



What price water?

Ideas on the move

Hidden water

Water works

**Going with
the grain**

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TUNZA

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for youth. To view current
and past issues of this
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**Partners for Youth
and the Environment**



UNEP and Bayer, the German-based international enterprise involved in health care, crop science and materials science, are working together to strengthen young people's environmental awareness and engage children and youth in environmental issues worldwide.

The partnership agreement, renewed to run through 2010, lays down a basis for UNEP and Bayer to enlarge their longstanding collaboration to bring successful initiatives to countries

around the world and develop new youth programmes. Projects include: TUNZA Magazine, the International Children's Painting Competition on the Environment, the Bayer Young Environmental Envoy in Partnership with UNEP, the UNEP Tunza International Youth/Children's Conference, youth environmental networks in Africa, Asia Pacific, Europe, Latin America, North America and West Asia, the Asia-Pacific Eco-Minds forum, and a photo competition, 'Ecology in Focus', in Eastern Europe.

EDITORIAL

Cherrapunjee, high in the northeast Indian state of Meghalaya, is famous for being the wettest place on Earth. As a bold yellow sign on the way into the small town boasts, it averages a staggering 12,028.6 millimetres of rain annually. Yet for a third of each year its people are now short of water. In the dry months, from November to February, women and children have to go down into the valleys to get it, trudging back uphill under backbreaking loads. For the springs that used to gush with abundance all year round are drying up because the mountain forests, which used to trap the rainfall and allow it to percolate down to the water table, have been felled.

All over the world, the poor are making similar daily treks, often to bring back only dirty water. In all, a billion or more people lack access to steady, safe supplies. As a result some 5,000 people, mainly children, die every day from diarrhoea and other diseases – the equivalent of more than 15 jumbo jets crashing daily. If everyone in the world had safe water and adequate sanitation, the global incidence of death and disease would be cut by three quarters. It is one of the greatest scandals of history that these have not already been supplied.


At the same time, water is becoming scarcer and scarcer as the number of people on the planet increases and the vital services that nature provides to conserve and supply water are ignored, abused and destroyed. Already, a third of the world's people live in countries suffering water scarcity; by 2025 this proportion is expected to have shot up to two thirds.


There are some signs of hope. Much is being done to provide clean water where it is needed. The world may yet meet the target – set by its governments in the Millennium Development Goals – to halve the proportion of the world's people without access to clean water by 2015. But hundreds of millions will still not have it. Meanwhile, the destruction of the world's natural systems – and the loss of their vital role in providing water – continues apace. There are few tasks more urgent or important than conserving the world's water supplies and making sure that they are available to all. We must pledge ourselves to ensure that these are achieved.





COOL
&


COOLER


 **COOL:** Make a low-flush lavatory by putting a plastic bag filled with pebbles, a brick, or a plastic bottle of water in the cistern. This could save up to 1,135 litres of water per month.

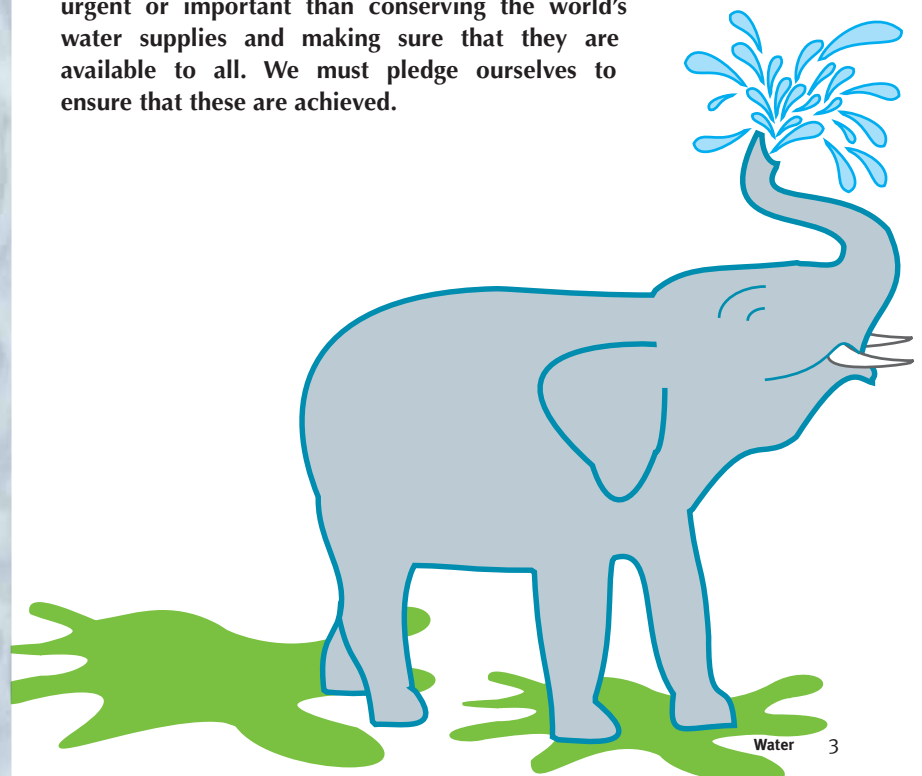
 **COOLER:** Harvest and store water with a rainwater butt collecting runoff from the roof. Use it for watering the garden, flushing lavatories, in washing machines and for washing cars, or even filtered as drinking water.

 **COOLEST:** Build an aquaponics system – a combination of aquaculture (fish farming) and hydroponics (farming without soil) – in the garden or garage or even on the roof. Wastes produced by the fish nourish the plants, which in turn purify the water.

 **COOL:** Keep a bottle of clean tap water in the refrigerator for drinking. This avoids running the tap until the water cools, which can save more than 300 litres a month.

 **COOLER:** Carry a refillable water bottle to replenish rather than buying – and discarding – new bottles.

 **COOLEST:** Go and see *Flow: For the Love of Water*, which argues that water distribution should be based on need and environmental sustainability – not commercial gain – and stresses that no one can go on taking water for granted.





Hidden water

Vanessa Pike-Russell

By Fred Pearce, environmental author and correspondent of *New Scientist*

INEQUALITY comes in litres. While most of the poor have too little water to meet their needs, the relatively well-off consume enormous amounts. Indeed, few realize quite how much water someone living a Western urban lifestyle – whether in Europe or North America, or among the middle classes in developing countries – actually uses.

It's not the obvious uses that really add up. On average, each person drinks not much more than 5 litres of the stuff daily. Even after washing and flushing the lavatory, it increases to only around 150 litres each. But that is just the start. The numbers begin to soar when the water needed to produce food and drink is added in.

It takes between 2,000 and 3,500 litres of water to grow a kilo of rice. That is more water than many families use in a week. It takes 1,000 litres to grow a kilo of wheat, and 500 litres for a kilo of potatoes.

And when you start feeding grain to animals to make meat and milk and cheese, the numbers become even more startling. It takes 11,000 litres – that's 11 tonnes – to grow the food for enough cow to make one hamburger; and between 2,000 and 4,000 litres for it to produce a litre of milk.

Every teaspoonful of sugar in a cup of coffee requires 50 cups of water to grow it. That's a lot, but not as much as the 140 litres of water (or 1,120 cups) needed to grow the coffee itself. Growing cotton for clothes is no better. On the Internet you can buy jokey T-shirts with slogans like 'Save water, bath with a friend'. It's a good message,

but please don't buy the T-shirt. You could fill roughly 25 bathtubs with the water needed to grow the cotton to make it.

In all, an average citizen of the United States consumes 2,483 cubic metres a year – about three times as much as a Kenyan or a Chinese. For myself, I reckon that, as a typical meat-eating, milk-guzzling European, I account for as much as a hundred times my own weight in water every day.

WHERE DOES IT ALL COME FROM?

Some of that water falls as rain on fields. But most of the food and all the cotton consumed around the world is grown using water collected from rivers or pumped from underground. In some places, two, three or even four times more water is taken to irrigate crops than a generation ago – and as a result these once abundant sources are drying up.

Many places are in danger of running out of water. In India, farmers are taking 100 cubic kilometres more water from underground sources every year than the rains replace. That's six times more water than Britain, for example, uses in a year.

As rivers run dry and underground water tables fall, countries have tried to get round such local crises through trade. Not in water itself – which is too heavy and expensive to transport far. Instead, more and more dry and densely populated countries are importing thirsty crops rather than growing them themselves.

Economists call the water needed to grow these traded crops 'virtual water'. Think of it this way: every tonne of wheat arriving at a dockside carries with it, in virtual form, the 1,000 tonnes of water needed to grow it. All sorts of traded products require water for their production: it takes, for example, about 400,000 litres of water to manufacture a car. But about 90 per cent of the 'virtual water' trade is in food and cotton.

The biggest exporters are the United States of America, Australia and Canada, while major importers include Japan and Europe and, increasingly, China, which no longer has enough water to grow the food it needs. In one way this trade is good news. The Middle East, for instance, ran out of water to feed itself some years ago, the first major region ever to do so. Without the trade, Jordan, Iran, Egypt and Algeria would starve. There would be water wars.

VIRTUAL WATER: REAL SHORTAGE

Virtual water carries risks because not everyone can be a net importer; someone has to do the exporting. Water prices have soared round the world in the last two years, partly because Australia, a major source of thirsty crops, had a drought. Its exports of rice, sugar and wheat fell by more than half.

Climate change means that more and more countries are likely to suffer droughts in future. Who will feed them? In such a world, countries that rely on importing virtual water could be in trouble.

What can be done to provide enough water? There are some technical solutions. Coastal regions can desalinate seawater, for instance. That is OK for providing drinking water, but too expensive for the big users – like farmers.

