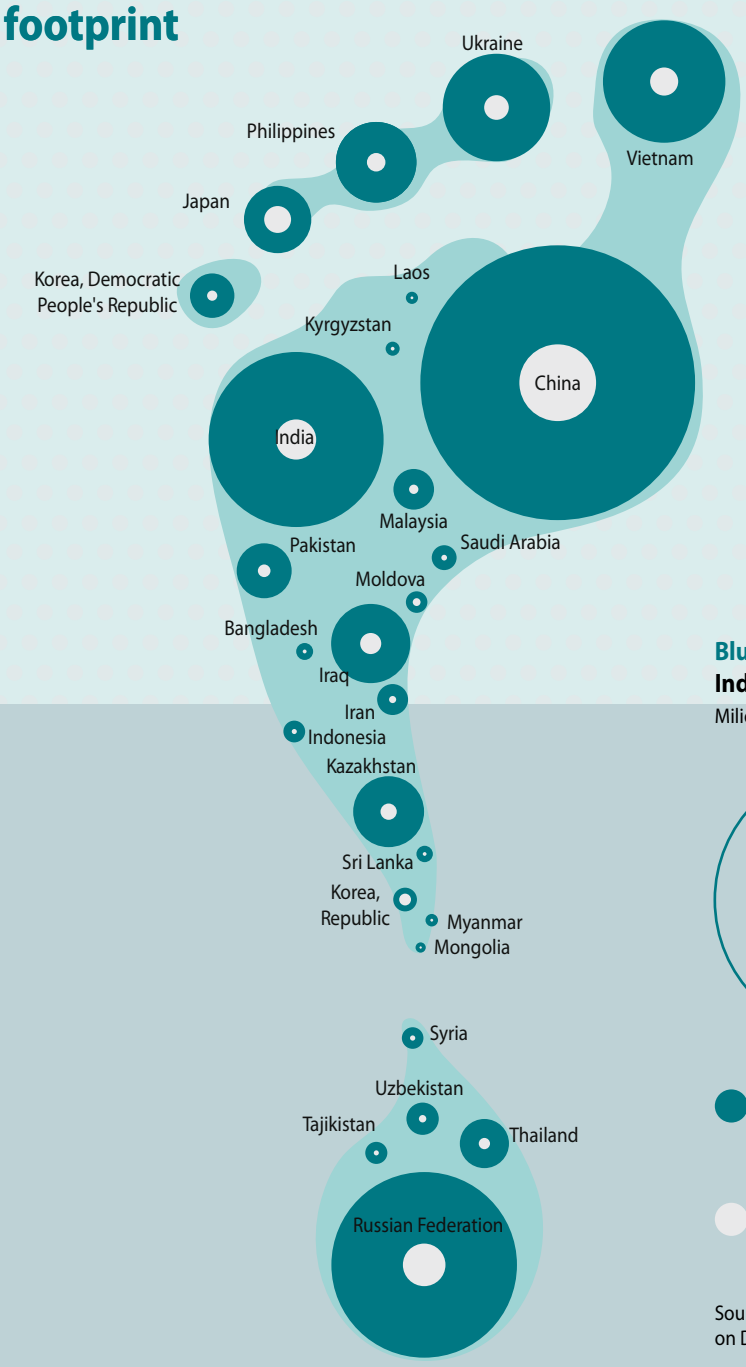
UNEP GRID ARENDAL
Environmental Knowledge for Change

ENVIRONMENT & POVERTY TIMES 07

A periodic publication by UNEP/GRID-Arendal

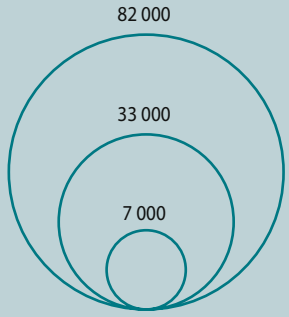
February 2012
20 pages

Water footprint



Blue and Grey water footprint for the Industry sector in selected Asian countries

Milion of cubic metres per year



The **Blue Water Footprint** refers to consumption of blue water resources (surface and groundwater) along the supply chain of a product.

The **Grey Water Footprint** refers to pollution and is defined as the volume of freshwater that is required to assimilate the load of pollutants given natural background concentrations and existing ambient water quality standards.

Source: Water Footprint Network database, accessed on December 2011.

Contents

Low carbon, smart solutions and green growth for sustainable water management in Asia

In the past decade the Asia-Pacific region has become the largest consumer of natural resources in the world. This includes water, raw materials and energy resources. The East Asia Climate Partnership (EACP), an international development-cooperation project supported and facilitated by South Korea in cooperation with the UNEP Regional Office for Asia and the Pacific, aims to address the challenges associated with the use of natural resources. The purpose of the partnership is to share thinking and strategies for green growth through practical approaches and technological solutions for a resource-efficient and low-carbon future in East Asia.

EACP is fostering strategic alliances for green growth, developing a water management and capacity building platform for water accounting, and supporting demonstration projects for waste management and wastewater treatment tools.

In 2012 the most vibrant, fast growing economies in the world are in Asia and the Pacific. At a regional and national level, many countries are working to decouple economic development from environmental degradation. There is mounting pressure on freshwater resources, which can be attributed to greater economic and industrial activity, population growth, improved standards of living, and the effects of climate change.

Research has shown that improved resource-efficiency and green growth, through more sustainable consumption and production, can help to decouple economic growth from environmental pressures. Research, business, civil society and government clearly all play a role in paving the way to a low carbon, socially inclusive and resource-efficient green economy.

Asia's share of world material consumption grew from just under 25 per cent in 1975 to more than 53 per cent in 2005, accounting for nearly 85 per cent of global growth over a 30-year period. Energy use in Asia and the Pacific has grown too since 1970 at a compound annual growth rate of 3.9 per cent, whereas the equivalent rate in the rest of the world was only 1.4 per cent.

The Resource Efficiency: Economics and Outlook for Asia and the Pacific initiative, launched in September 2011, highlights concern about the rate of water withdrawals in China, India, Pakistan and Sri Lanka. From 1985 to 2000 total water withdrawals increased by around 25 per cent in the region. Scenarios suggest that rising water extraction will put many river basins under severe stress by 2025 and that groundwater levels will continue to fall. UNEP and the other organisations behind the report estimate that per capita resource consumption of 'materials' in the region needs to be some 80 per cent lower than at present to achieve sustainable development.

The EACP partnership is addressing these dynamics by promoting green growth, innovative integrated approaches and low carbon solutions.

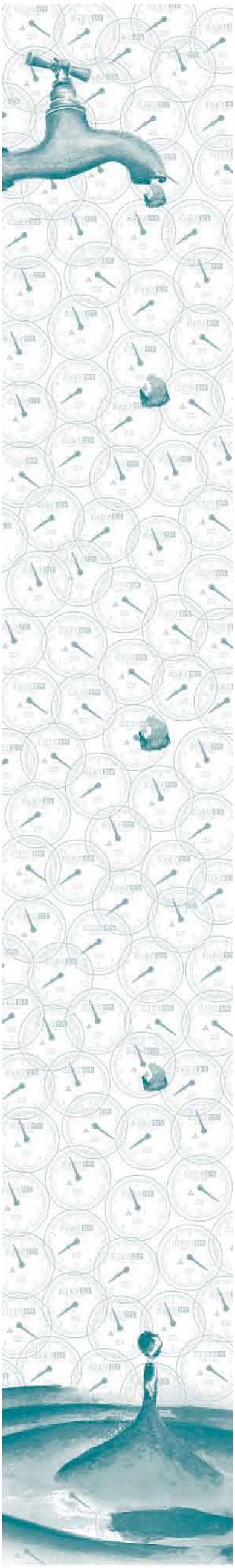
Project activities have enhanced environmental sustainability and better management of resources in recipient countries. These partnerships have successfully assisted countries in deploying green-growth and green-economy concepts by developing policy statements and national action plans on sustainable consumption and production. They have also identified activities to encourage investment and public-private partnerships. With the green-growth attitude embedded, we may look forward to more investment and infrastructure, to low-carbon, green-growth technologies associated with water-resource management and development. This should contribute to new green jobs in the region.

Water resources are unevenly distributed in the region. With climate change increasingly causing drought and precipitation, enhanced water efficiency and management is a challenge not only for direct water users, water managers and policy makers, but also for business and consumers. Access to clean water, reliable water accounting systems, and appropriate sanitation are essential to human wellbeing. It is consequently vital for Asia to build capacity and develop infrastructure for managing water.

Political leadership and commitment, backed by local project teams, are key to effective implementation. To bring about change, teams need a mix of technical staff, community representatives, policy-makers and private sector input.

This publication, which has been prepared as an EACP outreach activity, is a development-cooperation project supported by the Government of South Korea through the Korea International Cooperation Agency (KOICA) and facilitated by UNEP. The aim is to share the green-growth paradigm in East Asia in order to enable sustainable economic development whilst coping with climate change.

More than 2.8 billion people are projected to face water stress or water scarcity by 2025, with annual water supply of less than 1700 m³ per person. The reasons are many and include population growth, global warming, eutrophication and agriculture. Are we heading for a freshwater crisis, and what can be done to prevent it?



The wastewater treatment pond at the Frangipani Langkawi resort. *Frangipani/Kuvinn Mallar Armugam*

Efficient water management in the Frangipani Langkawi resort and spa

*By **Anthony K. H. Wong** and **Tui Ai Ling***

At the Frangipani Langkawi resort and spa in Malaysia, sustainable management practices are used to ensure that guests enjoy their holiday and also learn about sustainability. Achieving sustainability in water supply and reducing dependence on government-supplied treated water is a key objective. This is done through the harvesting of rainwater, landscaping and natural wastewater treatment.

Water tanks for harvesting rainwater

Rainwater is harvested for irrigation purposes. Currently 85 water tanks, comprising 70 large tanks (3 331 litres) and 15 small tanks (2 082 litres), are installed around the resort. Rainwater from these tanks is channelled to taps located around the resort area. Storage capacity for recycled water is 264 411 litres. As government-supplied water is charged at US$ 0.40 per cubic metre, the resort saves a dollar for every 2 500 litres of rainwater harvested. As a result, water bills have been halved. Rainwater is harvested from the roof of the restaurant and is channelled to water tanks located at the public toilets to be used for flushing. Excess rainwater is used to wash the pool deck daily and to fill the swimming pool.

Underground water for watering the organic garden

During the dry season, well water is channelled to wetlands to dilute the waste discharge before further natural treatment by the aquatic plants in the pond. The water in the pond is used for watering the lawn and the plants in the resort. The wells are also used for irrigating the resort's organic farm.

Landscaping

Weather patterns and temperatures affect water consumption. For example, water use increases during the dry season as a result of increased transpiration and evaporation from plants and the soil. Landscaping can be used as a water conservation strategy by selecting different types of water plants to cleanse and filter the water. Plants such as water hyacinth (*Eichhornia crassipes*), water lily (*Nymphaea*), vetiver (*Chrysopogon zizaniodes*) and water spinach (*Ipomoea aquatica*) living in the pond help to stabilize the soil, manage water quality, and protect against soil erosion, pests and weeds. Irrigation is scheduled in the early morning and late evening to reduce evaporation.

Water storage at the fish pond

The water used in the fishpond is direct rainwater, which goes through a simple conven-

Global water footprint standard – An important step towards solving the world's ever increasing water problems

The first global water footprint standard, a scientifically credible methodology that will make all water footprints comparable, has gained international support from major companies, policy makers, NGOs and scientists. The Water Footprint Assessment Manual: Setting the Global Standard was launched in February 2011. It was developed through a joint effort by the Water Footprint Network and its 139 partners, assisted by scientists at Twente University in the Netherlands. It shows how individuals, companies and nations can measure their contribution to water use conflicts and environmental degradation in river basins around the world.

The water footprint – the amount of freshwater used in the goods and services consumed or used in production – is helping companies to reduce water use where it is most wasteful, and banks to assess water-related risks prior to making investments and governments to improve water management. Individuals can use the water footprint to understand how much water they are using through the food they eat, the clothes they wear, and the consumer goods they buy.

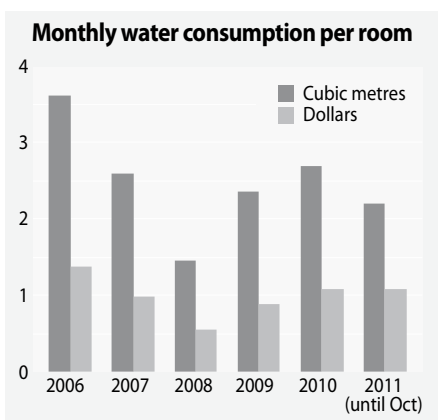
'The global water footprint standard helps us all know more about how much water we use, where it comes from and how we can take steps to make our water footprint sustainable, to ensure that the world's people and natural ecosystems will have the freshwater necessary to thrive well into the future,' said Ruth Mathews, Executive Director of the Water Footprint Network.

Partners from business, civil society, government, global institutions and academic organisations are working with the Water Footprint Network to push for improvements in water use efficiency, pollution reduction and sustainable water management. As more pressure is put on freshwater resources, using the standard in all sectors and in all river basins will be increasingly important. The publication of this standard helps individuals, businesses and governments take steps towards a sustainable water footprint.

Source: The Water Footprint Network (www.waterfootprint.org).

Water runoff from the road enters the pathway design for conventional, natural and zero-energy consumption filtering system. *Frangipani/Rosli Azimad*

tional sand filtering system incorporated in the drainage system. The pond also has a role in harvesting rainwater. Excess rainwater from the road and pond flows into an underground storage compartment in front of the pond. This compartment is filled with sand, stones and corals that purify the water by eliminating heavy metal components before it is pumped back into the fishpond. Excess water is used to irrigate plants around the front office and in the surrounding landscaped areas.



Graph 1 shows a clear reduction in average consumption of government-supplied water. The dip in water consumption in 2008 is attributable to resort renovations. The rainwater harvesting system contributed to a decrease in water consumption throughout these years. Water consumption increased slightly again in 2010 when a new salt water pool was built. In addition, the weather was hotter that year, which caused an increase in water intake by plants and lawns.

Wastewater treatment system

The Frangipani Langkawi resort and spa has its own man-made wetland, which is used to treat the wastewater in the resort. There are two types of wastewater – black water and grey water. Black water generally refers to sewage waste, whilst grey water is the wastewater from sinks, baths and the laundry. The wetland covers an area of approximately 2 370 square metres with a maximum depth of between 1.2 and 1.7 metres depending on the season. It is the first of its kind to be built in Malaysia. The wetland water is continuously monitored with help from the local public university and private laboratories to ensure that water quality meets Malaysian standards. A test on wastewater from the wetland carried out by a private laboratory in August 2011 showed that almost 99 per cent of E coli bacteria were eliminated.

Further reductions in water consumption are possible

While the unit price of water has increased by 20 per cent, the resort has successfully halved water usage. The average monthly water consumption for each occupied room dropped from 3.62 cubic metres in 2006 to 2.7 cubic metres in 2010. With on-going initiatives and improvements, the resort hopes to reduce government-supplied water usage by a further 20 per cent. Future plans include channelling the rainwater from the ultraviolet (UV) light filtration system to the resort's main water tank to reduce dependence on government-supplied water.

■ **About the authors:** Anthony K. H. Wong, a well-known environmentalist for the past 38 years, is the Group Managing Director at the Frangipani Langkawi resort and spa and Adjunct Professor at Taylor's University and Universiti Utara Malaysia. Tui Ai Ling is an environmental officer at the Frangipani Langkawi resort and spa, and holds a BSc (Honours) degree in environmental science from Universiti Malaysia Sabah.

Smart water metering

To conserve water it is vital to understand how, when and why water is used. Smart water metering can be an essential tool for measuring and monitoring water use.

How does a smart meter work?

By definition, smart metering is a concept that combines two distinct elements: meters that use new technology to capture water use information and a communications system that can capture and transmit this information immediately as it becomes available, or almost immediately. Conventional water meters count each kilolitre of water as it passes through the meter but they are not able to record when consumption takes place. Smart meters, on the other hand, quantify water use during a defined period of time and record data on consumption, demand and time of use.

