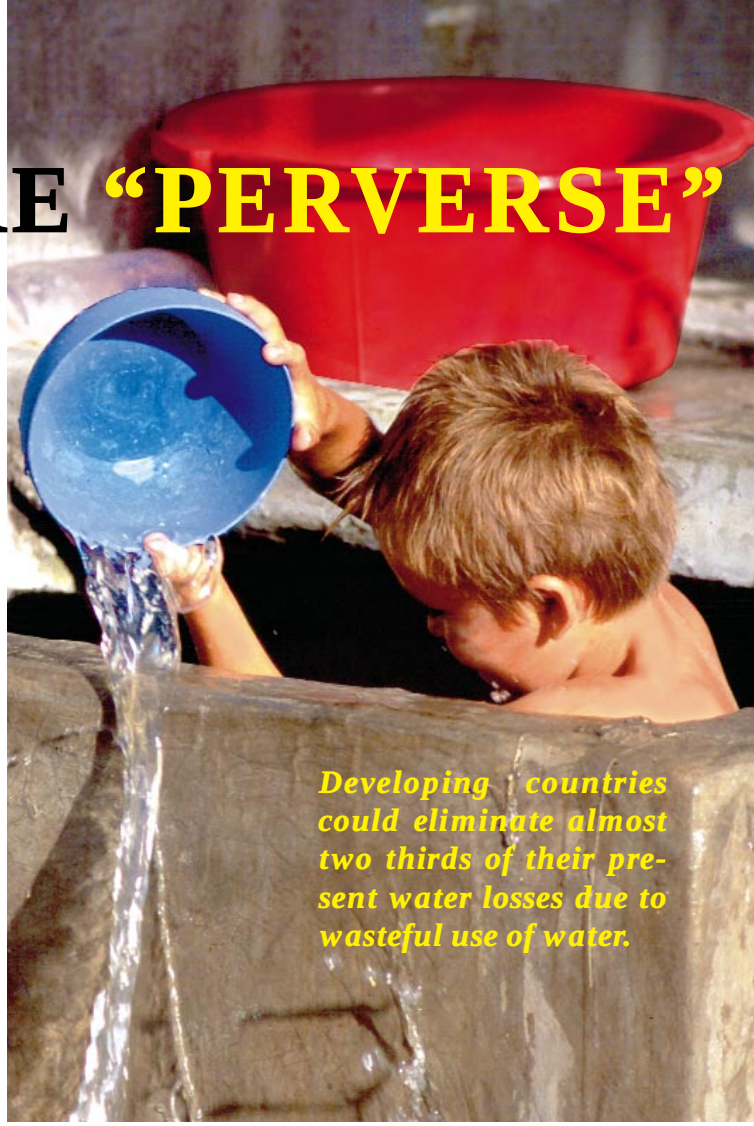
"I think the Zaragoza campaign has worked very well. You cannot expect a campaign of this sort to solve problems that are caused by those who administer water. At least you are creating a large group of people who can now say to the administration or to the agriculture sector: 'If I am saving at home, why are these people wasting water?'"

If the campaign has helped to turn a majority of the city's voters into water-conscious people, then this might help persuade the city hall to improve water efficiency. And if, at the same time, the campaign has turned a large percentage of Aragon's voters into water-lovers, then the regional Government might be persuaded to stop planning new hydrological schemes in the mountains.

That may, or may not, have been what the people who funded this campaign had in mind. At the end of the day, however, it may be the main reason for doing what could appear to be, in Marisa Fernandez's own words, "So much effort for so little."

SUBSIDIES ARE "PERVERSE"

Cutting water subsidies worldwide, except for the poor, would bring immense environmental and economic benefits, argues PROFESSOR NORMAN MYERS, of Green College, Oxford University - a consultant in environment and development.



Developing countries could eliminate almost two thirds of their present water losses due to wasteful use of water.

Water is a basic component of life processes and should be readily available to all. But there will be no good water management when subsidies are munificently dispensed to rich and poor alike, encouraging waste. The hard-scrabbling rice farmer should not have to pay the same amount for his water as the car manufacturer, the chemicals producer, the swimming pool owner and the golf player who do not pay the full cost of their water.