Some countries will build more reservoirs to catch the water in their rivers. But in more and more places, the rivers are already drying up. A global study published recently showed that a quarter of the world's people live in river basins where the water is already fully used.

So what else? Moving water over the hills from one river basin to another – from wet regions to drier regions – is possible. China is spending \$60 billion on a series of vast canals to move water from the wet south to the arid north. India is talking about an even bigger project to pump water from the great monsoon rivers of the north, like the Ganges, to the dry south and west. But it is very costly, because water is heavy and expensive to pump uphill.

GETTING IT RIGHT

First, we need to get better at catching the rain where it falls. I have visited villages across India and China where they are doing just this – reviving ancient methods of capturing the rain and pouring it into their wells to be used during the dry season. The water-rich, like me, also need a revolution to use water more efficiently in their daily lives. Huge gains can be made by such simple measures as turning off the tap while brushing teeth, using a bucket rather than a hosepipe to water the garden or wash the car, or not always flushing the lavatory.

But agriculture, as the biggest user of water, especially in the driest countries, can contribute most. Tens of millions of farmers worldwide still irrigate their crops simply by flooding their fields. Most of the water evaporates and little, in practice, reaches the plants. But cheap, modern systems of drip irrigation can deliver it drop by drop close to the crop roots, cutting demand by 50 per cent or more.

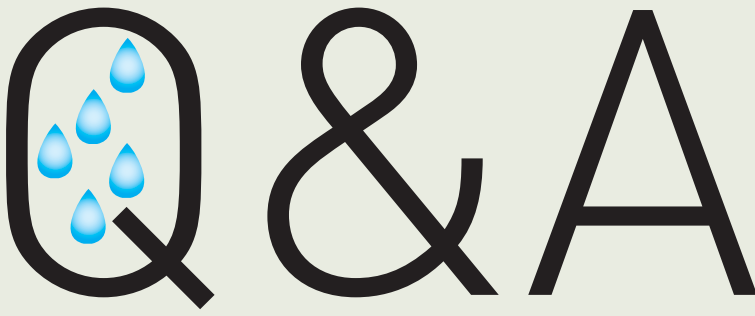
So there are solutions. If water is used right, everyone can be fed and have water. But first it must be properly valued. It must be treasured, not wasted.

THE 'NEW OIL'?

Some say that water is the 'new oil' – that it will be the cause of wars in the 21st century, as 'black gold' was the cause in the last one. Maybe so. But water is even more important than oil: after all, the world's people could manage without oil, if we had to. But no one can manage, even for one day, without water.

Carrie Cizauskas





Q Will the world ever run out of water?

A No, but for a lot of people it may feel like it. The amount of water in the Earth's system remains constant, but both population and demands are growing. And climate change will shift rainfall patterns, making some places much drier, and melt glaciers – depriving vast populations of a steady source of water.

Q What must be done to ensure that water is fairly distributed so that everyone has access to it?

A Our present failure to provide safe water and sanitation to all results in the death of some 1.8 million people, mainly children, from water-related diseases each year. We all must be aware that the world contains a fixed amount of water and there are ever more of us dependent upon it. Water is our common heritage, but it is also our common responsibility. The first step is to meet the commitment in the United Nations Millennium Development Goals (MDGs), to 'halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation'.

Q Most countries in West and Central Africa are unlikely to meet the Millennium Development Goal of cutting by half the proportion of people without safe drinking water. Do they need more investments in infrastructure and equipment, or are there more basic solutions?

A Investment is needed if we are to meet the MDGs, and on a wide scale infrastructure and equipment are essential of course. But we also need enough managers, engineers and farmers – who understand the need for a sustainable future – to help provide healthier and more secure lives for all.

Q As the world's glaciers melt, what are the prospects like for the billion people on Earth that depend on them for water?

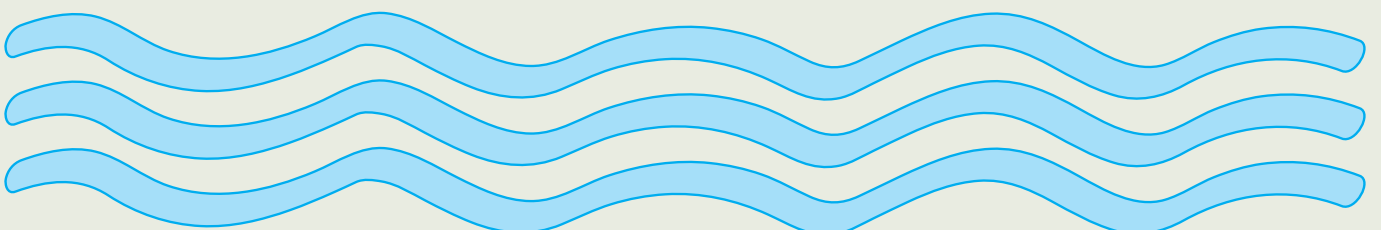
A Not good. Glaciers are incomparable stores of water, steadily releasing vital supplies, especially when they are most needed in the warmest weather. Without them the water will rush straight off the mountains as the snows melt, causing first floods, then water scarcity. It is an issue of survival.

Q What can be done to prevent 5 billion people suffering from water stress and scarcity by 2050, as is currently predicted?

A Clearly we can't continue on our current path. We all need to practise sustainable water resource management. There are more efficient ways of managing water with existing technologies, but there is also a need for further research and development. And, as citizens, we should all look at our consumption habits, and see if there are ways to reduce our use of water. International cooperation also has a major role to play, with countries coming together to build a global consensus on actions to counter global water shortages.

Q Since over 97 per cent of Earth's water is salty, why is desalination not more widely adopted? Is it a viable option?

A We do know how to desalinate water, and some very water-short countries, particularly in the Middle East, are doing it. But large-scale desalination requires expensive plants and sophisticated equipment, and is very energy intensive. Nonetheless, if we can truly harness renewable energy sources like wind, tide and solar power, it may become a more realistic option.



STAR PUPILS



WaterAid

Nienke Flederus, Dana Weidemann, Alex Lindsay, Angharad Thomas and Zartash Javaid made short films about the importance of water for a competition run by Simavi in the Netherlands and WaterAid in the United Kingdom – and won a trip to the villages of Mchemwa, Chingongwe and Msembeta in central Tanzania to look at water and sanitation. They talked to TUNZA when they got home.

‘When we first arrived, we hadn’t a clue what to expect. At first we were a bit shy, but we were warmly welcomed by the villagers, singing and dancing for us, and soon found we could ask anything and have all our questions answered. The women and children told us that they have to get up early to go and collect water. But even when they get it, it is not clean.

They showed us the place where they could still collect water several months after the end of the rainy season – a large, dry area but for a few holes containing extremely grey, dirty water.

It was a real eye-opener to see how they live, without clean water and basic sanitation. Coming from Europe, we had not realized the size of the problem – or that dirty water caused so many of the diseases and deaths in such communities.

In one village we helped lay foundations for a water pump: it was hard work but it was really rewarding to be able to help, even in this small way. We especially enjoyed visiting the schools: we were allowed to sit among the pupils, who told us about themselves. Almost everyone said they are often ill

from drinking dirty water, stopping them from being able to go to school.

This trip was a great chance to see projects funded by WaterAid and Simavi and to understand what they do and why and how they work. We have learnt so much about the differences between life in the poorest parts of Tanzania and back at home in Europe. It has been a life-changing experience. If only everyone at home could see what we have seen, they would understand just how lucky we are, in our part of the world, to have such simple things as water and sanitation.’

- **In Tanzania, women and children spend an average of more than two hours a day collecting water; in some areas, this journey can take six to seven hours.**
- **Tanzania’s Ministry of Water statistics show that 70 per cent of rural communities and 30 per cent of urban communities have no access to safe water.**
- **In Tanzania, diarrhoea is said to be responsible for at least 20 per cent of the country’s infant deaths.**
- **Worldwide, some 5,000 people – mostly children – die every day as a result of diseases caused by unclean water and poor sanitation.**
- **Around a billion people do not have steady access to safe water – roughly one in seven of the world’s population.**
- **2.5 billion people – nearly two fifths of the world’s population – do not have access to adequate sanitation.**
- **To meet the Millennium Development Goal targets of halving the proportion of people living without water and sanitation by 2015, total global investments in water and sanitation would need to double.**

Water works

Getting pumped

In agricultural Myanmar, many small farming households have to survive on less than \$2 a day. Farmers naturally need water to make their land productive – and it's available, but it's also time-consuming and physically challenging to get out of the ground with hand pumps. Most farmers find diesel pumps, and the fuel they require, too costly.

I work with International Development Enterprises, a non-governmental organization that helps rural families get water with foot-treadle pumps. We design, produce and distribute them, using research from Stanford University. They save time and energy, taking only half an hour to get enough water to irrigate a small plot, compared to two hours with hand pumps. They also easily bring water up from 7.5 metres below ground.

The extra time and water allow farmers to increase their cultivation and produce better-quality crops, which they sell to raise money to educate their children, thus helping the family escape poverty. The pump is so easy that even blind people can operate it and so can children when they get home from school. So far over 27,000 families in Myanmar have purchased the treadle pumps, doubling their incomes.

Naw Tsai Blut Moo, 23, Tunza International Youth Conference delegate, 2007, Myanmar

River detox

Local government, private industries, environmental groups and academia have teamed up to save the river systems of the Bulacan province, which provide water, food and livelihoods to over 250,000 people. This water is contaminated by toxic heavy metals from unmonitored wastewater dumping by various industries along riverbanks. One of the worst is chromium, which can cause dermatitis and, at high concentrations, even cancer.