How are data communicated?

Smart meters can communicate the captured data to a broad audience (for example, utility managers, power marketers, facility authorities) through a variety of methods including radio frequencies, telephone wires and mobile technology, local computer networks and the Internet.

How can smart metering help conserve water?

Information from smart water meters can:

- improve understanding of water consumption and flow patterns;
- track, predict and change trends in demand;
- warn of high and low flows and highlight anomalies; and,
- identify leaks and other waste minimization opportunities.

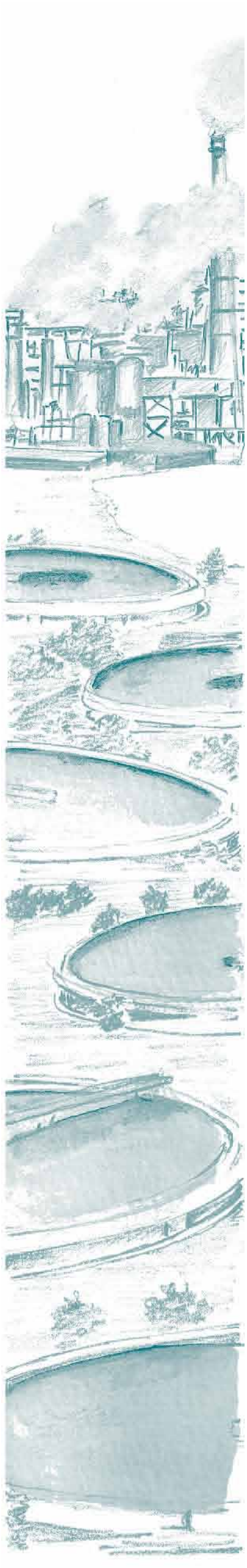
Water users who know their actual consumption during particular periods are better able to understand and reduce their water costs. The challenge, however, is to educate water users about the benefits of smart metering and encourage its use. As smart metering becomes more widespread, water conservation awareness will improve. This may also create an incentive for domestic and business consumers to save precious potable water.

Smart water metering gaining ground

According to a report from Pike Research, the worldwide installed base of smart and smart-enabled water meters will grow to 31.8 million by 2016, up from 5.2 million in 2009. By the end of that period, the cleantech market intelligence firm forecasts that smart water meters will account for 31 per cent of all new water meter shipments. Growth is expected in Asia. For example Mumbai plans to install 300 000 units and may increase deployment to 1.2 million units.

Sources: Smart metering: A significant component of integrated water conservation systems, by Elisa Idris (http://www.cwwt.unsw.edu.au/ywp2006/papers/YWP%202.3.pdf). Installed base of smart water meters to surpass 31 million by 2016, press release from Pike Research (http://www.pikeresearch.com/newsroom/installed-base-of-smart-water-meters-to-surpass-31-million-by-2016). Executive summary: Smart water meters. Advanced metering infrastructure for water utilities: market drivers, technology issues, deployment case studies, key industry players, and market forecasts (http://www.pikeresearch.com/wordpress/wp-content/uploads/2010/07/SWAT-10-Executive-Summary.pdf).

The use of freshwater resources for industrial purposes is an area where there is ample room for efficiency gains, and where improvements are now happening faster than in other regions of the world.



Wastewater management on an industrial estate

*By **Prabha Panth** and **Rahul A. Shastri***

Industry is under increasing pressure from environmental authorities and the general public to reduce pollution. But pollution control and treatment increases operating costs for companies, many of which are small and operate with narrow profit margins. If businesses refuse to comply, they can face penalties from government agencies. Polluting companies can find themselves with a dilemma – pollute and save on compliance costs but risk paying penalties, or treat pollution thereby avoiding penalties but increasing short-term expenditure.

However, pollution control does not necessarily only impose costs on companies; it can generate savings, which could outweigh the cost of pollution treatment. In this case, companies will be able to reduce pollution and the overall stress on the environment, whilst making savings and increasing their profits.

The three broad methods of wastewater management available to companies are:

- recovery of wastewater;
- recovery and recycling of waste from wastewater; and,
- compliance with water pollution abatement measures.

Each of these methods involves costs, but also brings economic benefits. Recovering and recycling wastewater saves costs on freshwater inputs, recovering waste from process streams generates profits or saves on input costs, and complying with water pollution abatement measures enables companies to avoid penalties. These methods are not mutually exclusive and a company may use more than one of them.

Wastewater recycling on the Bollaram industrial estate

In 2005-7 we carried out a study at the Bollaram industrial estate, a heavily polluted, water-scarce industrial estate in the Medak district of Andhra Pradesh, India. Each of these wastewater management methods was examined separately to estimate its economic impact on the polluting companies.

In water-scarce regions, industrial units recycle their wastewater since they may not have access to freshwater. By recycling wastewater, factories on the estate can increase savings on freshwater – both in physical and monetary terms.

We found that nearly 66 per cent of the estate's total daily freshwater input was recycled by just 83 of the 135 industrial units. Total monetary savings through wastewater recycling amounted to US$ 12 680 a day for these 83 units. Net savings came to US$ 12 560 a day or US$ 4 585 000 a year.

Industry location policy

In certain industries such as pharmaceuticals or chemicals, released effluents may contain many types of toxic pollutants, which have to be removed before the wastewater can be recycled. This raises the cost of wastewater treatment, and discourages recycling. Our analysis showed that not only did such industries recycle the lowest amount of wastewater (1 per cent in the chemical industry), but they also used the most freshwater on this industrial estate (55 per cent), subsequently released as effluent. We found that cleaner industries, such as metal, stone, steel and engineering, used only nine per cent freshwater, but accounted for more than half (56 per cent) of the recycled water in Bollaram. This was possible thanks to continuous recycling of wastewater in these factories.

These findings are important for industry location policy. Industries that are highly water-intensive and which recycle only a small proportion of their wastewater should not be allowed to locate in water-scarce areas. On the other hand, metal, stone, steel and engineering industries, which have high rates of wastewater recycling, will not put heavy pressure on the environment in terms of freshwater use.

Waste recovery

To reduce pollution, companies can recover waste material from effluents. This not only reduces the concentration of pollutants in the wastewater, but also earns profits for the company. Important chemicals and materials can be recovered and either reused or sold as inputs to other industries. The amount earned through selling or reusing the recovered wastes will quickly cover the cost of recovery.

Only 11 of the 135 factories operating in Bollaram attempted to recover and recycle waste from process streams. After extensive surveys of other companies throughout the world producing the same products as in Bollaram, we found that there was still scope to recover and reuse at least 41 more materials from the wastewater of 83 more factories at Bollaram. These include chemicals such as caustic soda, organic solvents, salts, acids and calcium chloride.

Profit from recycled materials divided by the cost of recycling per year was estimated for all 41 materials that could potentially be recycled from the 83 factories. The rate of return for different recycled materials ranged from less than 10 per cent to over 5 000 per cent, with an average return of around 800 per cent a year. The payback period of investing in waste recovery and cleaner production methods ranged from an immediate return on investment to around five years. For several materials, the payback period was less than a year. Figure 1 shows the potential rates of return for recycled waste materials across different industries in Bollaram.

It is clear that there is considerable scope for chemical units to recycle waste. The same is true, though to a lesser degree, for the pharmaceutical and steel units. If all these units recycled materials from their effluents, they would increase their profits and reduce their pollution load.

Pollution deterrents

The third conventional method of wastewater management is pollution abatement, implemented through the government's command and control policy. There are a number of industrial pollution laws in India. These are enforced at state level by state pollution control boards. Inspections are carried out periodically and non-compliant units are either closed down or their water and power supplies are cut off until they become compliant again. However, reports of high levels of industrial pollution still haunt this region, showing the low level of compliance.

Why do industrial companies continue to pollute in spite of stringent environmental laws and high penalties? Controlling pollution means an increase in costs, while not controlling it means that this amount is saved. But there is the chance of being caught and having to pay penalties. Risk-neutral companies will weigh the probability of being detected and the amount they will have to pay for not complying against the cost of immediate compliance. If the former two are high, companies will be wary about non-compliance. If they are low, companies will break environmental laws.

In our study we found that the probability of a violating factory being caught in Andhra Pradesh was just above 40 per cent. Since the chance of being caught was low, companies continued to default on pollution control. We compared the cost of immediate compliance (effluent treatment costs) with the expected cost of penalties.

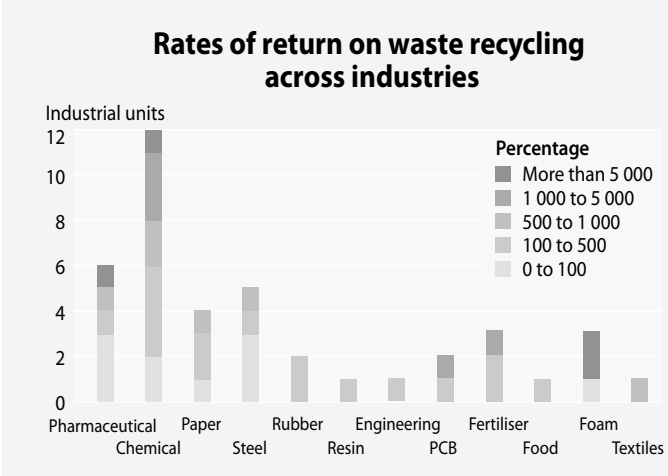


Figure 1

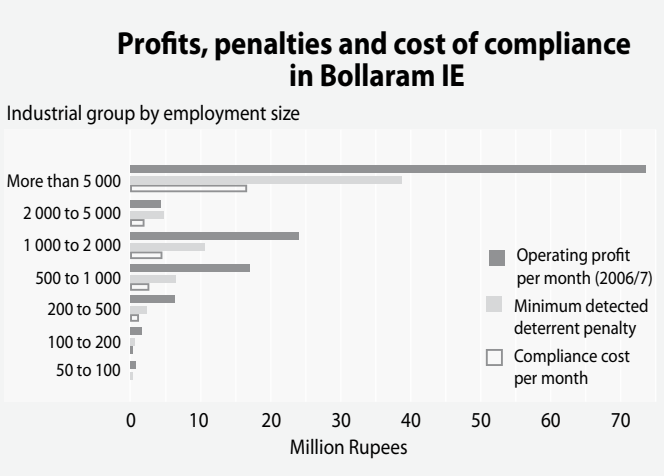
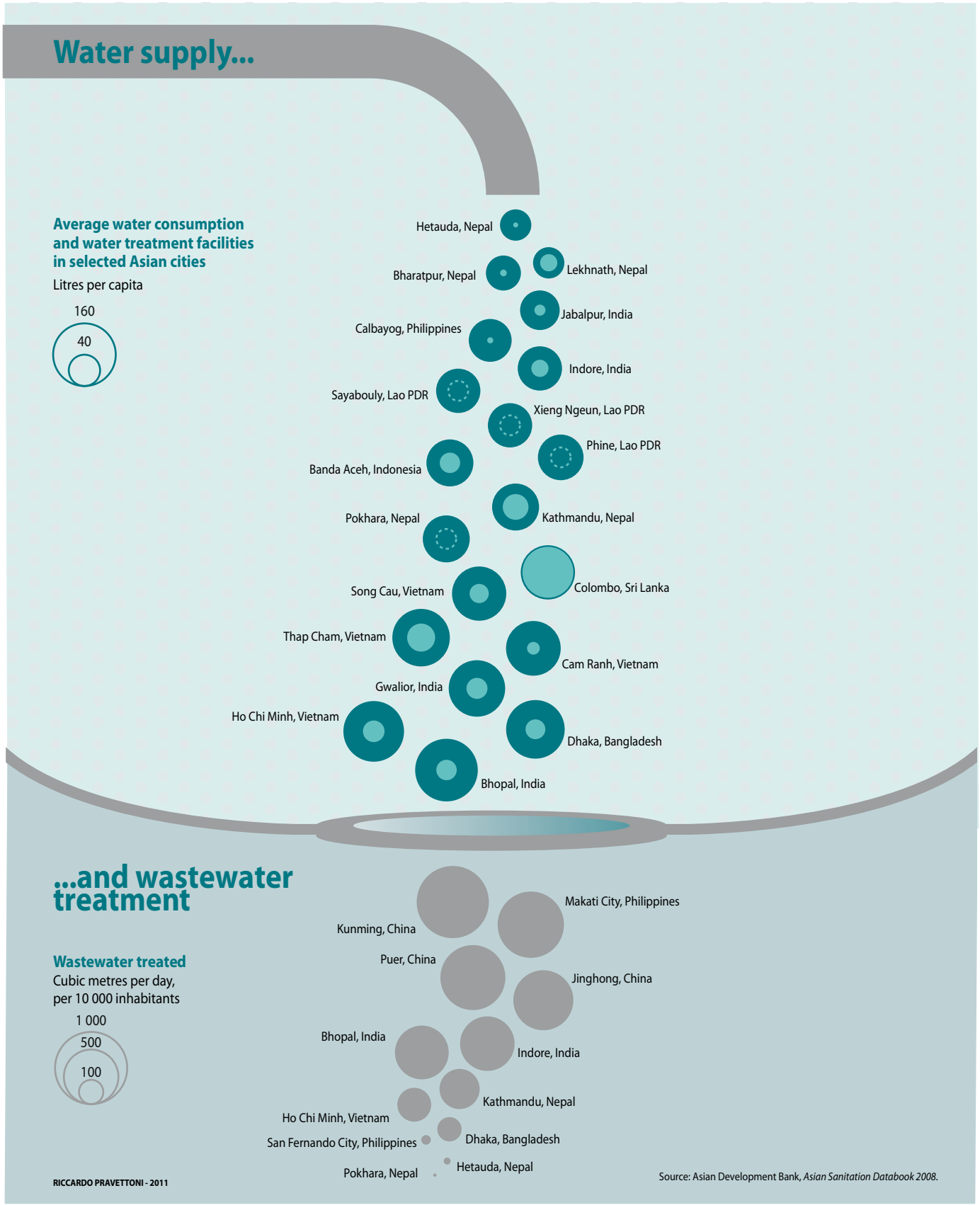


Figure 2



We estimated the minimum deterrent penalty across eight different workforce sizes for factories operating in Bollaram. We compared the cost of compliance, the expected penalty and the overall operating profits of the company. From Figure 2 it can be seen that the expected penalty (maroon bar) is higher than the cost of compliance (green bar) for all factory sizes. This means that if the company is caught not complying then its deterrent payments will be greater than the amount it would have spent on pollution control.

The dark blue bar shows the profits of the companies. Since one of the penalties is to shut down production, this bar shows the loss that companies would bear if closed down for non-compliance. The expected loss of operating profits alone should therefore be sufficient to make polluters comply with regulations. Also, the high profit levels suggest that all companies could easily bear the cost of compliance. Our analysis shows that, in theory, the present form of penalizing errant companies by stopping production, together with the rate of detection of violation in Andhra Pradesh, should be sufficient to deter companies from violating water pollution laws. This appears to be true for the factories belonging to all eight size segments.

In spite of this, violation of water pollution laws appears to persist. Many factories that have been closed for violation of pollution control acts often remain closed for a long time. There may be two explanations for non-compliance. First, violating companies may be risk-takers that gamble with the law even after the minimum deterrent penalty is imposed. The only way of deterring them is to further increase the detection rate. Second, the operating profits of a violating company may be less than the minimum deterrent penalty, and far below the average for their size segment. Factories that remain closed are likely to have an operating profit below than the cost of compliance. Thus, low profitability appears to be a plausible reason for the continued violation of pollution laws. If this is so, improvement of economic benefits (a company's operating profits) would seem to go hand-in-hand with environmental compliance.

Economics of wastewater

It is extremely important for industrial units to recycle wastewater, since there are many arid regions where industrial estates have been set up with little regard for water resources. There are industries that not only have low freshwater consumption, but also recycle their wastewater. When feasible, it can be advantageous for such industries to be located in water-scarce areas.