Humans withdraw water from rivers, lakes and other freshwater bodies for three main uses: household, industrial and agricultural (mainly irrigation, 65% of all consumption). Israel, the most water-efficient country, enjoys a renewable per-capita water supply of only one quarter as much as many countries, but it manages by keeping subsidies low in order to encourage efficient water use.

We need to produce twice as much food during the next 30 years simply to keep up with the projected rise in human numbers and human nutrition. Since at least half of this increase is scheduled to come from irrigated croplands, this places a premium on more efficient use of water.

Water is a renewable resource. It is available for repeated recycling, and thus it contrasts strongly with other natural resources such as topsoil and fossil fuels. But from California and Britain to Mexico and India, water is mis-used and overused, in major measure because of subsidies that discourage people from making improvements. Fortunately, and primarily through slashing of subsidies, developing countries - these being where water shortages are likely to become most pronounced - could eliminate almost two thirds of their present water losses due to wasteful use of water. This would be equivalent to increasing their actual water supplies by fully one quarter.

Water is becoming scarce in many parts of the world. Humans already use well over half of available water runoff. Global water use has tripled during the four decades 1950-1990, and demand is expected to double again during the two decades 1991-2010. The number of people experiencing water shortages is already 600m or one in 10 of humankind, and it is projected to reach 2.5 billion by 2025 or three persons in 10. These people use no more water for all purposes each day, viz. cooking, washing and sanitation, than an affluent person uses with every flush of the toilet.

Water shortages cause problems not only for agriculture and industry, but for public health. As much as 80 per cent of disease in developing nations, or 4 billion cases per year, are due to lack of adequate water for household use, and 6m deaths per year stem from water-related diseases such as malaria, cholera and especially diarrhoea. These water-related diseases levy a cost just through workdays lost to sickness, of at least $125 billion a year, by contrast with the cost of supplying additional water and sanitation facilities ie less than $10 billion a year. This effectively amounts to a concealed subsidy of exceptional scale.

Despite these adverse effects, governments find it politically easier to provide new water sources than to make users pay a price that reflects the true costs of supply, thus inducing consumers to treat water negligently if not prodigally. In Pakistan, more than half the Indus basin canal system, some 120,000 sq km of irrigated croplands, is waterlogged and 26 per cent is salinized, both a result of overirrigation. Worldwide, 454,000 sq km out of 2.8 m sq km are salinized enough to reduce crop yields, with crop losses worth almost $11 billion per year. Waterlogging and salinization are taking almost as much old land out of irrigation as is added through new irrigation networks.

There are other environmental problems from excessive irrigation. In parts of the north China plain around Beijing and Tienjin, the water table is currently dropping by as much as two metres a year. This area, roughly China north of the Yangtze River, contains nearly 500m people or almost 40 per cent of the country's populace. It also encompasses half of China's croplands, yet it accounts for only one fifth of the country's surface water.

Governments tend to support agricultural water with one subsidy after another, some of them of indirect character, difficult to discern. In particular, governments sponsor water-demanding crops. In California's Central Valley with its

desert-like climate, three of the main crops are alfalfa, cotton and rice, crops more suitable to a much moister climate. In an increasing number of semi-arid countries, the main use of water is to grow crops that are worth less than the water itself.

How large are the subsidies? In China, water prices are believed to be only 25 per cent of the cost of supply, while the cost of infrastructure (dams, piping, etc.) is left out of account altogether. In Algeria and Egypt, supply-cost recovery is 20 per cent or less, in Pakistan, Indonesia and South Korea it is 13 per cent, in Mexico 11 per cent, in The Philippines 10 per cent, in Nepal 4 per cent, in Thailand 3 per cent, and in Bangladesh 1 per cent of water supply's full economic cost to the Government (compare the United States - 17 per cent).

What about the scale of water subsidies worldwide? In developing countries, official subsidies - or conventional and overt subsidies - total at least $25 billion per year for irrigation alone, and in developed countries at least $10 billion. Then there is $13 billion from under-pricing of household water in developing countries, and $9 billion of losses through supply inefficiencies and illegal connections.