At university, I applied what I learned in microbiology to help try to solve the problem, isolating microbes that produce hydrogen sulphide gas. This precipitates and transforms the chromium into a much less toxic compound, making the metal more manageable and less risky to isolate. In the lab, the microbes effectively reduced the chromium by 99 per cent in four to seven days. Research is under way to establish a full understanding of what happens to the bacteria during and after treatment, and a more efficient and large-scale programme is being designed.

Clarisse Quimio, 21, Bayer Young Environmental Envoy 2007, Philippines

For the birds

The Konya Closed Basin gets the least rain in Turkey, but holds 40 per cent of the country's total potential fresh-water resources in a deep groundwater lake. But such is demand, especially for irrigation, that the water is being extracted twice as fast as it is replaced. Wetlands in the area have begun drying up, bad news for migrating birds such as cormorants, pelicans, ducks and terns. Many no longer stop there.

As an engineering student, I have developed a system to treat and divert wastewater to irrigate crops in the basin. The cleaned water is carried to the fields in existing drainage canals, so there is no need for new infrastructure. The system solves two problems at once: reducing water pollution and conserving groundwater. I have received funding from WWF, the global conservation organization, and done preliminary feasibility studies. Positive results mean that the next step is to build a prototype.

Sinem Erdoğan, 24, Bayer Young Environmental Envoy 2007 and WWF, Turkey



International Development Enterprises



Adopt a river

My youth group, the Zimbabwe Youth Environment Network, has taken the initiative to clean up the Masuie River, a tributary of the Zambezi. We took a water sample, sent it to a laboratory for testing, and found it was not safe to drink. We began meeting every two months to pick up papers and car parts littering the river. Eventually we realized that most of the rubbish was coming from a nearby tip, so we lobbied the local authority to move it to a different place or find ways of containing the rubbish.

We also met poor people scavenging for something to eat and helped them learn about the danger of eating polluted food. As a result of our work, litter at the tip is now being sorted and disposed of appropriately, and the authorities have advised people to boil their drinking water. Our group continues to monitor water quality, pick up rubbish and look for more ways to make our water as clean as possible.

Nominater Mpala, 22, Zimbabwe Youth Environment Network (ZIYEN), Zimbabwe

Fire and water

It was festival time in the small town of San Lucas Tolimán, Guatemala, which sits on the banks of the beautiful Lago Atitlán, the deepest lake in Central America.

And I had organized it. As a volunteer for IPADE – a non-governmental organization helping to improve water quality and supply to nearby farming communities – I wanted to focus attention on the importance of water by celebrating it (and the fact that all human beings are made of it) through spirituality, art and education.

The Festival de Agua Ya started with a parade: some 900 children and young people marched from the city gates to the central park dressed in brightly coloured traditional costumes, some relating to water myths. For the rest of the day, the youth shared artwork, musical performances, videos and discussions about how to get involved in water conservation. All discussions touched on the importance of caring for water and, therefore, all of life.

For me, the highlight was inaugurating a mosaic mural dedicated to water and peace. I had designed it as an act of urban recycling, and – with other young people – we put the pieces together, turning an abandoned lot into a beautiful public space.

As the sun went down, we lit a sacred fire in a ceremony of thanks, presided over by *ajq'ij*, Mayan priests who with devotion – and in the ancestral language – delivered a blessing of universal love to San Lucas Tolimán.

Oscar Gálvez, 24, Tunza International Youth Conference delegate, 2007, Chile



Green Action

Buffalo bull

Years ago in Debreshte, our small agricultural village, nearly all households bred water buffalo. They provided dairy products and, by grazing, helped prevent wetlands becoming overgrown. But with the mechanization of agriculture, they became very rare. My youth environment group, Green Action, investigated the issue and discovered that the last 13 water buffalo in our entire country lived in our village, kept by a single household for milk.

But there was no bull, and those females had not been pregnant for almost three years. If they lost their ability to produce milk, they would be slaughtered for meat. We began raising awareness in the village, collecting funds to buy food for the animals, and applied to the UN Small Grants Programme for money to buy a buffalo bull, which we donated to the breeder.

As a result of our project – which won second place in Volvo Adventure 2008 – young people in the region have learned about the importance of the water buffalo, the owners are benefiting from the milk, local citizens are relearning traditional practices, and best of all we have several new buffalo calves securing the future.

Aleksandra Aceska, 15, Green Action, Volvo Adventure 2008, FYR Macedonia



RICE FEEDS HALF THE WORLD – and demand is growing as both populations and appetites increase. By 2040 humanity will need to produce 1 billion tonnes each year, 40 per cent more than now.

But the world's most important crop also needs more water to grow than any other. Producing just a single kilogram of rice requires a massive 2,000 to 3,500 litres depending on the climate and the type of soil in which it is cultivated. In India it accounts for more than 70 per cent of all the water used in agriculture.

Already, rice cultivation is seriously depleting groundwater supplies in many areas and even leading to local conflicts over water. So how can humanity possibly hope to produce what it is going to need in an increasingly water-constrained world? By changing the way it is grown, says Biksham Gujja, WWF's policy advisor on global water issues. He says that switching to a new system now used in over 40 countries (albeit on a small scale) can greatly in-

crease yields while using up to half as much water and fertilizer.

Originally developed in Madagascar in the early 1980s by a French Jesuit priest, Henri de Laulani, the System of Rice Intensification (or more popularly SRI), 'is not technology, but methodology', explains Gujja. Farmers can choose a variety of their own choice, but need to cultivate it differently using SRI principles and practices.

Perhaps its most dramatic innovation is to do away with the flooded paddy field, concentrating on keeping the soil moist instead. The flooding, says Gujja, 'is used only to control weeds'. Instead, under SRI, farmers weed the land themselves using simple tools, but this has the added benefit of aerating the soil and mixing nutrients. 'This is a somewhat difficult task initially,' he says, 'but once farmers see the benefit and importance they get used to it.' The weeding helps the plants to develop more robust roots, facilitating absorption of nutrients, reducing the input cost of fertilizers and resulting in better yields.

It requires less than a tenth of the seed needed for conventional cultivation – cutting down on costs – and involves the individual planting of young seedlings (less than 10 days old), at regularly spaced 25cm intervals. The most difficult thing is 'persuading farmers to plant such young seedlings,' says Gujja, 'but this is the most important step for facilitating the absorption of sunlight and, later, for weeding.'

And whereas growing rice in stagnant water demands ever larger amounts of increasingly expensive fertilizers and pesticides, SRI uses organic manures or less than half the usual dose of inorganic fertilizers, most of which would usually drain into rivers or underground, causing nutrient overload and pollution.

Water savings, he adds, 'are reported to be between 30 and 50 per cent'. The increase in yield varies depending on local conditions, 'but is usually 30 to 40 per cent more than with a conventional system, so at least a tonne more per hectare is possible in most

Respect!



Shahier Ahmed

Tunza Youth Advisor Jamal Alfalasi explains how the people and authorities of the United Arab Emirates are addressing water needs in this water-short but rapidly developing country.

Imagine you're in a desert country with the sun blazing right above. There's hardly any shade, and no water in sight. Feeling thirsty?

This was the parched existence of my ancestors – Arabs who trailed oceans of sand in search of their two most precious commodities: knowledge and water. Knowledge was exchanged between towns and tribes; water was less easily found. My ancestors got most of it from wells that tapped into groundwater. Using their knowledge and experience, they managed to find it in the most remote places. A single date palm indicated groundwater close to the surface, for example, because it extends its roots horizontally rather than vertically.

I don't think I could have survived such conditions. Luckily, I don't have to! With today's technology, I can get fresh, clean water with a turn of a tap in the United Arab Emirates (UAE), a country with scarce natural freshwater resources.

Groundwater is still used for drinking, but it's simply not enough for the high demands of a quickly developing city like Dubai. So, in 1988, it adopted an expensive but effective way to

Going with the grain

places'. Many farmers have reported yields above 10 tonnes per hectare (India's national average is 3) and even up to 15.

'Some agri-scientists remain sceptical but farmers from 40 countries, from Mali to India, are enthusiastic. In the era of a water crisis, a food crisis and a financial crisis, this is a simple farm-based solution that needs no heavy investment in infrastructure, no long-term scientific development of special rice varieties, and no expensive inputs. Communities can help themselves, increase yields, and teach their peers rather than having to rely on experts.

'And of course there's a climate-change benefit, too,' Gujja concludes. 'Rice paddies release large amounts of methane, a potent greenhouse gas. But SRI cultivation is known to reduce these emissions significantly.'



Rosemary Terry

provide freshwater: desalination plants that pump seawater from the Arabian Gulf and evaporate it to remove the salts. As the plants desalinate the water, steam is produced to turn turbines that provide the city with electricity. Dubai isn't alone: desalination plants now account for 77 per cent of total water production in the Gulf region.

But just because water is more easily accessible doesn't mean we have lost respect for its value. As an Arab and Muslim, appreciation for water is entwined with my culture and religion. I was raised to use it efficiently, wisely and with a sense of respect. I perform five prayers a day. Before I pray, I cleanse myself with water, through 'ablution'. You'd think this would use up lots of water, but what is used for ablution in the *masjid* (mosque) is then used to water its garden. Still, in a metropolitan, multicultural city like Dubai, some of these values are fading, which sometimes means that not everyone shares this sense of respect.

That's too bad, because even with desalination, there's not always enough. Dubai's population is growing and its economy is booming faster than anywhere in the world, so water demand is increasing dramatically, while supply is diminishing. In 2007, for example, the city's demand was 365,646 million litres, while desalination plants provided 361,673 million litres. Groundwater, not easily recharged in the region, had to make up the shortfall.

And while desalination is an ingenious technology that improves many people's quality of life, it requires fossil fuels, which emit carbon dioxide, and needs more energy than it provides. The process also throws the acidity levels of the sea off balance, affecting life around desalination plants, such as dugongs, many types of corals and fish, and seagrass.