The economics of recycling waste shows that it is highly profitable to recycle. Not only are the profit rates high, but also the payback period for companies is relatively short, often less than a year.

Penalties for water pollution are theoretically sufficient to act as a deterrent. When factories are closed down, companies lose their profits as long as they remain non-compliant. The cost of compliance is usually significantly lower than the expected cost of penalties. This should encourage companies to implement pollution control on the basis that it costs less than the penalties.

■ **About the authors:** Dr (Ms) Prabha Panth is Professor of Economics at Osmania University, Hyderabad, India. Dr Rahul A. Shastri is Professor of Economics and Joint Director at the National Academy of Development, Hyderabad, India.

Did you know?

▸ Global Investment in smart water meters to reach $4.2 billion by 2016.

▸ Research shows that consumers react to the technology, curbing water use by at least 15 per cent just with the meter switch.

(Source: Pike research)

▸ In order for the Millennium Development Goal related to drinking water and sanitation to be met by 2015, 961 million urban dwellers must gain access to improved water supply, and 1 billion to improved sanitation.

(Source: UNESCO)

▸ For every $1 invested in water and sanitation, $4 is returned in increased productivity (UNDP).

(Source: UN WWAP, 2009)

▸ The total available water resources for the Northeast Asia Region (Japan, Republic of Korea, China, Mongolia) are 3 351 km³, about 0,3 per cent of the global total.

▸ Per capita water availability is 2 221 m³, about 25,7 per cent of the world´s average.

▸ The total water use in Northeast Asia is 684,3 km³, or 29,7 per cent of the global total.

(Source: UNEP, Facts and figures from "Freshwater Under Threat: Northeast Asia" Report)

▸ Freshwater ecosystems sustain a large number of identified species and provide more than US$75 billion in goods and ecosystem services for people but are increasingly threatened by a host of water quality problems.

(Source: Vié *et al.*, 2009)

▸ Globally, 96 per cent of the urban world today uses improved drinking water resources.

▸ Some 250 to 500 million m³ of drinking water get lost in mega cities each year. Saving this amount could provide an additional 10 to 20 million people with drinking water in each mega city.

▸ The water footprint of an individual, business or nation is defined as the total volume of freshwater that is used to produce the foods and services consumed by the individual, business or nation. A water footprint is generally expressed in terms of the volume of water use per year.

(Sources: UN-Water Decade Programme on Advocacy and Communication (UNW-DPAC), UNESCO)

▸ Virtual water is the water 'embedded' in commodities. Producing goods and services requires water; the water used to produce agricultural or industrial products is called the virtual water of the product. The production of 1 kilogram of:
– rice requires 3 000 litres of water
– maize requires 900 litres of water
– wheat requires 1 350 litres of water
– beef requires 16 000 litres of water.

(Source: UNESCO)

▸ 60 per cent of the world´s 227 biggest rivers have interrupted stream flows due to the dams and other infrastructure. Interruptions in stream-flow dramatically decrease sediment and nutrient transport to downstream stretches, reducing water quality and impairing ecosystem health.

(Source: UN-WWAP)

▸ 60 per cent of China´s 660 cities are short of water.

(Source: The Asia Water Project)

The use of water for manufacturing creates increased competition between water users and other demands. In many cases it can also lead to pollution and ecosystem degradation. There is a need for solutions to challenges such as water recycling, sanitation and water efficiency. Increasing water efficiency and reduction of water footprint will often also lead to increased energy efficiency.

Resource efficiency in the leather industry

By ***Kris Schneider***

In China, the Low Impact to Environment (LITE) classification system is helping the leather manufacturing industry to implement efficiency measures in the planning and design phase, significantly improving water and energy efficiency whilst reducing the overall environmental impact.

China's leather industry at a glance

The world's major bovine and performance leather manufacturers have relocated to China and neighbouring low-cost, developing countries such as Vietnam, Thailand and India, making Asia the centre of global leather production. China is the world's largest producer of bovine hides and performance leather and also the world's leading trader of finished leather. Statistics for 2010 show that the gross industrial output value for China's leather industry was US$ 115.14 billion, an increase of 26.9 per cent year-on-year. Imports in the industry were valued at US$ 6.11 billion (34 per cent growth year-on-year), while the value of exports increased by 33.8 per cent to US$ 53.83 billion.

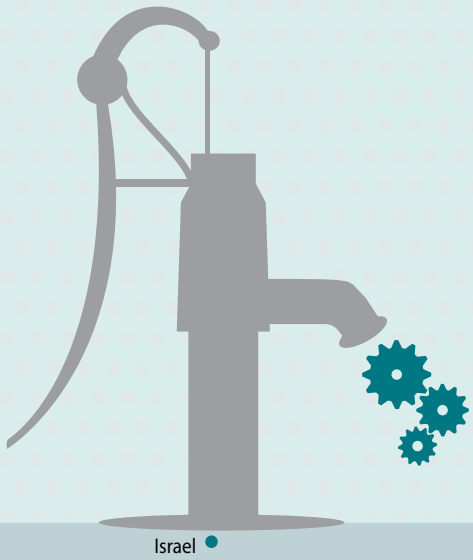
China's leather industry is composed of various sectors ranging from leather and fur as natural by-products, to chemicals, machinery, equipment, spare parts, and components and commodities for footwear and apparel.

Since becoming a member of the World Trade Organisation, China has introduced various reforms, with the implementation of policies, market-based instruments, and institutional frameworks to boost industrial growth. Leather industry manufacturing data show that energy consumption per unit of GDP fell by 44 per cent between 2001 and 2007, and energy intensity per value added unit improved by 52 per cent during the same period.

China's 12th five-year plan: key industrial targets

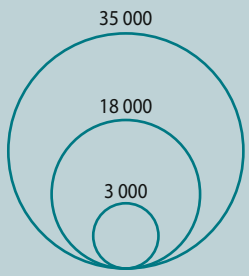
China's 12th five-year plan outlines a need for economic restructuring through implementation of a low-carbon development strategy. Emphasis will be on green and energy efficient industrial growth, with domestic consumption boosted through a facilitated breakthrough in strategic emerging industries. An indicative target for the value-added output of the service sector is 47 per cent of GDP, representing an increase of 4 per cent. To boost innovation, expenditure on research and development will be increased to 2.2 per cent of GDP. China aims to increase the proportion of non-fossil fuels in primary energy consumption to 11.4 per cent and to cut water intensity (water consumed per

Industry water withdrawal



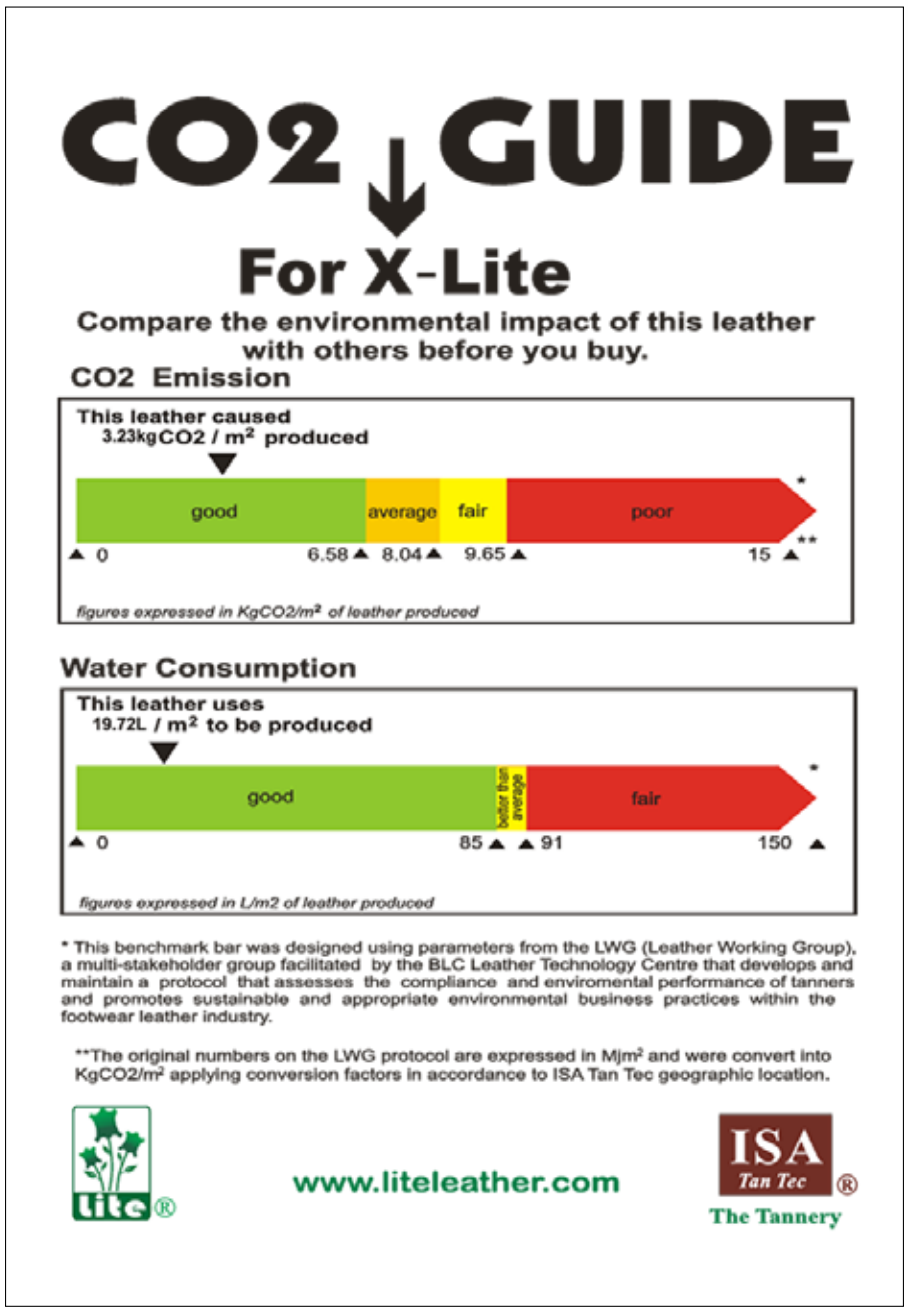
Water withdrawal by Industry sector in selected Asian countries

Milion cubic metres per year



RICCARDO PRAVETTONI 2011

Source: FAOSTAT, accessed December 2011



unit of value-added industrial output) by 30 per cent. Finally, it intends to reduce energy consumption per unit of GDP by 16 per cent and to cut carbon dioxide emissions per unit of GDP by 17 per cent.

Energy and water efficiency are key to sustainability and profitability

Uncertainty persists in the business environment in the face of climate change and the aftermath of the financial crisis. Most small and medium-sized enterprises in emerging economies are reluctant to invest in greening their production. In the leather industry, as in many other industries, the initial step towards eco-profits and business sustainability is to capitalize on opportunities generated by smarter and more efficient manufacturing methods.

Energy and water represent the main operating costs in the tanning industry. Very few tanneries are investing resources, time or money in improving their energy and water efficiency and waste management. Most tanneries use an end-of-pipe approach by increasing their wastewater treatment capacity or installing air filters to filter emissions from finishing equipment that uses cheaper conventional spraying machines.

The LITE leather classification in China

The LITE classification was developed to demonstrate that significant process improvements are possible in the tanning industry in order to reduce the environmental impact of leather production. Several demonstration projects have been implemented since 2007 by the leather company Guangzhou Tan Tec Leather Ltd. and its new plant, Heshan Best Way Leather Ltd. in Guangdong, China. The LITE classification provides information for each kind of leather, addressing CO_2 emissions and water consumption, and was implemented as a pioneer project to ensure greater transparency for customers. Based on monitoring and analysis of existing processes it has led to major reductions in water and energy consumption.

Given the success of the pioneer project, the company implementing the classification made further investments in training and know-how transfer to meet public interest. This initiative could open the way for replication of the LITE classification so that other industries can improve their environmental management and energy design and promote green value chain procurements, in cooperation with suppliers and customers.

In today's business world, market prices do not reflect the full cost of processing inputs and outputs. While economic interests and share values drive sustainable business growth, the principle of the LITE classification is to encourage eco-efficiency and resource productivity. By sharing the positive effects of its experience, the LITE classification supports customers in responsible sourcing and downstream green consumption. Furthermore, it helps to transform our re-industrialisation programme through service innovations so that companies can create eco-profits by doing more with less.

■ **About the author:** Kris Schneider is co-founding partner of ISA/Tan Tec leather (http://www.liteleather.com/) and a research fellow at China's Research Institute of Economic Transition (http://www.crcet.com/english_index.htm).

Remarkable resource efficiency: Case study – LITE Manufacturing system

ISA Leather was the winner of the China Leather Industry Innovation Award in 2009 and recipient of 2nd prize in the 2010 Energy Efficiency Awards of the German Energy Agency, sponsored by the German Federal Ministry of Economics and Technology (BMWi).

By applying best practice technologies, life cycle costing and appropriate management methodologies, it is possible to reduce energy consumption by 75 per cent and water consumption by 50 per cent. Below are some examples of improvements in energy and water efficiency in the tanning industry.

Water management: to save water, a closed-loop system can be implemented to reuse process water, while oil can also be recovered and used as input for steam generation. All that is required when reusing water is appropriate cleaning and proper monitoring of water quality. Constructed wetland technology can also be used to treat wastewater and at the same time produce biomass energy.

With wetland biological treatment, all nitrogen in the effluent is eliminated, while chemical oxygen demand (COD) is biologically degraded from 240 to 40 parts per million. Additional savings are made on chemicals otherwise needed for wastewater treatment and on electricity to run traditional water treatment facilities (energy savings are translated into 12 800 kg COD a year, equivalent to savings of 56 000 kWh and 153 000 kWh for nitrogen removal).

Equipment: by changing re-tanning vessels, the water needed in the process can be reduced by 50 per cent. The energy required for this kind of drum is less than 25 per cent of the energy used by a conventional drum. In addition to cost savings for freshwater, fewer chemicals are required, and wastewater volume is reduced, leading to savings in treatment and waste disposal costs.

Process control and data command: automatic dosing systems control water volume and temperature. For management control, virtual monitors are installed on each machine, while data reporting and graphic analysis are available in real time, including online/on screen error messaging, ready to be sent by e-mail and SMS to operating units whenever errors occur or limits are exceeded.

Leather drying: leather is dried on toggle dryers or vacuum dryers. Vacuum drying technology has been improved over recent years and low temperature dryers are now available on the market. These dryers require less energy than conventional vacuum dryers.

Finishing: conventional spraying machines require auxiliaries to dilute the chemicals before they are sprayed on the leather. The spraying process has an efficiency of only 50 per cent, causing the emission of chemicals into the air. Alternative direct coating application machines can now be used. These machines apply the chemical undiluted onto the surface of the leather and thus have no air emissions. Energy consumption on the drying side is also considerably reduced.

Facility management: facilities are designed as green buildings and integrated into the local natural environment. Energy costs are reduced through investment in industrial solar hot water systems and biomass energy generation.

Did you know?

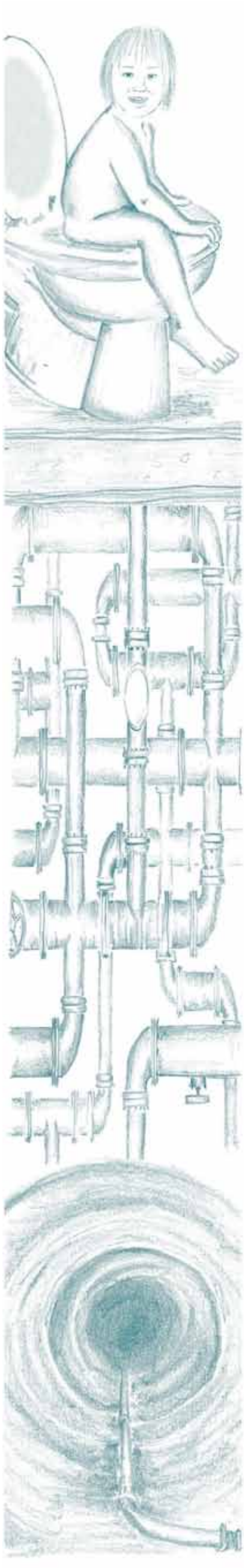
▸ In 2011, China vowed to limit its water use to 670 billion cubic metres (177 trillion gallons) annually over the next decade.