The overall subsidies total approaches $60 billion - and it could readily be twice as big, conceivably several times bigger, were we to consider all forms of water use and their subsidies both overt and covert. Given the harm that these subsidies impose on economies and environments alike, at least three quarters of the $60 billion, ie $45 billion, are considered "perverse" - bad news for economies and environments alike.

In addition to these myriad subsidies, there are the implicit subsidies of environmental externalities. Notable instances are water pollution and water deficits, both of which relate strongly to disease in developing countries. I have already pointed out the $125 billion a year lost to water-related diseases. A further way to shadow price the cost of water shortages is to estimate the numbers of people - at least 500 million - who must spend several hours a day carrying clean water to their homes, then to reckon their time opportunity costs at a minimum of, say, 25 US cents an hour. The result is an externality cost of at least $50 billion a year. These two implicit subsidies alone total $175 billion per year, and are to be counted as 100 per cent perverse. So total perverse subsidies amount to $220 billion per year.

The main priority is to reduce and eventually phase out water subsidies (except for poor people). There is plenty of scope to do this, especially in agriculture. California landowners can buy water for only a tenth of the price it costs the federal government to deliver it - and it can be worth six times as much on the open market.

Farmers do not need to fear the gradual elimination of subsidies. For most agricultural commodities, water is such a small component of overall costs that steadily climbing water prices would have negligible effects on crop prices. In fact, by growing less thirsty crops and making more careful use of water, California farmers could increase their revenues by 12 per cent while using 12 per cent less water.

There is lots of scope too in the urban and industry sectors. An increase in the water tariff in Bogor, Indonesia, from $0.15 to $0.42 per cubic metre has resulted in a 30 per cent decline in household demand. In Sao Paulo, Brazil, three industrial concerns have reduced water consumption by 40-60 per cent in response to effluent charges.

"Governments find it politically easier to provide new water sources than to make users pay for the true costs of supply, thus inducing consumers to treat water negligently."

A further policy initiative lies with water markets. In areas as disparate as California, India, Indonesia, China, and central Asia, when farmers are encouraged by subsidies to view water as "cheaper than dirt", they treat it as such. If, by contrast, the farmers could sell their water to higher-value users, farmers would have an incentive to conserve it. As soon as water markets emerge, they improve water use efficiency, they increase flexibility in resource allocation, and they reduce incentives to degrade the environment.

The gap between the value of a litre of water to a farmer and to a thirsty city dweller is so large, and agriculture's use of water so extensive as well, that there is abundant opportunity for trading deals. Since the late 1970s, a vigorous water market has sprung up in the United States, allowing urban authorities to buy up farmers' water and thus provide extra supplies for city communities. Similar water markets are emerging in Australia, New Zealand, Algeria, Morocco, Tunisia, Brazil, Peru, Mexico, Chile, China, India and Pakistan. They all epitomize the saying "Water flows uphill to money."