The UAE is trying to combat these problems by increasing water awareness among its many different ethnic communities. Dubai now prohibits groundwater withdrawal beyond a specific level, while the UAE is looking to non-carbon energies such as solar and nuclear, which may help fuel desalination in the future.

Non-governmental organizations, government authorities and even youth activists have come together to support a new regulation passed by the Dubai electricity and water authority, which states that all taps should have a water-reduction filter. The authority has been distributing these for free, while supermarkets have been selling them relatively cheaply. Campaigning along with my fellow activists, I have been going to schools and universities to increase awareness.

The future is uncertain, and problems have yet to be solved. But I am proud of my country for acknowledging the issues, and acting swiftly to change the situation – and I am sure that the solution is on its way.

Where's the water?

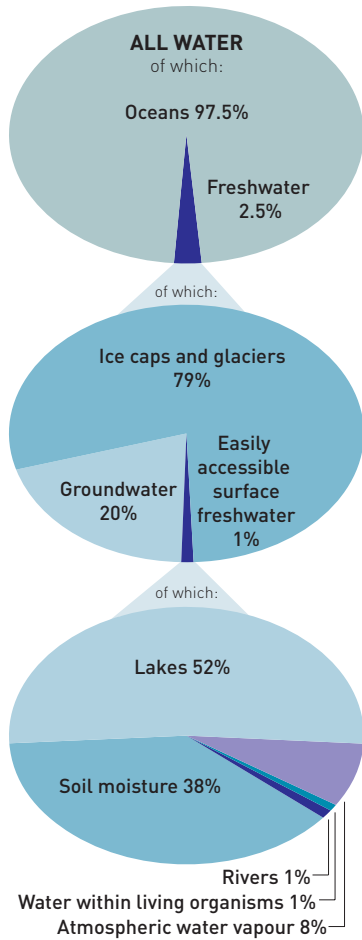
We call this the blue planet: water covers 70 per cent of the Earth's surface, and that's a lot of water. So what's all the fuss about the world running out?

Well, it's not actually running out. Earth's land, oceans and atmosphere hold a fixed amount of water – about 1.26 billion trillion litres – in the forms of ice, vapour, or liquid. And nature endlessly circulates all this water via the process known as the hydrologic or water cycle (see below). This means that the water coming out of your tap is every bit as recycled as the air that you breathe – it could once have been sipped by a dinosaur!

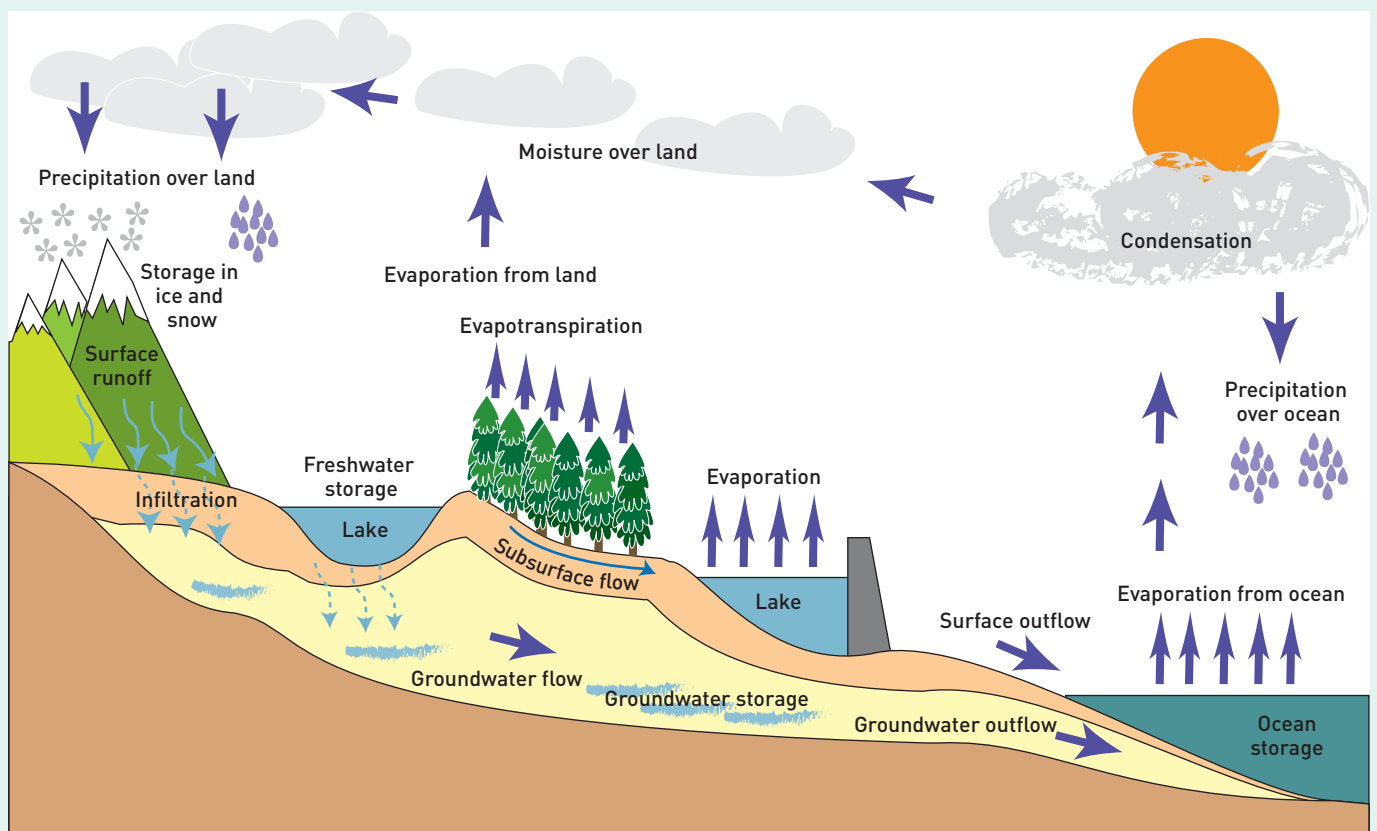
The real problem is availability. About 97.5 per cent of Earth's water is in the oceans, and therefore unfit for drinking. The 2.5 per cent that is fresh is mainly locked up in ice and groundwater, leaving only about 0.007 per cent – in the forms of lakes, rivers, reservoirs and shallow underground sources, which are replenished by the processes of evaporation and precipitation – readily available for people to use.

This relatively tiny amount is unevenly distributed around the world: there is almost no rainfall in deserts, for example, but there are several metres per year in the rainforests. Just a handful of the world's biggest rivers – such as the Amazon and Congo – carry most of the planet's freshwater flow, while arid and semi-arid regions, which comprise 40 per cent of the Earth's landmass, carry only 2 per cent of global runoff.

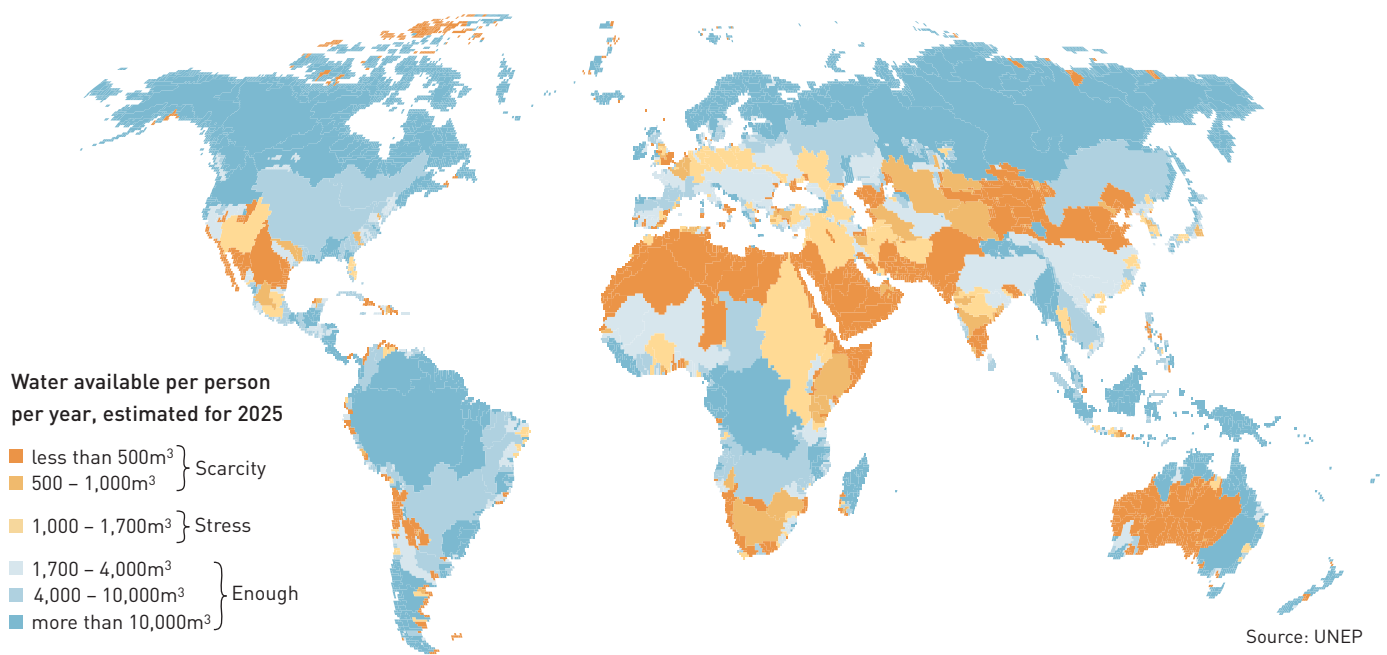
In regions where water is plentiful, it is often misused – polluted, wasted and overexploited. In the meantime, the ever increasing human population, along with ever more thirsty consumption habits, is stretching this finite resource even thinner.