(Source: The Asia Water Project)

▸ South Korea made huge investments in water and sanitation during the 1960s, when its per capita income was the same as Ghana's, and during that decade, under-five mortality more than halved, while the number of medical staff stayed virtually the same.

(Source: Harvard Business Review "China leads the Clean Economy Race", September 23, 2010)

Water pollution and sanitation have huge repercussions both for local ecosystems and humans. The sources of pollution are many, and the cost of cleaning contaminated water can be high and energy intensive. We feature possible solutions, opportunities and creative action.



Ecological sanitation

By ***Ryuichi Fukuhara***

Wastewater management has received increasing attention in recent years, as the global water crisis concerns not only the quantity but also the quality of available freshwater. Rising water demand for urbanization and food production is resulting in unregulated and illegal discharge of untreated wastewater to the environment, which contaminates freshwater resources. In Asia there is growing concern that inappropriate wastewater management will hamper sustainable socio-economic development.

Promising decentralized solutions

Remarkable progress in sanitation has been made in big cities over the past decades. However, this development is still not keeping pace with the needs and impacts of an ever-increasing urban population. It is estimated that 84-89 per cent of wastewater is discharged untreated, reaching freshwater and coastal water areas. The negative economic impacts of lack of sanitation cost several percentage points of national GDP in some Asian countries.

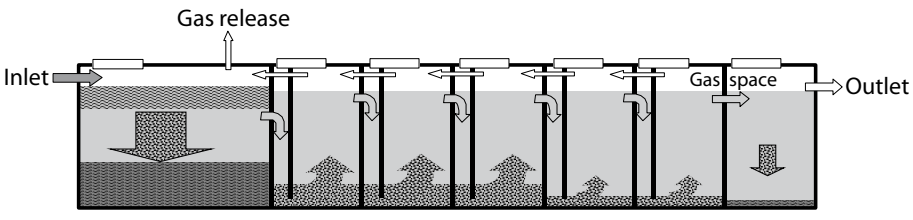
The demonstration of ecological sanitation and other decentralized sanitation projects in the Philippines, funded by the Korean International Cooperation Agency, addresses wastewater management issues by adopting small-scale environmentally sound technologies at a local community level on a pilot basis. Unlike Asian megacities, where sanitation coverage is relatively good, most peri-urban and rural areas lack appropriate wastewater management. Centralized treatment systems require a dense population to be cost-effective and are not realistic solutions for these areas. Alternative solutions are needed. Decentralized wastewater treatment systems (DEWATS) and ecological sanitation (Ecosan) have been identified as promising options to balance socio-economic development and provision of basic services for less privileged communities.

Integrated approaches

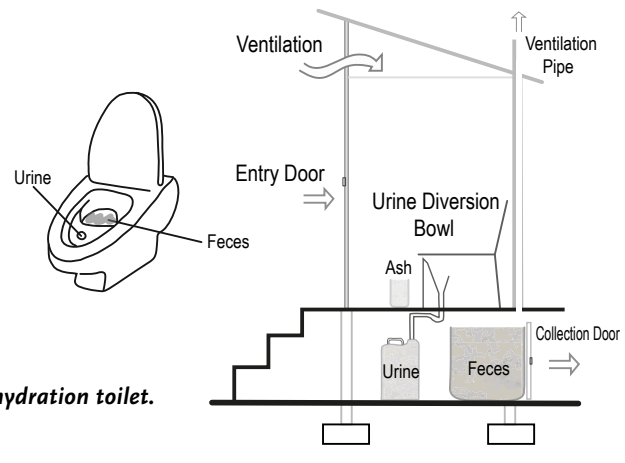
DEWATS and Ecosan are approaches to sanitation rather than just technical hardware package. DEWATS is based on a combination of treatment options such as a biogas digester, an anaerobic baffled reactor (see figure), an anaerobic filter and a planted gravel filter. These components are selected on the basis of their reliability, longevity and tolerance of inflow fluctuations. Most importantly, these treatment principles dispense with the need for sophisticated control, maintenance and technical energy inputs. Ecosan is based on the systematic reuse and recycling of water and nutrients as a hygienically safe, closed-loop and holistic alternative to conventional sanitation solutions. Ecosan systems enable nutrients to be recovered from urine and faeces for agriculture, thus preserving soil fertility, assuring food security, minimizing water pollution and use of synthetic fertilisers, and sometimes recovering bio-energy.

To promote sustainable sanitation, the project addressed urine reuse for pilot cultivation in local farms. *Ryuichi Fukuhara*

Fifty households from five local communities in La Union Province took part in demonstration of an ecological sanitation system. A urine-diverting dehydration toilet was installed in each home. *Ryuichi Fukuhara*



DEWATS is based on a combination of treatment principles such as a biogas digester, an anaerobic baffled reactor, an anaerobic filter, and a planted gravel filter.



A urine-diverting dehydration toilet.

The UNEP International Environmental Technology Centre (UNEP-IETC) in Osaka, Japan implemented the project in collaboration with the Centre for Advanced Philippines Studies (CAPS). Fifty households from five local communities in La Union Province took part in a demonstration of ecological sanitation. A urine diverting dehydration toilet (UDDT, see figure) was installed in each household, and the local community members received the instructions on UDDT operation and maintenance as well as potential reuse of diverted urine in their gardens. The project also mobilised financial and other substantial contributions from the Bauang Municipality and other partners to install a community-based decentralized wastewater treatment system. To promote sustainable sanitation, the project also looked at the question of urine reuse for pilot cultivation projects in local farms. These components were supplemented by an awareness raising campaign among toilet users, local farmers and government officials through community meetings and training workshops.

Success through cooperation

The project owes its success to the active participation and involvement of stakeholders. Thanks to the longstanding efforts of people at the Bauang Municipality, the town is now recognized as a model for decentralized wastewater treatment systems and ecological sanitation and receives many visitors, including some from abroad. This recognition encourages users, farmers, local communities and government staff to further improve the performance of existing facilities and promote their achievements. This virtuous cycle boosts the sustainability of activities. UNEP-IETC will analyse and systemize this best practice for further implementation of similar activities.

Acknowledgements: The author would like to express his sincere appreciation to Mr Danilo Lapid, Head of CAPS, and his colleagues as well as to Martin de Guzman III, Mayor of Bauang Municipality, his staff and local community members for their work in implementing this project. The author is grateful for the generous contribution by KOICA, which enabled UNEP-IETC and CAPS to implement the project.

■ **About the author:** Ryuichi Fukuhara is Programme Officer at UNEP's International Environmental Technology Centre (IETC).

Prime Minister Lee Hsien Loong visits Integrated Pavilion on city development during SIWW 2011. PUB

Young kids learn water knowledge. PUB

Research and development. PUB

The Singapore water story

By ***Michael Toh***

With over 5 million people living in an area of just 710 square kilometres, managing Singapore's water resource is no mean feat. In the 1960-70s the island faced a myriad of water problems, most of them associated with accelerated urbanization: water shortages, flooding and pollution of its rivers.

Today the situation is vastly different. By investing in water technology and adopting an integrated approach to water management over the past 40 years, Singapore has developed a diversified and sustainable water supply system. The Four National Taps system provides Singaporeans with good, clean drinking water at the turn of a tap. The name refers to water from four different sources: rainwater from local catchments; imported water; recycled water (NEWater); and desalinated water.

Currently about two-thirds of Singapore's land area is water catchment, with the completion of Singapore's first reservoir in the city – the Marina Reservoir – which was commissioned by then Minister Mentor Lee Kuan Yew on 20 November 2010, as well as the Punggol and Serangoon reservoirs. A widespread network of 32 major rivers and more than 7 000 km of drains and canals channel storm water to 17 reservoirs that supply the city with drinking water.

A new chapter

PUB, Singapore's national water agency, was among the first in the world to purify treated wastewater using advanced membrane technology to produce ultra-clean, high-grade reclaimed water that we brand as NEWater. Introduced in 2003, it heralded a new era in Singapore's water history. The water has been vetted by more than 65 000 scientific tests, surpassing even the World Health Organisation standards for drinking water.

NEWater is supplied primarily for non-domestic use in wafer fabrication parks, industrial estates and commercial buildings, where it is used for industrial and air-cooling purposes. A small percentage is mixed with raw reservoir water before being treated for drinking water.

NEWater can currently meet 30 per cent of Singapore's water needs. The plan is to expand NEWater capacity so that it meets 40 per cent of Singapore's water demand by 2020 and 50 per cent of water demand by 2060.

Desalinated water

Desalinated water was added to Singapore's water sources in 2005, with the opening of Singapore's first desalination plant. Its second and largest desalination plant with a capacity of 320 million litres a day is under construction and expected to be ready in 2013. By 2060 Singapore plans to increase desalinated water capacity so that the Fourth National Tap can meet at least 30 per cent of water demand.

Mr Khoo Teng Chye, Chief Executive of PUB, attributed Singapore's success to several factors. He said, 'we believe that innovation is important and have always placed emphasis on R&D and investing in technology. PUB has worked hard over the last 40 years to overcome our water challenges and it is through strong political will, good governance, effective implementation and a motivated workforce that we have been able to put in place a robust and sustainable supply of water in Singapore.'

Managing demand

Simply putting the infrastructure in place is not sufficient to secure Singapore's water supplies. Demand management is also imperative for sustainability. In a study carried out for the United Nations Human Development Report in 2006, Stockholm Water Prize laureate Professor Asit Biswas highlighted this as a key ingredient in Singapore's effective water management. 'Singapore is one of the very few countries which looks at its water supply in totality,' he said. 'One of the main reasons why it is successful in managing its water supply is the concurrent emphasis on supply and demand management.'

The country's holistic approach to water resource management includes a water demand management programme, which incorporates proper handling of the transmission and distribution network to minimize losses, as well as implementing water conservation measures. This has brought about a considerable reduction in unaccounted-for water, down from 11 per cent in the 1980s to less than five per cent today, one of the lowest levels in the world.

Water pricing

Key to demand management is pricing water at its true value. Singapore believes that water must be priced appropriately to prevent misuse and wastage. But at the same time, targeted assistance is also provided to the underprivileged in the form of utility rebates, to ensure that the poor are not deprived of a supply of clean water.

In 1991 the government introduced a water conservation tax (WCT) as a pricing tool to discourage excessive consumption of water. In 1997 a fundamental pricing review was conducted with the aim of recovering the full cost of production and supply, and to also reflect the higher cost of alternative water supply sources. This underlying 'marginal cost' principle reinforces the message that when demand goes up and existing sources of supply run out, the next drop of water, or the marginal source, will come at a higher price. The WCT was adjusted to reflect the difference between the prevailing water tariff and the marginal source (which was desalinated water). Over a four-year period from 1997 to 2000, water tariffs were adjusted to current levels. The water-borne fee (WBF) is a fee collected to offset the cost of treating used water and for the maintenance and extension of the public sewerage system.

Educating the public

Singapore considers its people to be joint stakeholders of their water resources and also actively seeks to engage the community in its water management efforts.

In 2004 a series of public education programmes were launched to encourage water conservation through daily habits. These efforts have shown results: per capita consumption of water in households has inched downwards, from 165 litres a day in 2003 to 154 litres a day now. The long-term target is to reduce daily per capita water consumption to 147 litres a day by 2020.

Individuals and organisations are also encouraged to adopt the island's waterways, to take care of them and learn the value of keeping them clean. PUB also actively promotes recreational activities at its reservoirs and they are now a haven for water sports such as kayaking and wakeboarding.

To better integrate water into the urban environment and bring people closer to water, PUB has embarked on a long-term initiative called the Active, beautiful, clean waters (ABC waters) programme, which will transform the country's drains, canals and reservoirs into vibrant streams, rivers and lakes, creating beautiful new spaces for the community's enjoyment.

In addition PUB launched a lifestyle magazine called PURE to stimulate public interest in water issues. A mascot named Water Wally helps spread the water messages to the young in a lively and interactive way.

The goal of these initiatives is to encourage Singaporeans to bond with water, so that they will cherish and better appreciate this precious resource.

Singapore, the global hydrohub

Over the years, Singapore has managed to turn its water woes from vulnerability to a strategic advantage, and more recently, a growth industry for the country. The Singapore government has identified the water industry as a new growth sector for the country's economy. A total of US$ 362.4 million has been allocated to water R&D since 2006 to develop Singapore into a hub for water technologies. The country is now a hotbed for water technologies, home to a thriving cluster of more than 70 Singapore and international water companies.

To raise its profile as a global hydrohub, PUB has hosted the annual Singapore International Water Week for the past four years. This event is a global platform for water solutions, bringing together policymakers, industry leaders, experts and practitioners to address challenges, showcase technologies, discover opportunities and celebrate achievements in the water world. The event is a major step in PUB's efforts to develop Singapore into a vibrant and thriving hub for water technologies.

■ **About the author:** Michael Toh is Director of the Industry Development Department of Singapore's national water agency (PUB). For more information, visit www.siww.com.sg.

Towards the Millennium Development Goals: from sanitation to a safe environment

*By **Pierre Flamand***

In many developed countries the sewerage system is the main system used for wastewater treatment. Data on sewerage coverage in European countries such as Denmark, the UK and the Netherlands show that sewerage systems in these countries cover more than 90 per cent of the population. Japan has a little-known but different and interesting profile, which is rooted in its unique history.

Growth of cities

The history of human waste treatment in Japan from ancient times to the present day has been closely linked to the growth of cities. Human waste problems, like those of other household wastes, are an intrinsic part of human communities. In early times, human waste was simply discharged as natural waste. But over time a system gradually developed whereby human waste was used as fertiliser for agriculture. To secure food supplies for cities, agriculture developed in suburban areas during the Edo Period (17th to mid-19th century). These areas in turn received human waste as manure, giving rise to a circular flow of resources. The high-volume, low-cost human manure available from large cities was indispensable to the growth of commercial farming, since Japanese agriculture lacked a self-regenerating soil fertilization process.

The flow of urban human waste for farm use as manure continued to increase until the end of the Edo Period (19th century), but this system gradually started to collapse in the early 1900s. Among contributing factors were the difficulty securing farm labour due to the population exodus to industrial cities, an imbalance in supply and demand caused by a reduction in farmland in suburban areas, and the introduction of chemical fertilisers.

Inspecting septic tanks during a field visit in Bhutan. *Japan Sanitation Consortium*

Sanitation field assessment in Indonesia. *Japan Sanitation Consortium*

Consequently, human waste generation began to exceed demand in some cities, giving rise to environmental and public hygiene problems. Some city governments took over the responsibility of human waste collection and discharged it into sewers or the ocean. Sewer systems in those days were almost non-existent or only intended for the treatment of household wastewater (excluding human waste) and industrial effluent. The discharge of human waste into public sewers was undertaken as an emergency measure due to the lack of other facilities or means for disposing of human waste.

Shift in demand

With the decline in demand for the use of human manure on farms and the resulting supply/demand imbalance in human waste, problems associated with the inappropriate handling of surplus human waste began to appear around 1950, in the form of environmental pollution as well as the spread of waterborne diseases, parasitic infestations and other health hazards. Improvement of public hygiene was recognized as one of the most urgent national policy goals. In response the central government put forward a number of policy measures to promote mechanized human-waste transportation, the sanitary treatment of human waste and combined treatment of human waste and wastewater. Human waste finally came to be treated and disposed of in a hygienically sound manner within a socio-economic framework. Japan's very first treatment facility for human waste and night soil was built in Metropolitan Tokyo in 1952. Today around 1 100 facilities are operating all over the country, treating human waste and sludge in a hygienically sound manner. For comparison, more than 2 070 wastewater treatment plants are now operating in Japan.