WETLAND GRASS TO MAKE COMEBACK IN FIJI

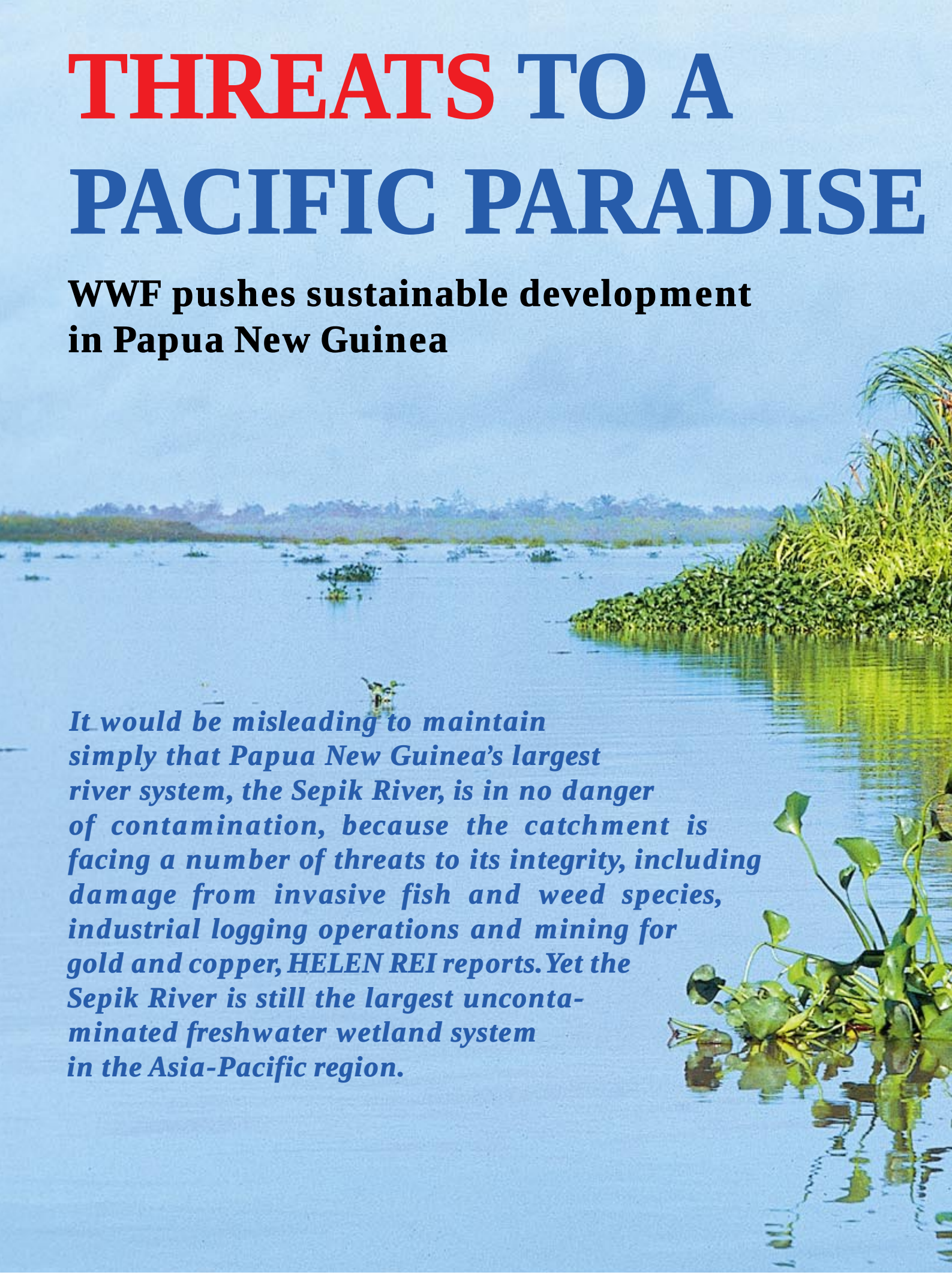
For centuries women on the Pacific islands of Fiji have used the wetland grass known as kuta to weave soft mats for swaddling babies. Over the last 20 years the wetlands where kuta thrives have been adversely affected by weeds, siltation caused by deforestation and chemical runoff from sugar-cane farming.

The World Wide Fund for Nature (WWF) has been working with women from two Fijian villages to record their knowledge of kuta. The women, who once used abundant supplies from nearby ponds, revealed that they now have to pay for drivers to take them to ponds much farther away.

At a recent WWF workshop, the women developed a detailed restoration plan for their wetlands, which entails back-breaking work, including hand-digging channels and transplanting native trees. But they regard these efforts worth while because they can see that their wetlands and kuta supplies are being restored. They have also launched a handicraft business, weaving kuta grass into bags and purses, which are then sold as tourist items, as well as making their traditional mats.

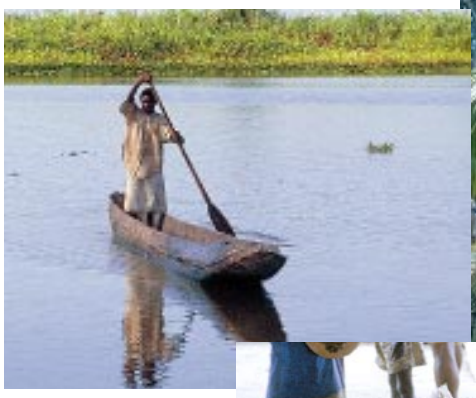
THREATS TO A PACIFIC PARADISE

WWF pushes sustainable development in Papua New Guinea



It would be misleading to maintain simply that Papua New Guinea's largest river system, the Sepik River, is in no danger of contamination, because the catchment is facing a number of threats to its integrity, including damage from invasive fish and weed species, industrial logging operations and mining for gold and copper, HELEN REI reports. Yet the Sepik River is still the largest uncontaminated freshwater wetland system in the Asia-Pacific region.