How it works



Water in the 21st century



Already, demand for water is outstripping supply in much of the world, with about 50 countries suffering water stress or scarcity all the year round, and even more going short at certain times of the year. Even within countries, water availability varies from region to region because it depends on catchments and river basins, not on political boundaries, as the map above shows. Many parts of the world that are currently under water stress are expected to move to a state of water scarcity, and some that appear to have enough water for now will begin to experience stress.

Evaporation

The sun's energy transforms water from a liquid to a gas, at which point it enters the atmosphere as water vapour. About 80 per cent of evaporation comes from the oceans; about 10 per cent comes from inland water (like lakes and rivers); and around 10 per cent from vegetation, which absorbs water from deep in the soil and delivers it to the atmosphere through plant stems and leaves. Surface air currents also affect evaporation – the windier it is, the faster the water changes from liquid to vapour. Winds then blow the water vapour all over the world, affecting humidity levels.

Condensation

As warm air rises it cools, and the colder it gets, the less water vapour it can hold. This condenses and forms droplets which are lifted by rising air – such as the currents that move over mountains or from above the ocean to the land – and form clouds.

Transport

Evaporated moisture is moved around the world in the form of water vapour and clouds via air currents such as wind, breezes and jet streams.

Precipitation

When the air can no longer hold water vapour, either because it has cooled or because it has become over-saturated, the water condenses and falls to Earth in the form of rain, snow, hail, and so on.

Infiltration

When water hits the ground, part of it seeps into the earth, becoming groundwater. The rate at which this happens depends on the soil's permeability – the rate at which water can be absorbed and flow through it. Both soil and vegetation retain a certain amount of water, but the rest of it percolates down and settles in the gaps between soil particles in an underground layer. The top of this layer is called the water table, which rises as the soil becomes more saturated. When groundwater is exploited faster than precipitation can replenish it, the water table falls.

Runoff

When the soil can no longer absorb more water – whether because it is too saturated, the surface is frozen, or it has been degraded by deforestation, agriculture or grazing – water runs across the surface of the earth, forming streams that feed rivers and oceans. Where there is not enough of a channel to contain the runoff, flooding occurs.

Aquifers

Water percolates downward until it hits impermeable rock, where it is stored. If the aquifer fills up, water can move on to feed lakes, rivers and the ocean, or push back up through the soil as springs. When water becomes trapped underground and sealed off so that it can't be recharged, it is called a fossil aquifer. The water in these aquifers can be thousands of years old, and is considered a non-renewable resource.

EMBRACE THE TAP

Embrace the tap. With that slogan the city of London, Ontario stopped the sale of bottled water at city-run premises such as offices, community centres and sports arenas. Seattle and San Francisco have taken similar steps, and Chicago is taxing bottled water. Suddenly the plastic water bottle – long seen as a cool accessory carried by sports teams and thirsty people on the go – is being seen as antisocial.

WHY?

The approximately 200 billion litres of bottled water consumed each year is increasingly being recognized as a massive waste of resources in a world where they are getting ever scarcer. Enough oil to fuel 100,000 cars is used just to make a year's worth of plastic water bottles in North America alone. And more fossil fuels are burned – helping to warm the planet – in shipping the water around the world. All in all, it has been estimated, each bottle has consumed enough oil by the time it is drunk to fill it a quarter full.

The process wastes water too: for every litre of water poured into a bottle, another two are used in its manufacture. And four out of every five of the bottles – some 27 million tonnes of plastic, which could have been recycled – end up in waste dumps.

MAINS WATER

Mains water, that comes out of a tap after travelling through a vast infrastructure of underground pipe, is far more resource efficient and very much cheaper than bottled water. And despite its image – and the marketing hype surrounding bottled brands – it is usually just as safe to drink in developed countries, and other areas that can give it adequate treatment. Sometimes it is even more so: worrying levels of contaminants have shown up in some bottled waters.

In many parts of the world, of course, the only clean water available comes out of a bottle. But that still does not make bottled water the solution, for it is far too expensive for the 1 billion poor who can only get unsafe drinking water. There is an urgent need to make sure that everyone has access to clean supplies.

IT CAN BE DONE

The Millennium Development Goals, adopted by the world's governments, stipulate that the proportion of the world's people who don't have access to safe drinking water should be cut in half by 2015 – and the world has made remarkable progress towards this goal. But much still needs to be done. After all, as former UN Secretary General Kofi Annan puts it, 'the lack of safe water jeopardizes both the physical and social health of all people. It is an affront to human dignity'.

How about diverting some of the vast resources devoted to supplying unnecessary and wasteful bottled water to the rich to meeting the needs of the poor instead?



Jay Dee

Steve Randolph

GOING FOR GREEN

Few sportsmen are bigger – or more astonishing – than the 2.29-metre tall Yao Ming. The 28-year-old Chinese centre for the National Basketball Association's Houston Rockets is one of the most popular athletes in the United States of America. In China, where he plays for the national team, millions more claim him as their own. Indeed the world's eyes were on him as he carried his country's flag for China at the opening ceremony of the 2008 Beijing Olympics.

BRIGHT STAR

Yao's given name, Ming, means 'bright', a character that comprises the characters for 'sun' and 'moon'. But he now also officially represents the planet. In August 2008, he accepted an invitation from the United Nations Environment Programme to serve as its first-ever Environmental Champion, agreeing to harness the love of sports to help make greenness cool.

'Through sport,' he says. 'I will work with young people across the world and try to inspire them to plant trees, use energy-efficient light bulbs, harvest rain-water and to become environmental champions in their own communities.'

Born 28 years ago to two former basketball players – then China's tallest couple – Yao's destiny might seem to have been fixed from the start. But he was a reluctant athlete, a bookish boy who would rather read about ancient Chinese history than play ball. All the same, he began training in a sports school six days a week before his ninth birthday. By the age of 17 he was playing professionally for the Shanghai Sharks, and in 2002, at 22, he joined the Houston Rockets – the first international player to be drafted first overall in a National Basketball Association Draft.

GREEN PIONEER

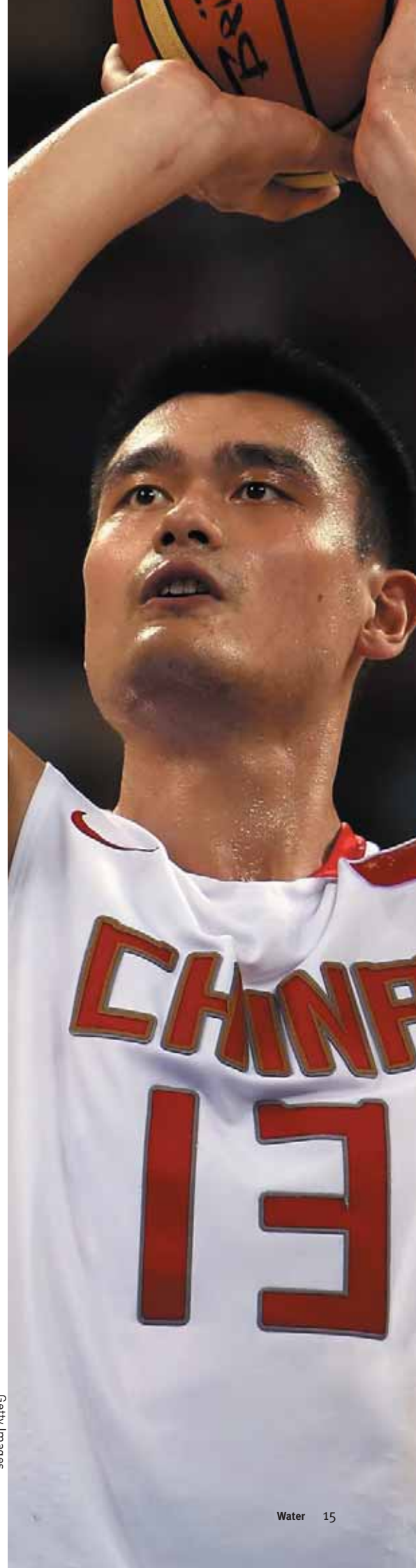
He has, however, always wanted to be a pioneer – 'an explorer travelling into new worlds' – rather than someone simply following in his parents' oversized footsteps. In 2006 – as part of a campaign by the conservation group WildAid – he declared that he would no longer eat sharks' fin soup. By doing so he risked controversy and his own popularity, since the dish – which dates back hundreds of years – is a well-established part of Chinese traditional cuisine, particularly at formal banquets. But he addressed a serious problem: catching sharks for their fins, and then throwing the rest of the carcass away, is devastating the species.

'As the human population increases, many wildlife species are decreasing,' he says. 'The primary reason is that people fail to treat animals as friends.'

He also wants to green his own profession. Around the time of the Olympics, he called on organizers of major sporting events to 'make sure they use public transport facilities, build proper waste management systems and use greener forms of energy'.

After the disastrous Chinese earthquake in May 2008 – which killed some 80,000 people, including many schoolchildren – he gave \$2 million to the relief fund and then launched the Yao Ming Foundation to raise money to build seismically safe schools. Once this relief work is completed, the Foundation will 'raise funds and awareness of children's wellness and welfare issues in China and the United States'. Yao is also to receive an honorary degree from the University of Hong Kong for his work supporting the prevention and cure of AIDS.

Sport has taught him that, no matter how skilled individual players may be, it is the team that counts. It is the combined efforts of many people that will make the difference for the environment too, he says. 'I sincerely believe that small actions done by many over a long period of time can really bring about positive change. By doing a little now we can avoid doing a lot later. Please join me in this global team effort.'