The use of sewerage facilities rapidly expanded and in the late 1980s they became the main sanitation system used in Japan. Through massive investment (1 per cent of GNP invested annually – equivalent to the defence budget), numerous national subsidies, and an appropriate legal and institutional framework initiated through strong political determination, Japan achieved total sanitation coverage within 40 years. The sewerage system now accounts for more than 70 per cent of total sanitation coverage, whereas decentralized systems such as the johkasou system and night-soil collection and treatment system cover the rest of the population (20 per cent and 10 per cent, respectively). By combining various systems designed to meet different needs and specific local conditions, enhanced by tremendous technological development, Japan has effectively addressed water-related issues. Today in Japan, people can drink water from the tap and enjoy a safe and sound environment.

Knowledge hub for sanitation

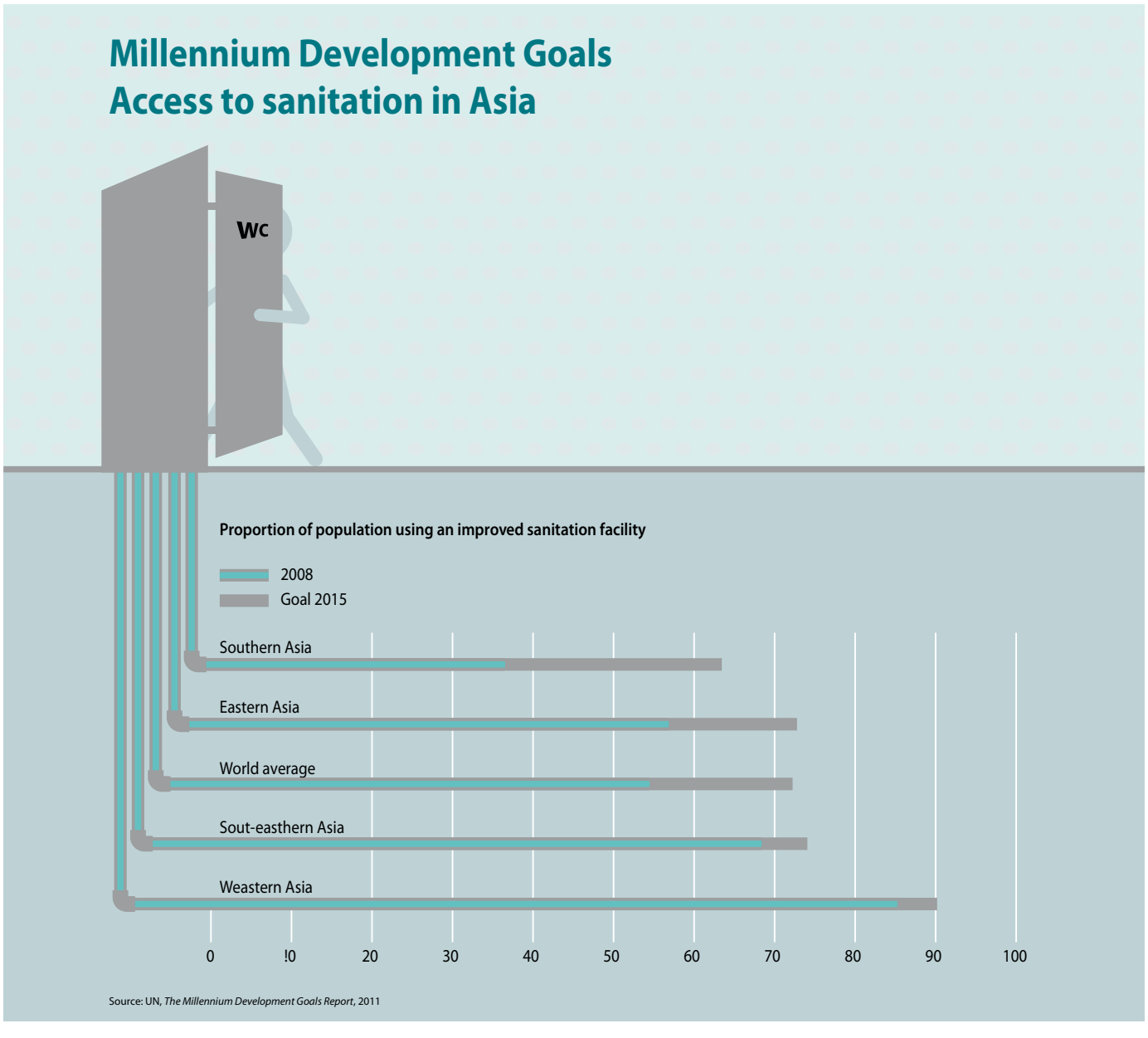
Building on Japan's expertise in sanitation, the Japan Sanitation Consortium (JSC) is a newly established organisation that was internationally recognized in 2009 as the Asia-Pacific Water Forum's knowledge hub for sanitation in the region. Knowledge Hubs is a network of regional water knowledge hubs, including 17 hubs with various areas of expertise. It was initiated by the Asia-Pacific Water Forum – a non-profit, non-partisan, non-political organisation – to generate and share knowledge while developing capacity in various fields of water science domains. JSC is a unique organisation because its area of expertise covers basic sanitation (toilets), as well as on-site and off-site sanitation. JSC aims to support countries of the Asia-Pacific region with low access to sanitation through information sharing and advice. The aim is to enable them to acquire the knowledge and capacity to develop and diffuse sanitation systems in order to improve public health and living conditions and reduce water pollution.

Holistic approach

Treatment of human waste and wastewater requires a holistic approach, its ultimate aim being to preserve the quality of water resources. Decisions such as the choice of toilet and selection of (individual or collective) treatment processes should not be made on a case-by-case basis, but rather from a broader perspective that takes into consideration the overall development and sustainability of the system and its impact on the environment. Furthermore with rising demand for water, efficient use of this resource has become an urgent goal and one that can be achieved by reducing daily consumption per capita and reusing and recycling water through appropriate wastewater treatment. Equally important is public awareness on health and hygiene issues, the development of sanitation policy – including legal, regulatory and institutional structures – and the training of experts and staff so that they have the proper level of expertise in managing waste-water and sludge treatment systems.

JSC's aim is not to sell technology. Its main goal is to assess and advise on sustainable ways to improve local sanitation conditions while advocating for sanitation to become a high-profile political issue. More specifically, JSC aims to promote the empowerment of local communities through education, training and knowledge exchange, in order to create demand-driven systems. By developing strong networks and sharing our success stories, together we can take a big step towards achieving the Millennium Development Goals for sanitation.

■ **About the author:** Pierre Flamand is a survey staff member at the Japan Sanitation Consortium, mainly involved in international networking and country sanitation assessments in the Asia-Pacific.



Appropriate sanitation technology for improvement of health and the environment

By ***Anita Jha***

Quoting a pre-millennium opinion poll, Time Magazine reported that people voted the toilet the most important invention of this century – more important than life-saving drugs, space vehicles and the mobile phone. In other words, the toilet is humankind's top achievement. This is true because it has helped considerably reduce the age-old practice of open defecation in most countries, including India.

Inadequate sanitation, poor hygiene

It is estimated that as many as 2.7 billion people in the world or two-fifths of the global population do not have access to adequate sanitation and that 1.5 billion suffer from parasitic worm infections stemming from human excreta and solid wastes in the environment. In developing countries an estimated 2.2 million people, mostly children, die every year from disease associated with open defecation, inadequate sanitation and poor hygiene.

If sanitation is poor in developing countries, it is because Western solutions have often been used. These responses are often not economically, culturally or socially suitable for local conditions. For instance, sewerage systems developed in the West are often inadequate and inappropriate for developing countries with different habits, social practices and water constraints. An alternative system is consequently required. The system developed in the 1970s by Sulabh International, a non-government organisation, has proved to be an acceptable technology for human waste disposal, winning broad recognition from many national as well as international organisations.

Open defecation and scavengers

Poor sanitation coverage is primarily due to low awareness, coupled with a lack of access to affordable sanitation technology. In India only a few towns have appropriate sewerage systems, and some use bucket toilets and septic tanks. The two systems that are prevalent on a large scale are defecation in the open, and manual cleaning of human excreta by a class of people called 'scavengers'. They clean dry toilets and manually carry human faeces.

It is believed that the practice of scavengers manually cleaning excreta has existed for 4 000 years in India. They were treated as 'untouchables', the lowest of the low in India's caste hierarchy. The practice continues even today in some places. Ironically the scavengers were humiliated and insulted, even by those who employed them to clean toilets in their homes. They had to clean bucket toilets before sunrise, so that nobody could see them or touch them. They had to live on the margins of the village or town. There was no question of their going to school or entering temples to pray. Finding an alternative method of disposal of human excreta that would liberate these scavengers and rehabilitate them into other occupations has posed major challenges.

A sanitation breakthrough

Some of these challenges are being addressed by Sulabh International, which was founded by Dr Bindeshwar Pathak. A major breakthrough was achieved in 1970 when Dr Pathak developed and demonstrated two-pit pour-flush toilet technology for on-site disposal of household human waste. This became popularly known as the Sulabh toilet (see box). The technology is simple, economically affordable and socially acceptable. It replaces the bucket toilet and scavengers no longer required to clean and carry excreta by hand.

In 1974 Sulabh started converting bucket toilets into Sulabh toilets in cooperation with the government in Patna, Bihar state, India. The switch to Sulabh toilets has meant a big relief for many scavengers, now released from a humiliating task. The programme has steadily gathered momentum and it is currently estimated that more than a million scavengers have found work in other occupations and joined the mainstream of society. About 7 000 are also receiving school education and vocational training in various trades such as tailoring, embroidery, plumbing, beauty care and cooking.

Reaching out

Sulabh has reached millions of people with more than 1.2 million bucket toilets. In addition the Government of India and state governments have built more than 54 million toilets using the Sulabh design. To achieve this widespread impact, Sulabh social workers have visited households to educate people on the benefits of giving up bucket toilets.

Scavengers are being retrained for other occupations, with vocational training for various trades such as tailoring, embroidery, plumbing, beauty care and cooking. *Sulabh International*

Efforts have also focused on schools where the absence of toilet facilities results in high dropout rates among girl students. Sulabh has tried to reverse this trend by providing toilet facilities in the schools. In all Sulabh has produced more than 7 500 public toilets, with NGOs and governments also installing many more similar toilets. The Sulabh design not having been patented may be used by anyone without permission.

Biogas technology and Sulabh effluent treatment technology

Human waste from public toilets, high-rise buildings, hostels and hospitals can be recycled using a simple technology, which includes on-site treatment of effluents and biogas generation. The excrement is refined by a biogas digester and converted into a usable fuel. The system organically breaks down faeces into trapped biogas that can be burned to provide cooking fuel and electricity. The water discharged from the biogas digester is treated using Sulabh Effluent Treatment (SET) technology, passing through a sedimentation chamber, a sand filtration tank, charcoal and finally ultraviolet rays. The biochemical oxygen demand of the wastewater is consequently less than 1 mg/l. The wastewater is pure containing phosphorus, nitrogen and potash. Its nutrients can raise farm productivity, but it can also be used as a fertiliser for flowerbeds and kitchen gardens.

A holistic approach

Achieving universal sanitation coverage requires close cooperation between local governments and communities or local NGOs. Neither the government nor the NGOs can complete the task alone. Technical as well as social problems need to be tackled, in a holistic manner. The strategy developed by Sulabh can easily be replicated in other developing countries to improve the sanitation status and quality of life.

■ **About the author:** Anita Jha is Senior Vice-President at Sulabh International Social Service Organisation.

The Sulabh twin-pit, pour-flush toilet

The Sulabh toilet requires only 1-1.5 litres of water to flush per use, thus saving a substantial amount of water. There are two pits, only one in use at a time and the other kept as a standby. When the first pit is full, the flow of human waste is switched over to the other. In the first one, the waste turns into manure after two years, containing nitrogen, potassium and phosphates. It works as a bio-fertiliser. The impact on health also seems to be positive, as cases of jaundice are reported to have dropped significantly in places where Sulabh toilets are in use.

Advantages of the Sulabh toilet

- Hygienically and technically appropriate, socio-culturally acceptable.
- Affordable and easy to build with locally available materials.
- Design and specifications can be modified to suit the householder's needs and budget.
- Can adapt to various physical, geological and hydrogeological conditions.
- Free from health hazards, with no pollution of surface or groundwater, if proper precautions and safeguards are taken during construction.
- Can be located within the premises as it is free from foul smells and pests such as flies and mosquitoes.
- Can be installed on the upper floors of houses.
- Pits are generally designed for a three-year de-sludging interval, but if required, can be designed for a longer period or can be reduced to two years.
- Easy, simple, low-cost maintenance.
- Needs only 1–1.5 litres of water for flushing, while conventional flush toilet needs 12 to 14 litres.
- Needs less space than a septic-tank toilet system.
- Householders can clean the pits and dispose of sludge.
- Produces rich fertiliser and soil conditioner.
- Easily connected to sewers when the area is connected.
- Low-volume flushing cistern may be attached to avoid pour-flushing.

Community based initiatives

Community based initiatives focus on behavioural change needed to ensure real and sustainable improvements – investing in community mobilisation raising awareness that the actions of individuals and communities does make a difference. The ideal is local solutions leading to improved sustainability.

Collection of surface run-off water by the ponds made for groundwater recharging (Chak Ramnagar village, Bharatpur). *RSNH Photo Library*

Water conservation through community participation

By ***Satya Prakash Mehra***

To resolve local environmental problems, especially related to water, the scientific community must consider available traditional options and solutions. In Project Boond the Rajputana Society of Natural History (RSNH) has combined traditional Banjara knowledge with advanced modern water-harvesting techniques Sustainable community structures for collecting and storing water were built keeping local environmental conditions in mind.

From floods to droughts

Bharatpur, the eastern gate of Rajasthan, lies in the Yamuna flood plain, at the confluence of three rivers: Ruparail, Banganga and Gambhiri. The region has a history of floods and droughts. The frequency of these natural phenomena changed in the late 1990s and early 2000s, with fewer floods and more droughts. The main cause was almost certainly human interference in the natural flow patterns of the rivers, including the building of dams. By the mid-2000s, water inflow from all the rivers feeding Bharatpur had been reduced to nothing, resulting in an acute shortage of surface water all over the region. Due to the shortage of surface water people started exploiting the underground water table. The failure of the monsoon – with a lack of rainfall – made matters worse.

RSNH took on the challenge of raising awareness of the need to save water in the region. In 2007 an RSNH youth team surveyed the downstream areas of the earlier existing rivers to assess how people view water conservation and the importance of the Keoladeo National Park, a World Heritage and Ramsar site. The park also faced the threat of water shortages. The park's forest management team used the baseline data collected from the survey-questionnaire to identify gaps in research, highlighting the need for a change in public attitudes to water conservation. It was also apparent that long-term solutions to local problems of water scarcity were needed to change mindsets.

Community-led total sanitation – An innovative methodology for mobilising communities

Community-led total sanitation (CLTS) is an approach that helps communities completely eliminate open defecation. Communities are assisted in the conduct of their own appraisal and analysis of open defecation and take their own action to end open defecation.

At the heart of CLTS lies the recognition that merely providing toilets does not guarantee their use, nor results in improved sanitation and hygiene. Earlier approaches to sanitation set high initial standards and offered subsidies as an incentive. But this often led to uneven adoption, problems with long-term sustainability and only partial use. It also created a culture of dependence on subsidies. Open defecation and the cycle of faecal-oral contamination went on spreading disease.

In contrast, CLTS focuses on the behavioural change needed to ensure real and sustainable improvements – investing in community mobilization instead of hardware, and shifting the focus from toilet construction for individual households to the creation of 'open defecation-free' villages. By raising awareness that as long as even a minority continues to defecate in the open, everyone is at risk of disease, CLTS triggers the community's desire for change, propels them into action and encourages innovation, mutual support and appropriate local solutions, thus leading to greater ownership and sustainability.