PNG, as Papua New Guinea is commonly known, is located in the south Pacific and comprises a scattered collection of more than 1,400 islands between Australia and the equator. New Guinea is the largest of these islands. West New Guinea, or Irian Jaya, is part of Indonesia, while the eastern part of the island forms the largest land mass of PNG.



The Sepik Community Land Care project offers people a greater choice of environmentally sensitive development options.

Rising in the Drei Zinnen mountain range, part of the vast central spine of mountains running through the islands of New Guinea, the Sepik River flows strongly in a north-westerly direction into Irian Jaya as a braided river. It meanders back and forth across the border some four times before turning sharply to the east and then, as a single channel, flows towards the coast. For much of its course it has been described as a huge brown, slowly coiling snake.

With a catchment of 77,700 sq km, the Sepik is the largest river system in PNG and drains most of the northern half of the country. Many major tributaries join the Sepik, crossing the plain to add their aquatic loads to the main river system. Such rivers include the April, May, Keram, Yuat, Karawari and Korosameri.

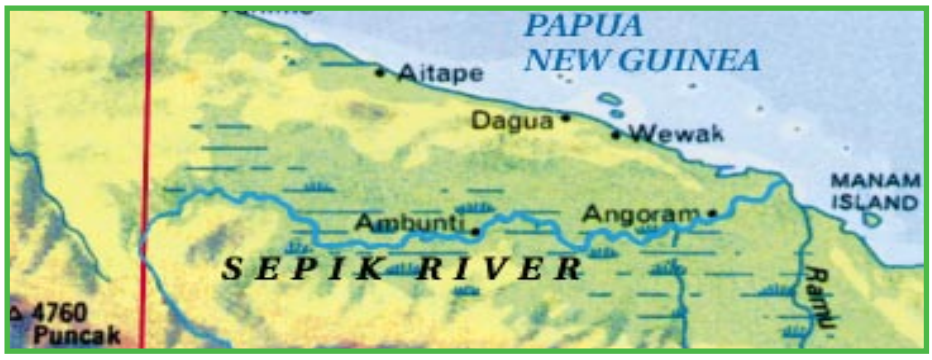
Unlike other rivers in PNG, it discharges into the sea through a single outlet. The water level rises 3.5metres during the rainy season, spilling over on to a floodplain, which is up to 70km wide and 78,000 sq km in area. The river has only a small delta at its Bismarck Sea outlet because the sea floor drops off sharply to a depth of 700m. At its mouth, the Sepik discharges freshwater up to 75 km out into the sea, leaving a clearly discernible brown stain in the otherwise blue ocean.

As in every province in PNG, the rich natural resources of the Sepik area have development potential, but the area has been well preserved. For the moment, there are no large mining projects, no industrial plants and no large timber extraction projects operating within the region. Compared to other parts of New Guinea, much of the area has a low rate of population growth.

The upper Sepik is recognized as one of the most important areas of forest and wetlands biodiversity in the Pacific. It has one of the areas of greatest bird diversity in PNG with at least 165 resident forest species. There are extensive tracts of diverse tropical lowland and mountain forests, swamp forest and important lake systems in the country. The Hunstein Range is home to the Klinki pine and contains perhaps the world's largest stands of Kauri pine.

Some of PNG's rarest plants are to be found in the Sepik area, where vegetation in the catchment varies from mangrove forest to grassland and dense montane forest. The extraordinary richness of the Sepik's forest, wetlands, wildlife and human communities is catalogued in *The Sepik River: A Natural History*, by Phil Shearman. According to this report from the World Wide Fund for Nature, some 55 per cent of the region's plant life is endemic to or found only in the area. The Sepik's tropical habitat has contributed to the richness of its fauna with possibly 120 of New Guinea's 200 mammal species - the most diverse mammal fauna in Australasia. It is similarly rich in bird life. Of the 725 species of birds in New Guinea, at least 387 species have been recorded in the Sepik catchment.