Getty Images



I Shpilenok/Wildlife/Still Pictures



J Peltomaeki/Still Pictures



Biosphoto/Hinze Kerstin/Still Pictures

Eco-Camp KOREA



Surrounded by sea on three sides, the Republic of Korea has a wealth of both fresh- and saltwater wetlands, five of which are recognized as sites of international importance. Yet wetlands are also the country's most threatened habitat, often being drained for agriculture, or for industrial or housing development. For instance, the reclamation project at Saemangeum, the most important shorebird site in the Yellow Sea, recently attracted worldwide attention because it has destroyed the habitat of 400,000 migratory shorebirds.

So it's no wonder that the theme of the 2008 Bayer Young Environmental Envoy (BYEE) Korean Eco-Camp was Healthy Wetlands, Healthy People. Each year, Bayer honours young people from 18 countries who have demonstrated their commitment to environmental work. Young environmentalists are invited to attend national Eco-Camps in their own countries – an opportunity to broaden their knowledge – and two or more from each country are selected to travel to the annual BYEE international conference in Leverkusen, Germany.

Wha Young Cha (24) and Yumi Chang (22), two of the delegates chosen to represent Korea in 2008, told TUNZA how the Korean Eco-Camp had opened their eyes to the plight of wetlands.

TUNZA: Tell us about what you did during Eco-Camp.

Chang: We were taken to visit some of the most beautiful wetland sites in the country: Janghang foreshore, Upo wetland and Suncheon Bay – two of which are internationally protected areas.

Cha: Before the camp, most of us knew little about Korea's wetlands or how important they are – but we had come to learn. Together, we went on a crash course.

TUNZA: What did you learn about wetlands and the role they play in the global ecosystem?

Chang: We learned how wetlands store water, filter pollution, and serve as spawning grounds and habitat for a huge diversity of animals and plants. Wetlands also help maintain the health of surrounding ecosystems – reducing flooding in downstream communities or by removing nutrients from wastewater, for example – and they are important for people's livelihoods. But wetlands have global influence, too: they have a significant effect on air quality because they are integral to the nitrogen, sulphur, methane and carbon dioxide cycles.

TUNZA: Did you learn anything that surprised you?

Cha: Yes! I had no idea how many migratory birds from around the world use Korea's wetlands. Birds that have spent seasons in Australia move to Alaska via wetlands in the Republic of

Korea. If our wetlands are not protected, some birds may not be able to rest or eat, and will starve.

Chang: And I was shocked that it takes as much as six months for a foreshore to recover from simple human activities such as stepping on the ground. I remember as a child walking with my friends along a beach, digging to find little crabs and clams. We ran and jumped. Now I understand how we might have harmed the animals living there. Clearly there's a need to educate even very young people about the impact they can have.

TUNZA: What solutions do you think there might be, and how can youth play a role?

Cha: One good idea is to enlist the residents of the wetlands to help conserve them. After all, they are the people who stand to benefit or lose the most. And international conventions on wetlands are very important, because wetlands preservation is a cross-border issue. I do not expect perfect solutions from youth, nor can I boast that youth can bring back the damaged environment. But I don't doubt that we can bring about change by taking small actions.

Chang: After all, humans are part of an interdependent ecosystem. We should all put our heads together to help find solutions regardless of our age, nationality, background and economic situation – or there will be no bright future for us.



Farrukh Younus

ALL CROPS NEED WATER, and – where there is not enough rain – farmers need to provide it by irrigation if they are to get good harvests. Since 1950, the amount of irrigated land around the globe has doubled, which has done a lot to help increase food production to meet the growing world population and its increasing demands.

But irrigation is as old as civilization itself. And one of the most ingenious systems ever invented, the *qanat*, originated in Persia some 3,000 years ago.

It works by carrying underground water from hills and mountains down a gently sloping man-made tunnel, often many kilometres long. The tunnels are punctuated with vertical shafts for ventilation and maintenance, and provide people with a reliable supply of drinking water as well as irrigation for fields.

The precision engineering and architecture that went into the *qanats* confirms the Persians' place among the great ancient civilizations. *Qanats* are so sophisticated and well built that more than 22,000 – with 273,588 kilometres of underground tunnels – remain in use in Iran alone; by contrast the aqueducts of ancient Rome have long been largely tourist attractions.

The system was so successful that it spread widely. Remnants of *qanats* are scattered throughout the lands where the Persians and then Islam traded, invaded and interacted – from China in the east to Peru in the west.

It began in 518 BC when the Persians introduced the technology to Egypt: remnants of a *qanat* built to carry water over 150 kilometres from the Nile to the oasis of Karg are still in use. The system then spread rapidly throughout the Arabian peninsular, on to Pakistan, and northeastwards along the Silk Road trading route. Today's *qanat* museum in Turpan, China, shows how well the technology worked and how highly it is regarded – helping farmers here in the arid northwest of the country.

And as Islam spread westward along North Africa and up into Sicily and Spain, so too did the technology. So crucial were the irrigation systems to the rich and abundant agriculture of Al Andalus, that – when this Moorish empire was finally conquered and all Moors expelled from Spain in 1492 AD – a small number of Moorish farmers were forced to remain to operate and maintain the irrigation systems, and train the Spanish to maintain them.

In the same year that the Moors left Spain, Christopher Columbus first stepped on American soil, and the Spanish conquistadores who followed took *qanat* technology across the Atlantic to the dry climates of Central and South America. Evidence can still be found in western Mexico, in the Atacama regions of Peru, and in Chile at Nazca and Pica.

Despite centuries of technological progress, the *qanat* is still so useful that this year students from UNESCO's Qanat College in Yazd, Iran, graduated from the first two-year course on their rehabilitation and maintenance.

Ideas on the move



Ellen Mack

Silent menace

Droughts steal fewer headlines than hurricanes or earthquakes, but they usually take an even greater and longer lasting toll, especially on the poor. They have, of course, always been part of the weather – caused by such events as wind shifts moving arid conditions to normally wet areas, volcanic activity, or changes in the sun’s intensity – but human activities make things worse. Overgrazing, overcultivation, felling forests and poor irrigation all affect the ground’s ability to absorb and retain water, and lead to desertification. The loss of vegetation changes the topsoil temperature and the air’s humidity, in turn influencing the movements of atmospheric masses and rainfall, which can lead to drought.

Evidence suggests that the 15-million strong Mayan civilization, which once stretched from Mexico’s Yucatán peninsula to Honduras, came to a sudden end through an extended drought made worse by human activity. Lake sediments reveal a long dry period punctuated by three intense droughts between 810 and 910 AD, which coincided with the fall of the Maya; other researchers have found evidence of deforestation and soil erosion.

Now, as then, droughts trigger malnutrition and famine. As always, the poor are hit much the hardest. Developed countries usually have mechanisms to cope: during the severe American dustbowl drought of 1931, the government, as part of the New Deal, could support struggling farmers by refinancing mortgages and restricting the power of banks to dispossess those in debt. But developing countries may not have the resources to support or protect their people – the Ethiopian drought of 1983-1984 led to a famine that killed some 300,000 people.

Australia is now in its 12th year of drought – the worst on record – with worldwide effects. Its rice crop, once enough to feed 40 million people around the world, has been cut by 98 per cent as farmers turn to less water-intensive crops. This helped rice prices to double over three months at the beginning of 2008, seriously contributing to the growing world food crisis. Yet weather experts warn Australians that this may be the ‘drought that will never break’ as the climate changes.

Certainly, global warming will make things harder worldwide. The Intergovernmental Panel on Climate Change warns that the frequency and intensity of drought is likely to increase as global temperatures rise. Even worse, drought magnifies the warming because it reduces the environment’s ability to absorb carbon dioxide from the atmosphere: a severe North American drought in 2002 cut the continent’s natural uptake of carbon dioxide in half because drought-affected forests, grasslands, crops and soil were incapable of absorbing it as much a usual.

One authoritative study, by the British Meteorological Office, estimates that drought will spread across half the world’s land surface by the end of the century if global warming goes unchecked.



Lito C Ocampo/UNEP/Topham

QUESTION: WHAT IS CLEAN WATER WORTH?

ANSWER: IT’S PRICELESS, IN MORE WAYS THAN ONE.

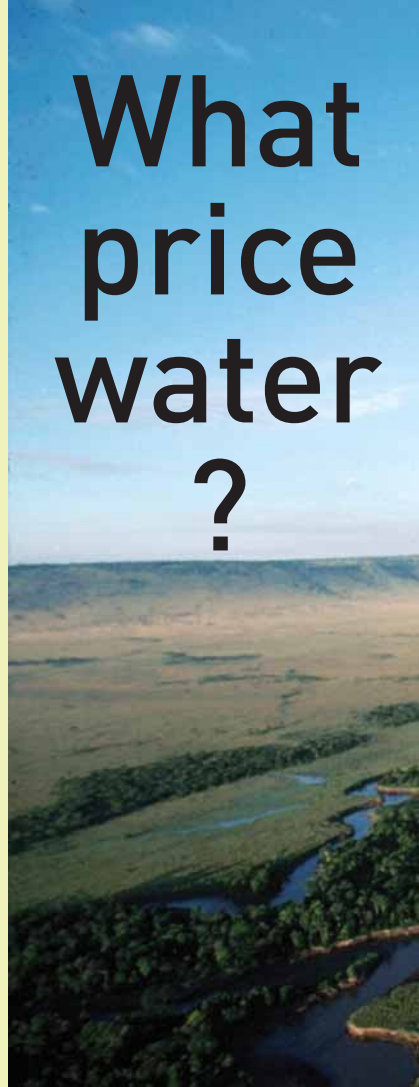
It is priceless in the sense of being invaluable. After all, no life on Earth could exist without it. But it also has no obvious price attached to it: nature purifies and replenishes freshwater supplies for free. And because nobody pays for this vital service, conventional economics often treats water as having no value. So it gets polluted, overexploited and wasted.