CLTS was pioneered in 2000 by Kamal Kar, a development consultant from India, together with the Village Education Resource Centre, a partner of WaterAid Bangladesh, while evaluating a traditionally subsidized sanitation programme in a village in Bangladesh. The approach spread fast in Bangladesh where informal institutions and NGOs play a key role. The World Bank's Water and Sanitation Programme (WSP) played an important part in extending the project to neighbouring India and subsequently to Indonesia and parts of Africa.

Source: The CLTS website http://www.communityledtotalsanitation.org

Village pond filled with surface run-off water and nearby well, inspected by community youth leader Surjit Singh. *RSNH Photo Library*

Promoting traditional solutions with Project Boond

Project Boond was carried out in the village of Chak Ramnagar and changed the lifestyle of the deprived Banjara community, also known as the gypsy community of India. The Oil Industry Development Board (OIDB), the Drought Relief Trust (DRT) and Bharat Petroleum Corporation Ltd (BPCL), through their corporate social responsibility programmes provided financial support for the participatory community work to resolve water problems along with the expertise involvement of Natural Solutions consultants.

Banjaras are known for their age-old practices of water harvesting, carried out throughout the desert state of Rajasthan. With passing time the community has lost the traditional knowledge of its forebears due to a lack of interest from the scientific community and government policies. It is now open to doubt whether many water-harvesting structures will provide sustainable, long-term solutions. Unplanned structures are worthless in a context of climate change and monsoon failure. On the other hand age-old structures (old wells) in Rajasthan are still major sources of water even during the drought period.

The project implemented approaches rooted in traditions from Rajasthan, which rely on natural solutions to solve water problems. Ponds were built to collect and store water, but were made in a way conducive to groundwater recharging. The deep infiltration of the surface water through *kuccha* constructions – traditional, bio-compatible materials – recharges groundwater, in a way which reduces the salinity problems of the area. Only minimal use was made of cement-based concrete and other materials that stop water percolation, with a high proportion of materials that encourage natural seepage. The reservoir systems were designed to trap every drop of rainwater without checking its downstream movement.

Before Project Boond the target site had only one well, with saline water (the concentration rising from slight to moderate between winter and summer). It had not been used for human consumption for the past decade. After improvements were made to groundwater recharging and surface-water harvesting, the conditions changed. Saline water was improved to freshwater and is now consumed by villagers. Similarly, traditional well-digging know-how combined with advanced assessment techniques led to the construction of a new well yielding freshwater. This well is important because all the nearby underground pumps have saline water. It is now not only feeding the target village, but also allowing people from nearby villages to collect water from it. The reservoir developed in the village is designed so that as much water as possible can be harvested from nearby open areas, thus helping the fields to retain their moisture content for longer. Livestock is getting freshwater from the reservoir all year long.

Community involvement

Project Boond encouraged community participation through camps to motivate the various target groups in the village. The camps featured street theatre, screening of films and documentaries, lectures, one-day events related to the environment and so on. Children and women were the main targets, as they cannot move out under prevailing social conditions. Women are the first to feel the impact of water scarcity, as they are responsible for collecting and managing water use in their families.

It is also interesting to note that many of the children from villages involved in the project played an important role in encouraging their parents to work for a safer and more sustainable future. To this end the RSNH organized meetings and programmes with children. The RSNH team, taught the children that they – not old people – will have to cope with future problems. So the children should demand that the older people in their family help them to a safer future. Women often face more immediate problems than men regarding access to water. As a result more women became involved in development work through self-help groups.

Impact on the region

The villagers of Chak Ramnagar took part in building work, so Project Boond generated extra income for deprived villagers, an additional asset for the community. Since completion of the drought-proofing work, the women have saved time previously spent collecting water, thus contributing more effectively to other activities. Thanks to improved groundwater conditions the land was fit for crops requiring more water. The most significant impact was the reduction in irrigation time due to the soil's moisture content. Furthermore they revived local plant species, especially various types of grass (*Desmostachya bipinnata*, *Vetiveria zizanioides*, *Saccharum spontaneum* and *Saccharum munja*). These species help bind the soil as well as retaining moisture. In addition to their ecological importance these species are of economic value to the local community. Some are used for traditional Banjara artefacts, which appeal to visitors and tourists. So with improved water conditions the village is also protecting local plant species and reviving the site's original ecological conditions. These activities entailed public participation in practices to preserve livelihoods derived from local natural resources, fulfilling the aims set by global conservation groups for World Heritage at Keoladeo national park.

■ **About the author:** Satya Prakash Mehra is Advisor for the Rajputana Society of Natural History and Manager for Project Boond.

UNICEF supports rainwater harvesting for families on remote islands in Indonesia

By ***Suzanna Dayne***

This article was previously published on the UNICEF website: http://www.unicef.org/infobycountry/indonesia_42209.html

The island of Alor is just two short flights away from Bali, and yet it is a world away in terms of clean drinking water, one of the most basic necessities.

Climate-change experts warn that the problem could get worse. It rains here a mere four months a year, and residents often resort to collecting water from local streams. The only alternative used to be buying water from small tanker-trucks which travel round the island. 'If it's the dry season we have to walk five kilometres from early morning, and sometimes we don't get home till noon,' says Juliana, a homemaker. 'I have to bring this 20-litre can. Sometimes it's enough, sometimes it isn't.'

Teachers at the local school say children often have to help and then they are too tired to study. 'We used to have to go down to the river in the morning before school,' said Lahal Ayub Bain, a junior high school student. 'Then we'd take a quick bath and take water back home. Then we could go to school.'

A community effort

UNICEF is working on the island to help families like Lahal's through its rainwater harvesting programme. Rainwater harvesting is a community effort. First, local residents are taught how to build the tanks, which collect water run-off from tin roofs. They then fan out to different villages and build more tanks with the help from residents.

It takes just a couple of days to build a tank for a home. The system can supply enough water for drinking and cooking for a family to last most of the year.

'Every house has one'

The people on Alor say the tanks have changed their lives. Ema Dolpali lives on nearby Pura Island in a simple home with her husband and two children. There are no streams or water trucks, so the entire village had been relying on one well for all its water needs. 'Our ancestors lived up the mountain but then they moved further down, and the population increased, so we had to add a well – but the water was often salty,' she says. 'Now we have help from UNICEF and we are very happy with the rainwater tanks. Every house has one, so we rarely have to go to the well.'

The rain clouds are beginning to gather over the island and suddenly it starts to pour. Children run out of their homes to wash their faces, splash and play in the puddles. In this part of Indonesia, a rainy day is not a day to stay indoors.

■ **About the author:** Suzanna Dayne is UNICEF correspondent in Indonesia.

Water security will soon rank with other main security concerns. The world community must elevate the issue of water for peace policy. As the demand for freshwater grows and in the absence of clear consensus on how best to use shared water resources for the benefit of all, that competition can create severe disputes.

The Third Pole – Hindu-Kush Himalaya narrative

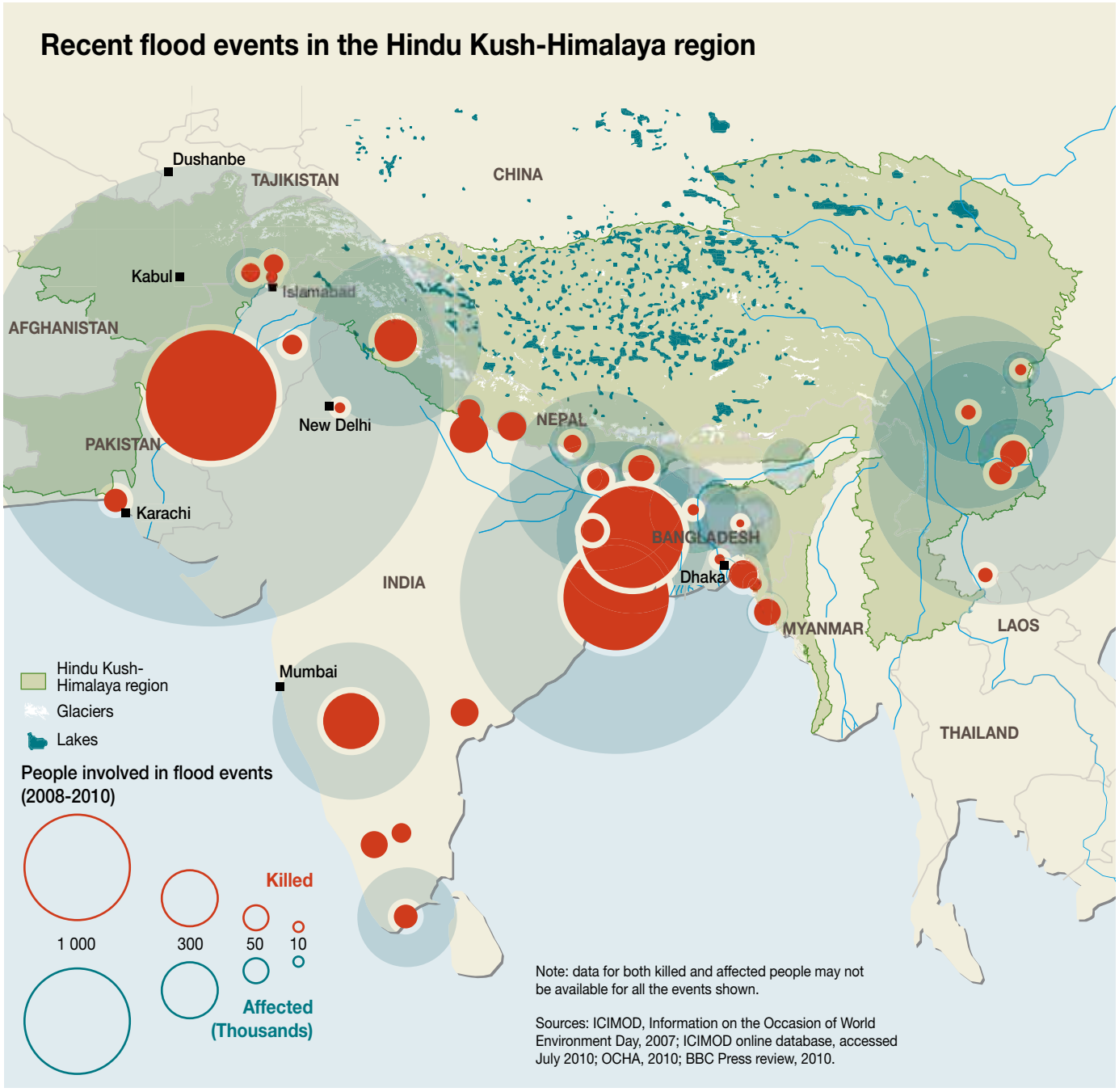
By ***Lawrence Hislop***

The Hindu-Kush Himalaya (HKH), sometimes referred to as the 'Third Pole', is one of the most dynamic and complex mountain systems in the world. It contains the largest amount of snow and ice found outside the Polar regions, including more than 100 000 square kilometres of glacier cover, and the sources of ten of the largest rivers in Asia. This mountain system, stretching 3 500 kilometres through some of the world's wettest and driest environments, rising eight vertical kilometres through nearly every life zone existing on Earth, and at the geographical centre of the largest and densest concentration of humanity, is recognized as an extremely fragile environment and particularly vulnerable to global warming.

Potential impacts of climate change

Uncertainties about the rate and magnitude of climate change and potential impacts prevail, but there is no question that climate change is gradually and powerfully changing the ecological and socio-economic landscape in the Himalayan region, particularly in relation to water and ecosystem services, with significant implications for mountain communities and livelihoods, as well as downstream users, including women. Ultimately the changes that take place in the mountains impact the availability of resources downstream.

In the mountain areas the influence of changing climate has to be understood in the overall context of change due to modernization (communications, transport, infrastructure, monetization, etc.) and migration, both of which affect traditional cultural patterns and gender relations. Climate change is one among many other drivers of change, which also need to be taken into account. Moreover, it has to be recognized that climate change, while exposing the region to severe adverse impacts, may also create opportunities, which need to be identified and leveraged.



Poor and marginalized groups such as mountain populations, particularly women, are vulnerable to climate change. *Lawrence Hislop*

Extreme vulnerability to natural hazards among countries in South Asia is cyclical and repeatedly causes major setbacks in the socioeconomic and equitable development of the region. According to UN estimates major disasters may cut the GDP of countries in the region by up to 20 per cent. Climate change is expected to increase both the frequency and magnitude of hazards leading to disasters. It calls for speedy action to help communities cope with such large-scale disturbances.

Mudslides and unstable ground induced by floods (see figure above) are serious threats to low-income settlement areas. The rough topography of the Himalayas combined with the precariousness of many homesteads, due to low incomes, makes the region a particularly flood-sensitive area. Moreover, the risks of death and destruction are increased by the fact that people, after floods, often rebuild on the same risk-prone areas.

Implications for human well-being

Climate change impacts in the HKH region are particularly severe due to the large number of people depending on climate-sensitive livelihoods such as agriculture. Here, more than 20 per cent of the population live below the poverty line, amounting to around 260 million people. Recent studies conclude that the Himalayan region and its downstream areas, including the Indo-Gangetic plains, the grain basket of South Asia, are also particularly vulnerable to climate change. More than 1.3 billion people live downstream from three of Asia's major rivers and these people are strongly dependent on agriculture for their livelihoods.

Poor and marginalised groups such as the mountain populations and inhabitants of downstream flood plains are particularly vulnerable to climate change. Mountain livelihoods are much more susceptible to environmental and economic change than are livelihoods in the plains. Poverty in the mountains is exacerbated by climate change. Women are often more exposed and vulnerable to the impacts of climate change and environmental degradation. From a poverty-reduction perspective, coming to grips with the expected increase in climate-induced disasters is an important step towards being prepared to face it.

■ **About the author:** Lawrence Hislop is Head of the Polar Programme at UNEP/GRID-Arendal.

Millennium Development Goals and water

In 2000 governments committed to a wide range of Millennium Development Goals (MDG) that rely upon access to water. They also made a specific commitment to halve the number of people without access to clean water and adequate sanitation by 2015.

The 2010 update on progress towards the water-specific goals reports that 884 million – nearly 1 billion people – lack access to clean drinking water. When it comes to sanitation, 2.6 billion people do not have access to improved sanitation services. One in seven of those people without access to adequate sanitation services live in rural areas (WHO/UNICEF 2010).

At the current rate of investment progress, the Millennium Development Goals for sanitation will be missed by 1 billion people. Most of these people live in sub-Saharan Africa and Asia. Significant progress has been made in India and China (WHO/UNICEF 2010).

Economic impacts of poor sanitation

Together, Cambodia, Indonesia, the Philippines and Vietnam lose an estimated US$ 9 billion a year because of poor sanitation (based on 2005 prices). This amounts to around 2 per cent of their combined GDP, varying from 1.3 per cent in Vietnam, 1.5 per cent in the Philippines, 2.3 per cent in Indonesia and 7.2 per cent in Cambodia. The annual economic impact of inadequate sanitation is approximately US$ 6.3 billion in Indonesia, US$ 1.4 billion in the Philippines, US$ 780 million in Vietnam and US$ 450 million in Cambodia. In these four countries, the total value of this impact is US$ 8.9 billion per year. In 1991 a cholera epidemic swept through most of Peru and cost US$ 1 billion to control.* If one-tenth of this amount (US$ 100 million) had been spent on providing sanitation services, the epidemic would not have occurred.

*The epidemic also spread into several other countries in South, Central and North America.
Source: World Bank, Water and Sanitation Programme (2008) and Tropp (2010) in UNEP (2011) Green Economy Report.

Water – Investing in natural capital

From Chapter 3, Water, Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication (UNEP 2011). Available at www.unep.org/greeneconomy

Over the past two years the concept of a green economy has moved into the mainstream of policy discourse. Heads of state and finance ministers increasingly speak about the green economy; it is referred to in the text of G20 communiqués and discussed in the context of sustainable development and eradicating poverty.