But clouds loom on the horizon for this seemingly idyllic freshwater environment. There is potential for major disruption to its careful natural balance through the arrival in recent years of invasive weeds and fish species, such as the climbing perch *Anabas testudineus*, as well as proposals for logging and mining in the river basin. The major threat of large-scale logging comes from a forest management agreement (FMA) over the extensive April-Salumei area, which is within the Sepik catchment. The FMA has not been rescinded despite a PNG government survey report that recommended a ban on intensive logging because of the are-



The WWF programme helps conservation of community-held land, forest and wetland, including biodiversity.

Overleaf: awareness work with local people and mapping where they live are also being carried out.

a's extraordinary biodiversity and high value for local people as undamaged forest.

The major threat of mining comes from a proposal known as the Frieda Mine, which is planned for the upper Sepik. If it goes ahead, the mine will be bigger than the infamous Ok Tedi mine, which contaminated 600 km of the Fly River system, flowing in the south of the country into the Gulf of Papua.

The World Wide Fund for Nature has established a major programme of support to local communities and government for integrated conservation and development in the province. WWF is concerned that the mine, its associate infrastructure and tailings waste could cause irreparable damage to one of the world's last great untouched natural treasures.

The programme includes assistance with management and conservation of community-held land, forest and wetland resources; development of resource-based business ventures, and integrated planning for sustainable development, cultural conservation and biodiversity protection. The 6-year project, which is funded through WWF by the Dutch Government, started operations in 1998. Its launch followed five years of background research and small-scale activities with partner organizations in the Ambunti and Hunstein Range areas between 1993 and 1997.

The project-financing agreement reached between WWF and the Dutch Government has allowed for a more committed engagement by WWF in the region. With bases in Wewak and Ambunti, WWF has become an important contributor to the sustainable development of this environmentally important area.

As the pressure on Sepik communities to sell their resources and develop sources of cash has grown, the need to develop alternative economic options that protect the land has become more and more important. The people have expressed a desire to keep their land intact while moving towards sustainable development. WWF is working with communities to identify projects and activities that help them develop while conserving their natural resources.

The Sepik Community Land Care (CLC) project area covers 1m hectares, taking in the upper reaches of the Sepik River and the relatively untouched tropical moist forests of the Hunstein Ranges known locally as the Sepik Hills. The Sepik CLC project has been set up to work with communities, so that the people have a greater range of environmentally sensitive development options to choose from.

The mining of economically important minerals in the Sepik catchment is likely to be a major issue in the next decade because of the development opportunities for local communities and the environmental impact of extractive operations. Mining activity in the region can be divided into two forms - village-based small-scale gold mining and large-scale industrial mining. Mining and petroleum developments entail clearing vegetation and changing habitats in their immediate area.

From a conservation perspective, mine-related clearance is of minor concern in PNG especially in comparison to both the riverine and secondary impacts. All large mines on mainland PNG have used local river systems to dispose of tailings, overburden and other mine wastes. This method of disposal has been justified as the only option on the basis of the steep terrain, high rainfall and seismic activity that characterize much of New Guinea. The combination of these factors makes tailings impoundment either unsafe or technically impossible. It has long been argued that because of the high discharge and sediment of loadings of New Guinea rivers, mine-derived sediments are unlikely to affect their ecosystems.

WWF is currently carrying out awareness work with local people along the river. It is also gathering information, carrying out tests and mapping the various types of forests and the places where people live. The purpose is to ensure that there is enough background information to support WWF awareness campaigns against any form of mining and exploration. WWF is also gathering information to find out how best to go about helping people to keep their land untouched or unpolluted. Local communities in the Sepik basin are well aware of the disadvantages of major mining exploration activities in the area and say they will not support any in the future. Since the pressure on the people to sell their resources and develop sources of income has grown, there has been a need to develop alternative economic options that protect the land.

WWF's initiative paves the way for more projects of this kind that will enable people to earn at the same as protecting their land and the river. The Sepik River is not in danger and will be left untouched only if the local people continue to pursue their own welfare by preserving their natural land for the benefit of future generations.

The author is a journalist on the staff of *The Independent* newspaper in Boroko, Papua New Guinea.