Complex natural processes have been purifying water since time immemorial. Soils and vegetation – like forests, pastures or streamside trees and grasses – slow the runoff of rain to streams and rivers. The more it slows down, the more time plants have to absorb impurities like heavy metals, the more soil or silt can filter out debris and fine particles, and microorganisms like bacteria or fungi can process pollutants including chemicals as well as excess nutrients like nitrogen and phosphorous. Similarly, once the water

Paul Richardson



Boesch/UNEP/Topham



Noriyoshi Kanda/UNEP/Topham



T Oh/UNEP/Topham

What price water ?

reaches a stream or river, debris like dead trees and branches slows the flow to help yet other microorganisms clean it.

The plants, trees and porous soils of watersheds also draw moisture into the ground, where – filtered clean as it percolates down – it is stored as groundwater. The more vegetation there is, the better the soil can absorb water and, in its turn, the slow-moving water promotes growth. Together, they prevent the topsoil necessary for green growth from washing away.

All this only works, of course, if the water isn't overloaded with more pollutants than natural filtration systems can cope with. WWF estimates that there are some 12,000 cubic kilometres of heavily polluted water around the globe – that's more water than is contained in the world's 10 biggest river basins. It gets contaminated by sewage, agricultural fertilizers and pesticides, industrial chemicals, urban pollution and sediments from construction or logging.

And ecosystems can only cope if they are intact and healthy. Felling forests

and paving over land prevents the ground absorbing water, defeating the natural cleansing processes, and forcing water to run off rapidly when it rains heavily, causing floods. Draining wetlands and canalizing rivers also speeds up the flow of water, making such inundations more common.

Keeping the Earth's natural water purification in working order means protecting ecosystems and helping to restore those that have been degraded. And part of this requires recognizing the true value of the services they provide – and the real cost of losing them – and translating it into economics. The sums are massive. New research shows, for example, that every year the felling of forests deprives the world of over \$2.5 trillion worth of such services in supplying water, generating rainfall, stopping soil erosion, cleaning the air and reducing global warming. By comparison, the global financial crisis last autumn was estimated to have cost the world the smaller one-off sum of \$1.5 trillion.

Negotiators of a new treaty to combat climatechange(tocomeintoeffectwhen

the provisions of the Kyoto Protocol run out in 2012) are examining ways of compensating developing countries that leave their forests intact through a financial mechanism dubbed Reduced Emissions from Deforestation and Degradation (REDD). In Ethiopia, the government is mobilizing its people to plant a billion trees as part of UNEP's Plant for the Planet campaign.

Trying artificially to replace what is lost is rarely as effective and always much more costly than simply protecting natural services in the first place. And, in the few instances when governments and local authorities have observed this simple rule, they have reaped dividends.

To take just one example: instead of splashing out \$8 billion on a water purification plant, New York State spent just \$1.5 billion on restoring a watershed in the Catskill Mountains that provides drinking water for New York City. In so doing, it not only cut the cost more than fivefold – saving a massive \$6.5 billion – but provided a host of other benefits from recreation areas to fighting global warming.



PumpAid



Abhijit Bora



3
IDEO

Keeping it simple

If small is beautiful, simple is often effective. Straightforward solutions using local materials and skills usually work better than high-tech interventions, especially in remote areas with limited resources. They offer hope to the more than 1 billion people without safe drinking water, and the 2.5 billion without adequate sanitation. Here are a few examples.

1 LIFE-SAVING ELEPHANTS

When two children in a Zimbabwe school died from drinking polluted water, three of their teachers – Ian Thorpe, Tendai Mawunga and Amos Chitungo – vowed that it would never happen again. Their resolution led them to develop a simple pump that has spread rapidly through the country and neighbouring Malawi.

Expensive pumps in many developing countries stand idle because they have broken down and there are no spare parts to repair them. So the teachers set out to design a cheap one that could be easily mended with readily available materials. Based on a 2,000-year-old Chinese design, the water is brought up from a brick-lined well by a series of cupped plastic washers tied every 70 centimetres along a nylon rope. It is operated by muscle power rather than a motor – but needs so little strength that a child of five can work it. Using a hand crank or foot treadle, water is drawn up from as much as 50 metres underground, at a rate of a litre per second, to a PVC pipe (the Elephant Pump's 'trunk'). The well is capped to prevent pollution.

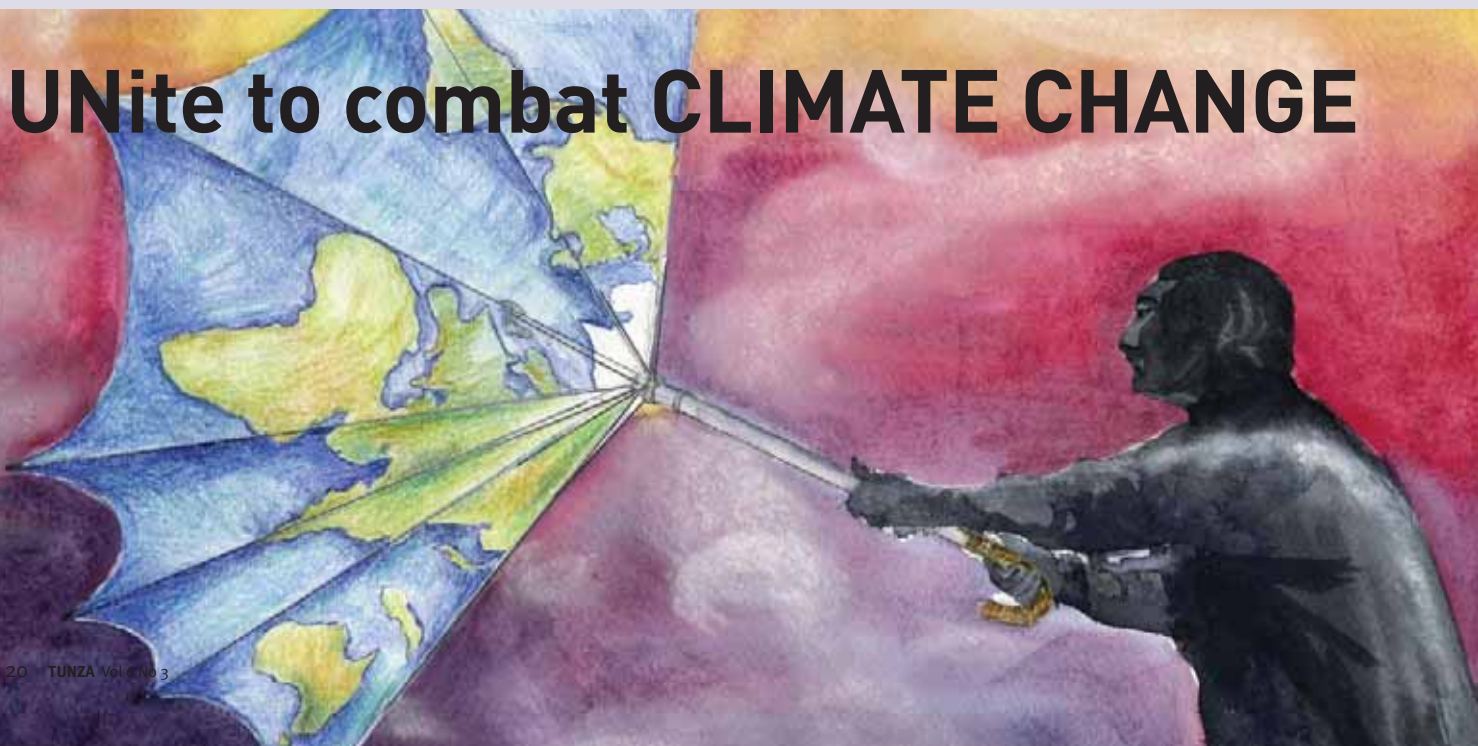
Easy to install, there is no machinery to go wrong and – if the rope breaks – it can be repaired merely by tying a

knot. Each pump can provide 250 people with 40 litres of clean water a day, and PumpAid – a charity started to spread the pumps – is now installing 80 per month in Malawi and Zimbabwe. So far it has provided clean water to more than 1 million people in those countries, and its expansion has only just begun. And not content with this, PumpAid has now developed a concrete Elephant Toilet – that costs only \$30 to install – to help address the sanitation crisis.

2 MORE CROP BY DROP

Harvests depend on irrigation but, used wrongly, it can waste vast amounts of water and, worse, cause soils to become salty and infertile. Dispensing the water drip by drip, targeting the right amount at the plants' roots – rather than just sending the water down channels – avoids these problems. Farmers in the Indian state of Meghalaya have known this for two centuries, using bamboo for such drip irrigation. They divert 18 to 20 litres of water per minute from an uphill stream or spring through a complex network of open bamboo pipes to be dispensed near the roots of black pepper plants at the rate of 20 to 80 drops per minute – making a little go a long way.

UNite to combat CLIMATE CHANGE





4

Spectrum/HIP/TopFoto



5

Gary Warner



6

BIOS/Lattes Emmanuel/Still Pictures

3 THAT'S RECYCLING

Hundreds of millions of women in developing countries walk many hours each day to fetch water – often carried on their heads – that is unsafe to drink. A firm in California's Silicon Valley is developing a tricycle to address this. The cyclist rides to the water source, fills an attached tank with about 77 litres of impure water, and rides home. The act of pedalling purifies the water by moving it through a carbon filter and into a separate clean tank. Just over 3 kilometres of cycling can purify an entire tank – and the purifier can also be powered manually.