UNEP's green economy report, Towards a Green Economy, aims to debunk several myths and misconceptions about "greening" the global economy, and provides timely and practical guidance to policy-makers on what reforms they need to unlock the productive and employment potential of a green economy. Perhaps the most prevalent myth is that there is an inescapable trade-off between environmental sustainability and economic progress. There is now substantial evidence that the greening of economies inhibits neither wealth creation nor employment opportunities. On the contrary, many green sectors provide significant opportunities for investment, growth and jobs. For this to occur, however, new enabling conditions are required to promote such investments in the transition to a green economy, which in turn calls for urgent action by policy-makers.

Key messages in the water chapter

Water, a basic necessity for sustaining life, goes undelivered to many of the world's poor. Nearly 1 billion people lack access to clean drinking water; 2.6 billion lack access to improved sanitation services; and 1.4 million children under five die every year for lack of access to clean water and adequate sanitation services. At the current rate of investment progress, the Millennium Development Goal for sanitation will be missed by 1 billion people, mostly in sub-Saharan Africa and Asia.

The existing inadequacies in provision of water and sanitation services generate considerable social costs and economic inefficiencies. When people do not have access to water, either large amounts of their disposable income have to be spent on purchasing water from vendors or large amounts of time, in particular for women and children, have to be devoted to carting it. This erodes the capacity of the poor to engage in other activities. When sanitation services are inadequate, the costs of water-borne disease are high. Cambodia, Indonesia, the Philippines and Vietnam, for instance, together lose about US$ 9 billion a year because of poor sanitation – or approximately two per cent of combined GDP. Access to reliable, clean water and adequate sanitation services for all is the foundation of a green economy.

Continuing current practices will lead to a massive and unsustainable gap between global supply and demand for water withdrawal. This is exacerbated by failure to collect and treat used water to enable subsequent uses. With no improvement in the efficiency of water use, water demand is projected to overshoot supply by 40 per cent in 20 years time. Historical levels of improvement in water productivity, as well as increases in supply (such as through the construction of dams and desalination plants as well as increased recycling) are expected to address 40 per cent of this gap, but the remaining 60 per cent needs to come from investment in infrastructure, water-policy reform and the development of new technology. In the absence of such investments or policy reforms, water crises will be even more serious.

The availability of an adequate quantity of water, of sufficient quality, is a service provided by ecosystems. The management of, and investment in, ecosystems is therefore essential to address water security for both people and ecosystems in terms of water scarcity, the over-abundance of water (flood risk) and its quality.

Accelerated investment in water-dependent ecosystems, in water infrastructure and in water management can be expected to expedite the transition to a green economy. Modelling suggests that, under the green investment scenario, global water use can be kept within sustainable limits and all the MDGs for water achieved in 2015. With an annual investment of US$ 198 billion on average over the next 40 years, water use could be made more efficient, enabling increased agricultural, biofuel and industrial production. By 2030 the number of people living in a water-stressed region would be four per cent lower than under 'business-as-usual' conditions and up to seven per cent less by 2050.

When investment is coupled with improvements in institutional arrangements, with entitlement and allocation systems, more extensive payments for ecosystem services, and improved water charging and funding arrangements, the amount which needs to be invested in water can be significantly reduced. Moreover opportunities to improve water management are being undermined by a significant proportion of water management policies and measures in other sectors, such as input subsidies. Resolving global water supply problems is heavily dependent upon the extent to which agricultural water-use can be improved. Irrigated land produces 40 per cent of the world's food and, as populations grow, a significant proportion of this water will need to be transferred to urban, commercial and industrial uses.

The five key dimensions of water security: indices and analysis

Key dimension 1: household water security
Measured by access to water supply and sanitation services across rural and urban communities and all income groups, with additional research in selected countries on sustainability and new indicators explored for peri-urban and rural areas.
Key dimension 2: economic water security
Measured by efficiency and productivity of the major water-using sectors: agriculture, industry, and energy, with new indicators explored for allocative efficiencies to sustain security.
Key dimension 3: urban water security
Measured by supply efficiency, water-treatment technique, storm drainage and public involvement, with new indicators explored in a 'water sensitive city' framework.
Key dimension 4: river health
Measured as the capacity of river basins to maintain their functions and services under pressure and threat from pollution and land-use change, with new performance indicators explored for river basin stewardship.
Key dimension 5: water resilience
Measured by risk and resilience from water-related disasters – floods, droughts, windstorms and storm surges – with new indicators explored for adaptive capacity.
Water Security Index
Measured as an aggregate of the five key dimensions, with sub-regional comparison and hotspot analysis, and additional applications explored for cities, river basins and regions.

Source: Asian Development Bank
http://www.adb.org/Documents/Brochures/Water-Brief/awdo-a-preview.pdf
See also the article on Asian Water Development Outlook 2011 on page 18-19.

Micro-scale infrastructure provision in Western Jakarta

In Jakarta, Indonesia, a significant proportion of the population lives in informal settlements. While the government does not want to legitimize the unlawful occupation of land, it realises that access to safe water and sanitary conditions is necessary. A private water utility, PALYJA, is responsible for the water supply in Western Jakarta and is expected to supply water to all residents, including those in informal settlements. To this end, PALYJA has a water-supply contract with the government whereby it is paid for the cost of delivering water to users, and for building and maintaining the necessary infrastructure.

As part of this process, PALYJA is trialling the provision of access to groups of informal houses by establishing community-based organisations. Each organisation is given access to a single master water meter and is responsible for the management of the community's water-supply infrastructure as well as paying for the volume of water taken. MercyCorps has helped connect 38 households to a single meter, while USAID's Environmental Service Programme (ESP) has brought 58 households together. Once established, the community signs a supply contract with PALYJA, with a special tariff arrangement to account for the fact that many households are using a single meter. Under this arrangement, both sides benefit: the community gets reliable access to an affordable waste supply, while PALYJA supplies a large number of houses with water at much lower overhead and administrative costs.

Source: Fournier *et al.* (2010) in UNEP (2011) Green Economy Report

Recent experience of private companies providing water to households

The Phnom Penh Water Supply Authority in Cambodia has seen major changes between 1993 and 2009. The number of connections increased seven-fold, non-revenue water fell from 73 per cent to 6 per cent, collection efficiency rose from 48 per cent to 99.9 per cent, and total revenues increased from US$ 300 000 to US$ 25 million, with a US$ 8 million operating surplus. After receiving initial grants and soft loans from international financial institutions, the utility is now self-financing. Tariffs increased steeply in the early years, but they have been held constant at around US$ 0.24 per m^3 since 2001, because the combination of service expansion, reduced water losses and high collection rates has guaranteed sufficient cashflow to cover debt repayment and capital outlay.

Balibago Waterworks Systems serves around 70 000 customers in a rural area of the Philippines. The business has grown by reaching out to adjacent towns and villages and asking each community if it would like Balibago to build a network to supply them with piped water. When Balibago does this, it begins by showing the community its regulated schedule of tariffs. The community is then asked whether it wants access to piped water and is prepared to pay the scheduled price for access. Balibago has found that in many cases communities, which might previously have relied on hand pumps and wells, now see this as an attractive proposition. It makes good sense for the company's investors too.

Source: Adapted from Global Water Intelligence (2010)

Water supply in Asia in the future

Climate change, melting glaciers, contaminated water and water intensive industry and agriculture are some of the threats to water security in Asia in the future. But action is taken in local communities, by nations and regions. What is being done, to bring about a more sustainable future for water supply in Asia?

Climate-proofing wastewater treatment facilities is necessary in the face of climate change. Manila Water Company, Inc., one of the two private concessionaires in the Manila metropolitan area, built an elevated facility to counter increased threats from flooding and overflowing rivers. *Steve Griffiths*

Revolutionising wastewater management in Asia-Pacific

By ***Maria Corazon Ebarvia*** *and* ***Anand Chiplunkar***

Parts of this article were first published in the Asian Development Bank online water e-newsletter for April 2011 and September 2011 (http://www.adb.org/Water/enewsletter.asp?tab=2011#archive)

Many Asian and Pacific countries suffer from both the greatest lack of water and the poorest quality. Some 477 million people in the region have no access to a safe water supply, and 1.8 billion people have no access to improved sanitation, according to the 2010 Joint Monitoring Report.

Most Asian cities also lack the infrastructure to collect, treat and dispose of wastewater properly. Open defecation, lack of improved sanitation, and inadequate wastewater management systems pollute the same water bodies that we use for drinking, fishing, bathing and swimming. The Asian Development Bank's (ADB) Water Operational Framework consequently highlights expanded wastewater management and reuse, including hygiene sanitation, as one of the solutions to avert the water crisis in Asia.

Promoting a change of mindset for a sanitation revolution

The sanitation and wastewater challenge is a threat to sustainable development. Although there are opportunities to make sanitation investments sustainable, taking advantage of favourable circumstances, a sanitation revolution is nevertheless needed with a complete change of mindset. At present good sanitation polices are being held back by lack of investment, poor operation and maintenance, coupled with the view that investing in sanitation and wastewater management is a dead end. A shift can be achieved by reducing costs through efficiency gains, by recovering biogas and using it to meet most of the operational power requirements of treatment plant, and by boosting revenue through recovery of nutrients and productive use of biosolids.

ADB has proposed a Regional Capacity Development Technical Assistance scheme to promote an Asia-Pacific wastewater management revolution. It aims to speed up wastewater investments by disseminating examples of existing sustainable projects (knowledge drive); promote technology options for different applications and end products (technology drive); develop business briefs for sustainable investment opportunities in typical existing environments in Asia (financing and incentives drive); and raise awareness through advocacy not only to develop capacity but also to organize meetings for all stakeholders to give substance to identified business opportunities.

There are beacons of hope shining from initiatives, large and small, in small villages and major urban centres. The Second ADB – Developing Member Countries and Partners Sanitation Dialogue (held in Manila on 23-25 May 2011) showcased working models for household and environmental sanitation, and demonstrated ways to turn the sanitation challenge around.

It is critical to move away from high-energy solutions, or no treatment at all, towards something

Enabling conditions, such as supporting an economic regulatory framework (ensuring collection of user fees and a fair return on investment), and a Supreme Court decision requiring all related government agencies and utilities to clean up Manila Bay, have spurred investments in sewerage, wastewater and septage management. Private concessionaires in the Manila metropolitan area are investing millions of dollars to increase coverage and improve the water quality of rivers and the bay. *Steve Griffiths*

Constructed wetlands are a cost-effective wastewater treatment option, especially in per-urban and rural areas where land is available but capital may be a constraint. At Bayawan, a second-class component city, the local government raised funds to build and operate a reed-bed system in a coastal village. The treated wastewater is stored to supply water for gardens in the village and for fire-fighting. *Steve Griffiths*

affordable and doable. Many local governments are turning towards decentralized wastewater and sludge treatment facilities, which offer more operationally effective solutions. Constructed wetlands, reed beds and duckweed systems also provide low-cost treatment. Treated wastewater from these systems is used for flushing toilets, watering plants, irrigation and fire fighting, with savings on water bills.

A significant factor in successful public-private partnership projects is the enabling environment and economic regulatory framework provided by government, which reduces investment risks. In the Philippines private concessionaires will be investing about US$ 2 billion to improve environmental sanitation in the Manila metropolitan area, even without government subsidy. These companies have also treated septage, sludge and biosolids, turning them into organic soil-conditioners. In Surat, India, domestic wastewater will be treated and sold for industrial use by a concessionaire. This will allow recovery of costs, improve water quality and augment water supply.

Biogas digesters connected to toilets supply energy for lighting and cooking in many rural areas in the region. Safe fertiliser from eco-san toilets has turned some farmers into entrepreneurs.

Examples that have allowed households to gain access to improved sanitation include: innovative financing mechanisms as an incentive for households to invest in on-site sanitation systems and cities to invest in wastewater management systems; the socialized corpus fund in Orissa, India; a microfinancing and revolving fund in central Vietnam; a revolving credit pool scheme in Sri Lanka; output-based aid in Nepal; and emerging social financing schemes across Asia. To make sanitation more viable, user fees are now being levied in cities in China, Malaysia, Philippines and Vietnam. Wastewater treatment facilities can earn income by generating energy as well as from carbon credits through the Clean Development Mechanism. ADB has also developed mechanisms, such as the operational support fund in Pakistan and viability gap fund in Kyrgyzstan, to allow utilities to recoup costs and become a sustainable business.

Achieving sustainable sanitation

These success stories are still outweighed by the challenges that remain. The need for effective and lasting partnerships and collective efforts is increasingly urgent. The Sanitation Dialogue, in Manila on 23-25 May 2011, emphasized the need for public-sector decision-makers to work outside traditional silo-based approaches. Several key messages stand out in the Dialogue for implementing the Asia Wastewater Management Revolution. It is essential to obtain commitments from political leaders and finance ministries to prioritize sanitation investments. The socioeconomic and environmental costs of inaction on sanitation must be brought home to policy-makers and those who allocate budgets. Benefits derived and lessons learned are available from countries which have adopted national and/or city sanitation policies and strategies.

It is time to move away from traditional business methods. Sanitation does not end with the provision of household toilets, but includes wastewater collection, treatment, disposal and/or reuse, and maintenance of assets. Public and private-sector utilities alike must adopt a corporate approach to service delivery. Governments must introduce the necessary regulations and institutional arrangements, to reduce risks and cover operating and maintenance costs.

Wastewater management can make a substantial contribution to water security, as well as food and energy issues. Wastewater must be seen as a resource with potential financial returns – from augmenting water supply for irrigation, power cooling, industrial and non-potable uses to producing fertiliser and energy – and opportunities for green employment.

It is vital to raise public awareness and mobilise the community. Stakeholder consultations, involvement and partnerships are critical to overcome taboos and achieve success by motivating communities, creating demand for improved sanitation and building consensus on solution options.

Nor should the link between technology, and political and social knowledge be overlooked. Technology options are not widely known. The lack of capacity to select appropriate technologies and apply them to local conditions has resulted in either political indifference or failed projects. For many Asian cities, solutions can be implemented in phases over time, both in terms of upgrading and rolling out new systems to provide greater treatment and coverage. Circumstances vary from one area to the next, providing an opportunity to try a range of solutions.

Public funds must be optimized, with consideration for targeted subsidy schemes. Public-funded support should supplement sanitation markets, not replace them. Government incentives should be better geared to private-sector requirements, especially for long-term investments. Costs can be recouped through innovative financing mechanisms. The poor are willing to pay, if they are given affordable, flexible payment terms.

Capacity must be developed, particularly at local level. Such development – in sewage treatment and proper reuse, packaging bankable projects, procurement, asset management and contract management – is essential to the short-term success and long-term sustainability of sanitation improvements.

The Sanitation Dialogue revealed real, ongoing developments, which prove that household sanitation, wastewater management and reuse are economically and financially rewarding, and debunk the assumption that sanitation is an investment dead-end. In a changing world, innovative approaches and new currents of thought offer alternative avenues for decision-makers to explore. Thus, with enough attention and action from policy-makers, and financial movers and shakers, Asia may well be on its way to a wastewater management revolution.

■ **About the authors:** Anand Chiplunkar is principal water supply and sanitation specialist, and Maria Corazon Ebarvia is a sanitation and wastewater management specialist at ADB.

Asian Water Development Outlook 2011, a preview

By ***Wouter Lincklaen Arriens***

ADB

The forthcoming Asian Water Development Outlook 2011 will, for the first time, provide a comprehensive quantitative and analytical view of the current state of water security in the countries of the Asia-Pacific region. Targeted to ministers of finance and planning, the document will provide guidelines for investment with better governance to increase water security in the years to come.

The Outlook, preceded by the inaugural edition in 2007, was commissioned by the Asian Development Bank (ADB) and the Asia-Pacific Water Forum (APWF), in advance of the second Asia-Pacific Water Summit in February 2012 in Bangkok, Thailand.

Five key dimensions of water security

Ten of Asia's leading knowledge centres have joined the collaborative team effort to produce the Outlook, with input from advisers in all five sub-regions. In 2009 this team released their guiding vision for water security. 'Societies can enjoy water security when they successfully manage their water resources and services to:

- satisfy household water and sanitation needs in all communities;
- support productive economies in agriculture and industry;
- develop vibrant, liveable cities and towns;
- restore healthy rivers and ecosystems; and
- build resilient communities that can adapt to change.'