4 GARLANDS ROCK

Rainwater has long been collected using long lines of small rocks called 'garlands' mortared onto a larger rock surface, which direct it to a dam or tank. There are more than 400 of them in Kitui, Kenya, while the people of Gibraltar – famous for their Rock – collect much of their water by this means.

5 SQUARE HOLES

The people of Venice's lagoons have always had plenty of saltwater, but getting the fresh stuff has been a problem. Until the 9th century they used to trek to the mainland to get it, but then started building stone wells as rainwater catchments in the centre of their squares. The rainwater was channelled by the gutters of the surrounding buildings and sloping pavements into the well, where it was filtered through a layer of sand before being collected in a clay-

lined cistern. So dependent was Venice on this system that contaminating the wells was punishable by death. The wells are still to be seen all over Venice, though they are no longer in use: in 1886, an aqueduct was built to bring freshwater from nearby mountains. But the technique could be adopted in water-scarce areas today.

6 TRUST THE INCAS

Archeologist Ann Kendall was excavating high in Peru's Andes in the Cusichaca Valley, now part of the Machu Picchu Park, when it occurred to her to apply the results of her research to local needs. The long-abandoned ruins of Incan terraces and irrigation canals – which centuries ago fed tens of thousands of people – could be rehabilitated to help subsistence farmers now eking a living from the depleted land. She founded the Cusichaca Trust in 1977 which, over three years, helped villagers rebuild 7 kilometres of canals using local materials of stone, gravel, clay, earth and sand to restore broken sections, and sealing the canal beds with clay as the ancient Incas did. The water flowed into the terraces from uphill streams and lakes, reviving them and allowing farmers to plant quinoa, maize and other crops. Over the last three decades the Trust has helped restore 30 kilometres of irrigation canals and 600 hectares of agricultural terraces, as well as initiating rural development programmes – enhancing the livelihoods of 28,000 people and raising the possibility that the world's other ancient irrigation systems might be revived for sustainable agriculture.

Young people overwhelmingly want governments to spare no effort to address global warming. Almost 90 per cent of 12-18 year olds in Brazil, India, Russia, South Africa and the United States of America told an online survey conducted for UNEP during October 2008 that 'world leaders should do whatever it takes to tackle climate change'.

More than seven in 10 said that the leaders are at present not doing enough and a majority agreed that 'it's necessary to take major steps very soon'.

Such concern was vividly on display in New York on 24 October, at UNEP's Paint for the Planet auction of entries

to the Bayer-UNEP International Children's Painting Competition in New York. The 26 paintings raised more than \$21,000 for children affected by climate change disasters.

Thirteen-year old Charlotte Sullivan, whose picture (shown here) fetched \$2,200, said 'everyone must do what they can – climate change is happening, NOW'. And Guy Jayce Nindorera (12) from Burundi explained that his painting was inspired both by the situation in his country and by reading about what was happening around the world 'where people are dying of hunger and other catastrophes such as the tsunami, floods and drought – the result of human actions. We are becoming victims of our own interventions.'

7 watery wonders

Crater Lake

It must have been one of the biggest bangs in the Earth's history. Nearly 8,000 years ago a massive eruption took almost a kilometre off the height of the now 3,660-metre-high Mount Mazama volcano in Oregon. It left a 592-metre deep crater that filled with snow, which then melted to form Crater Lake. The deepest lake in the United States of America, and the deepest anywhere in the world that's entirely above sea level, it has no inlets or outlets: water arrives through rain and snow, and leaves by evaporation and seepage. Its water is among the clearest in the world, and its nearly pristine ecosystem is watched closely by researchers. The Klamath tribe of Native Americans – whose ancestors witnessed the explosion – remember it in their legends and still consider the lake sacred.



Stu Seeger



Kazwell

The Dead Sea

The Dead Sea is dying. The lake's salty waters – at the lowest point on Earth, 416 metres below sea level – have been retreating by about a metre per year. The waters of the river Jordan, which feed it, have been diverted to supply homes and agriculture. With no outlet, the Dead Sea's mineral-rich water evaporates in the desert climate, leaving concentrations of salt nine times higher than in the Mediterranean. True to its name, no plants or animals can live in it – only algae and bacteria – though people come to experience reclining effortlessly in the water, thought to have healing properties. A controversial plan would build a canal to bring water from the Red Sea, but environmentalists say that properly managing the existing supplies would be better.

Lake Baikal

Lake Baikal contains a fifth of all the world's unfrozen fresh water. It is the deepest (1,637 metres) and oldest (25 million years) lake on Earth. Its age and isolation give it a rich and unique biodiversity. One thousand of its 2,635 known species of animals and plants occur nowhere else. These include the rare nerpa, one of only three known species of freshwater seals in the world, which can swim for 70 minutes without breathing, and the multicoloured Baikal turbellaria, 30-centimetre-long worms that live on its floor. Its depths, until now, have been hidden from people. But in summer 2008 Russian scientists began to explore it with submersibles, so we may be on the brink of unveiling still more of its mysteries.



Fred Bruemmer/Still Pictures



Alistair Howard

Lake Titicaca

More than 25 rivers empty their waters into Lake Titicaca, the world's highest commercially navigable water body at a full 3,812 metres above sea level. A temple on the largest of its 41 islands marks the spot where, tradition holds, the founders of the Inca dynasty, Manco Capac and Mama Ocllo, emerged from the depths to establish their empire. Archaeological remains show that there was a civilization beside the lake at least a thousand years ago, but perhaps its most intriguing feature of all is its 40 'uros' – man-made islands named after the people who build and live on them. They are woven from layers of tortora reeds growing on the giant lake's shores, and anchored to its bottom with ropes and poles.

The Nile

So long and wide is the Nile – the world's longest river – that the surface area of its water, 3.35 million square kilometres, is five times the size of France. Flowing for some 6,500 kilometres from East Africa to the Mediterranean, the Nile gave birth to the ancient Egyptian civilization and ensured its prosperity. Its annual flooding, each June, deposited rich silt on its floodplains and delta, making them enormously fertile, and ensuring that Egyptian agriculture was the most productive and stable in the region. Now 105 million people live along the river, mostly in Egypt, and 160 million in its basin, putting its water and agriculture under stress; and their numbers are expected to double in just the next 25 years.



M Serena



B Norman/Ancient Art & Architecture Collection Ltd

Iraqi marshlands

Thought to be the inspiration for the Garden of Eden, the marshlands of Iraq – the largest wetland ecosystem in the Middle East – once spanned approximately 21,000 square kilometres. Among the world's most important wildlife habitats they are home to half a million people – descended from the ancient Babylonians and Sumerians – who fish and farm there as their ancestors have done for millennia. During Saddam Hussein's regime, the marshes were drained to a tenth of their former size, much of them becoming an uninhabitable salt desert. Recently, with UNEP's help, the marshlands are beginning to be re-flooded and restored, the people are returning, and there are plans to establish them as a UNESCO World Heritage site.

Greenland ice sheet

One tenth of the world's freshwater is locked up in the vast Greenland ice sheet; if it were to melt sea levels would rise by 7 metres, inundating many of the world's coastal cities along with low-lying countries like Bangladesh. Until recently scientist believed it would not melt for a thousand years, even with global warming, but it is now clear that it is happening very much faster, as its giant glaciers – stable for centuries – start moving rapidly towards the sea. Water gathers on the surface of the ice as it melts, and then plunges down in giant waterfalls through cracks, collecting on the rock beneath the glaciers and acting as great conveyor belts. The Sermeq Kujalleq glacier, the biggest in Greenland, is now losing a staggering 35 cubic kilometres of ice a year.



Norbert Rosing/UNEP

AT THE BEGINNING OF TIME ...

Water is central to all life: so it is not surprising that almost every culture, past and present, has myths and legends about humanity's relationship to it. Some – like the Norwegian and Icelandic stories of the Kraken sea monsters, or ancient Canaan's Leviathan – express terror at the immensity and power of the oceans. Others reflect water's benefits. The Greek naiades were said to guard springs, rivers, fountains and lakes: if the water dried up, the nymphs would die.

Stories of a great deluge – which include the tale of Noah in the Judeo-Christian tradition and 'Nuh' in Islam – exist in many variations across many cultures, including Hindu, Maori, ancient Babylonian, Zoroastrian and East African Masaai. They typically tell of how divine forces cleanse a disrespectful civilization with a great flood, allowing only a few humans and animals to survive to repopulate the Earth. The version in the story of Doquebuth – from the First Peoples of Western Canada – warns of what can happen when nature is not respected.

'AT THE BEGINNING OF TIME the Creator made the Earth. There was land and waters, sun and forests, and each element was given a secret name by the Creator.

The Earth was young and strong like a child. The Creator gathered up a few of the wisest people and told them the Earth's secret names, but he warned them not to tell the rest of the people. If everyone used the Earth's secret names, the Creator explained, the world would stop growing evenly.

Years passed and the Earth grew steadily. But after a while, the secret names slipped out. Soon everybody was using the secret names to speak to the elements. They asked the sun to bring warmth and light, they asked the rivers and seas to give them fish, and they asked the earth to look after their ancestors. But when the people started speaking to the forests, the Creator's warning of change came true.

A giant flood swept over the land. The people had just enough time to fill their largest canoe with plants and animals. As the waters rose, five of the wisest people boarded the canoe and steered it through the waves.

After the flood was over, the canoe landed on the flat, dry prairie. When the people stepped onto the land, one of the women held her new baby in her arms. His name was Doquebuth and he had many spirit powers.

As the waters receded the people walked back to their lands. When they arrived they found the bones of the people who did not survive the flood. The Creator told Doquebuth to gather up the bones and mix them with soil. Doquebuth fashioned new people out of the mixture and taught them how to plant the saved plants and hunt for the saved animals. Doquebuth, the child of the flood, became the new Creator.'