These five dimensions listed above depend on better governance. With better governance come better prospects of prosperity and lower poverty, greener growth, and resilience to the unprecedented transformations unfolding in the region, including climate variability and change.

The kind of governance needed to guide investments, however, is not much in evidence in the region. The Outlook aims to inspire finance and planning leaders. The economic and social rationale for pursuing water security is strong and concerns everyone from households and communities, through business sectors and cities, to river basins and increasingly integrated sub-regions. Water security is vital for food and energy security, and for more efficient industry and agriculture.

A preview of findings and recommendations

Findings and validations have been collected from this first step in quantifying the region's water security levels. Three key findings and recommendations are previewed here. They were presented to the Water Crisis and Choices Conference at ADB Headquarters in October 2010.

Pervasive inequity holds back household water security

Official figures are not telling the whole story of increased access to water supply and sanitation services as part of the Millennium Development Goals. Where improvements are achieved, they are often not provided equitably. Urban and upper classes are connecting to services at a much higher rate than rural and poor households. As a result, programmes that aim, but fail, to deliver drinking water and sanitation facilities to poor households can actually exacerbate the social injustice that still characterizes many cities and villages. There are also doubts about the sustainability of the services on offer and their real impact on households' social development. For example, if poor sanitation is not addressed, it cancels out many of the benefits from access to a clean, readily available water supply.


ADB

The social and economic returns on investments in water supply and sanitation services are huge and compelling. At household level, every US$ 1 earns up to US$ 46 in benefits to a poor family. For local and national economies, the savings from health care costs and gains from productivity, investment and competition are well documented. Without strategic governance to boost investments, increase social capital and human resources, and ensure connectivity in 'the last mile', the crisis of inequitable and unsustainable services will deteriorate. Leaders already have good, proven examples from within the region which show what can be achieved with the right mix and level of investments, and smart governance.

The poor state of many rivers threatens economic prosperity

Poor river health is a legacy of more than a century of development practices, which have failed to protect the integrity of natural and human systems in the region's river basins. Water pollution affects the economies, livelihoods, and health of people in unprecedented ways. Research shows that 80 per cent of the region's rivers are polluted or otherwise compromised by unsustainable growth. Economic development, urbanization and climate change will exacerbate the challenges facing river-basin management in the coming decade.

Most countries in the region have already adopted policies and legislation to foster integrated water resources management (IWRM) in river basins. Choices must now be made, supported by investment and better governance, to use IWRM processes in river basins to deliver balanced economic, social, and environmental results. To reduce pollution, nothing short of a 'wastewater revolution' will produce the necessary results. This

revolution calls for investments, incentives to promote the right technologies, and better governance. Leaders can draw inspiration from within the region to mobilise human and financial resources to transform their rivers; and in so doing, protect their economies, livelihoods and people.

High disaster risk and low resilience sap economic development.
The Asia-Pacific region experiences more disasters than any other region in the world. Rapid growth, urbanization, environmental degradation and climate change have brought new risks to the region's water security. Several countries, especially Pakistan and many Pacific island states, exhibit a high risk and low resilience to water-related disasters. Climate variability and change are expected to create even more hotspots in the region.

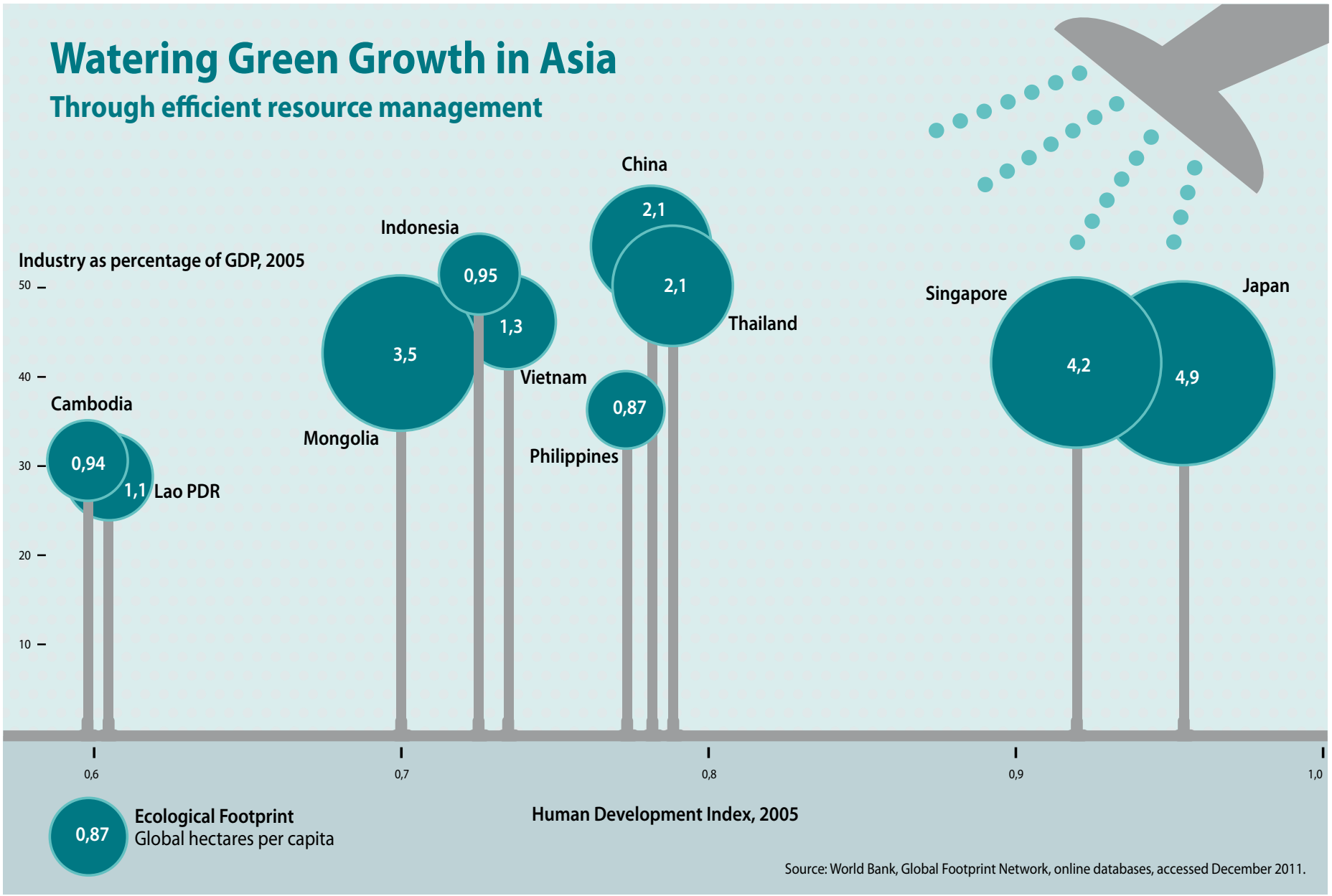
The region's leaders have already agreed to the Hyogo Framework of Action (2005–15). Physical risks can be managed through a combination of structural and non-structural solutions. Financial risks can be managed through pre-arranged agreements that allow governments to respond swiftly, such as catastrophe reserve funds and catastrophe bonds. Credit for livelihood diversification, structural measures and early warning systems will help communities build their own ability to mitigate, adapt and recover quickly from water-related hazards and disasters.

A repository of research and perspectives
The Asian Water Development Outlook 2011 will offer a wide range of findings and recommendations covering all key dimensions of water security, illustrated with case studies from across the region, and supported by an extensive bibliography. The print publication will be supplemented by a DVD and a website. Plans are being made to transform the current research into a full-time regional programme to support leaders in the Asia-Pacific region for the years to come.

Contributors: Assisting the author, Ravi Narayanan, Vice-Chair of the Asia-Pacific Water Forum Governing Council is co-chairing the team producing the Asian Water Development Outlook 2011. Ramesh Ananda Vaidya, Senior Adviser at the International Centre for Integrated Mountain Development (ICIMOD), is the lead writer for the main report. More information is available on www.adb.org/water.

■ **About the author:** Wouter Lincklaen Arriens is Lead Water Resources Specialist at ADB, and is co-chairing the team producing the Asian Water Development Outlook 2011.

*See also the box about the five dimensions of water security on page 15.



Resource Efficiency: Economics and Outlook for Asia Pacific – Water

Report published in September 2011

While the Asian and Pacific region strives for further economic growth, the region faces some of its toughest development challenges in the coming decades. Population growth, changing water regimes and climates, and rising demand for energy, water and other basic necessities are likely to intensify over the next few decades.

In the forthcoming Resource Efficiency Economics and Outlook for Asia Pacific, produced by the United Nations Economic and Social Commission for Asia and the Pacific, Chapter 4, Water, explores trends in water withdrawals in various sectors of the region in the past, and predicts future trends. Some of the findings are presented here.

Water use across Asia and the Pacific
The report outlines the important factors impacting water resources in the Asia-Pacific region. In particular it looks at natural resource endowment; pollution; increased water usage; changing patterns of consumption; water extraction rates; ecological efficiency of water use; and long-term sustainability of water supply.

Many countries have been extracting water in an unsustainable manner by withdrawing more water per year than is available from renewable sources. The situation is serious in Central Asia, particularly in Uzbekistan, Turkmenistan and Tajikistan. These countries are already withdrawing more water per year than is available from renewable sources. In South Asia, Pakistan, India and Sri Lanka have also seen a large surge in extraction. In North East Asia large volumes of withdrawals indicate that China has also been extracting water rapidly.

Agriculture takes a big percentage of the water withdrawals in the region (81.5 per cent of annual water withdrawals from 1998-2002). Central Asia had the largest water-intensity value for agricultural use at 18 315 litres per US$, coupled with the lowest productivity. Central Asia was using 63 per cent of total renewable water resources, more than twice the extraction of the other sub-regions (1998-2002).

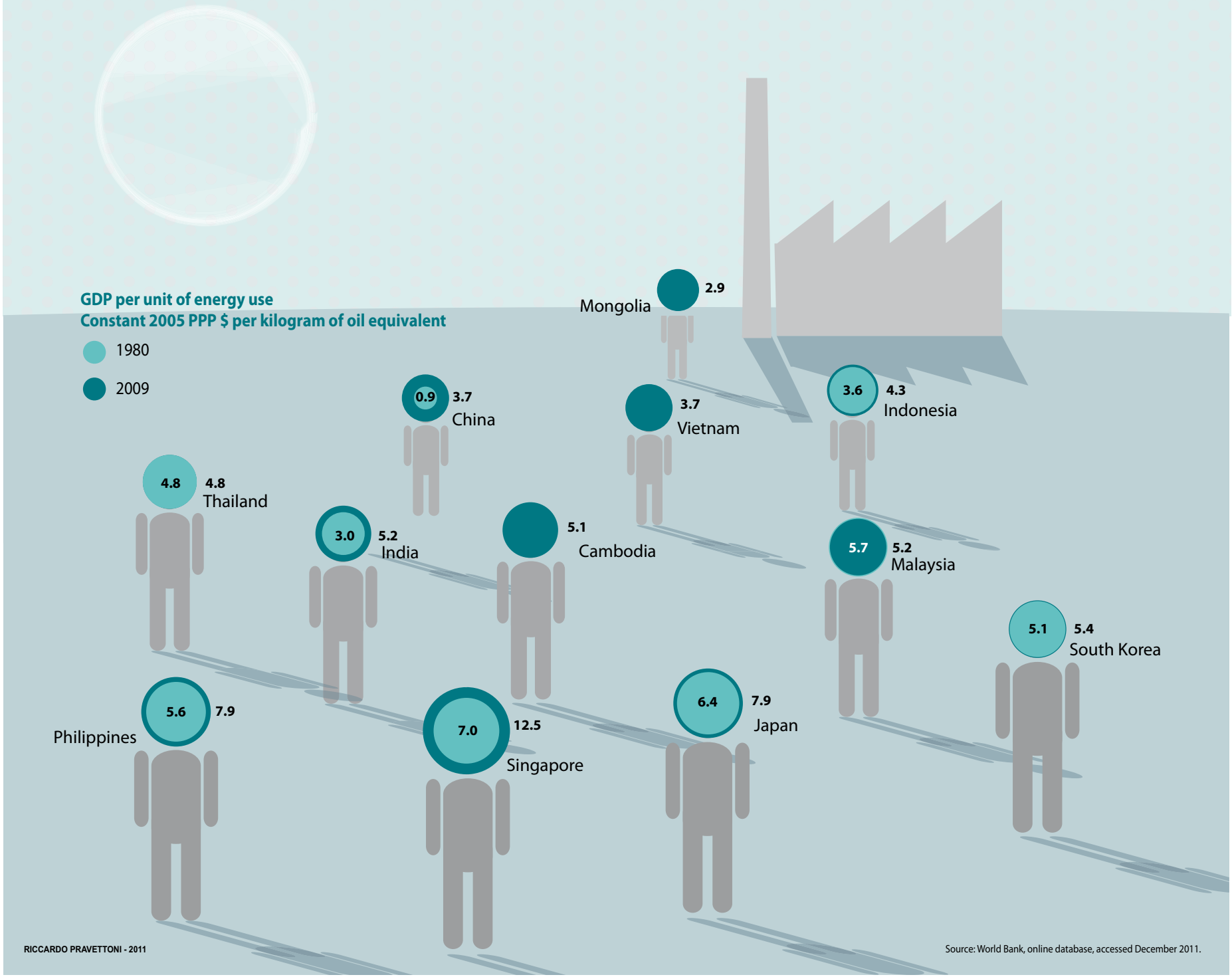
Emerging trends
Water withdrawals are predicted to decline in developed nations but rise in their developing counterparts, further increasing pressure on water resources. By 2025 demand for water withdrawal is set to rise by a factor of 1.3 in agriculture, 1.5 in industry and 1.8 for consumers.

An unsustainable trend is emerging in the region with increasing water withdrawals leading to over-extraction. The situation is serious in Central Asia, South Asia and increasingly so in North East Asia. In particular Central Asia is experiencing serious challenges related to water use, with the highest extraction for agriculture in the region. Central Asia also has the highest extraction per capita, and the lowest rate of water efficiency and productivity for the region.

A need for international and cross-sector collaboration
Today many river basins are already under stress, complicated by strong competition for scant water resources between households, industry and agriculture. All sectors are expected to increase requirements for water withdrawal in the future. Consequently, many of the world's transboundary river basins will be stressed or highly stressed, and the competition for these resources will cause ongoing tension between nations. These transboundary water issues should be addressed in an equitable and transparent manner using a negotiated international process.

Moving towards a low carbon green growth

Energy efficiency in Asia selected countries



Dear reader,

Clean, safe and accessible water for all is essential for a healthy life, livelihoods and communities everywhere. Water Management and Resource Efficiency for Green Growth in East Asia is the focus for the 7th issue of the Environment & Poverty Times. GRID-Arendal has been working with UNEP Regional Office for Asia and the Pacific to identify inspiring examples and stories implemented by individual business, communities, governments and organisations in the region.

The last decades have taught us that due to a lack of sustainability perspectives in economic development or poor infrastructure, every year millions of people die from diseases associated with inadequate water supply, sanitation and hygiene. Clean freshwater resources are depleted or are inaccessible resulting in water scarcity, poor water quality and inadequate sanitation. By 2050, at least one in four people is likely to live in a country affected by chronic or recurring shortages of freshwater – many of them in South and East Asia.

This issue of Environment & Poverty Times features stories about water management, policies, and practices for clean technologies to trigger a Low Carbon Green Growth path in South and East Asia.

You can read snapshots of inspiring cases highlighting themes such as water footprint, the use of water for industrial purposes, water pollution and community based initiatives. Stories show that significant gains can be made by introducing measures for efficiency and green growth, whilst building resilience and supporting more sustainable livelihoods and reduce poverty.

Environment & Poverty Times aims to be of interest not only to professionals working in the area of sustainable development, but also to the general public. By providing stories, interviews, maps, charts, and pictorials it attempts to demonstrate some of the potential wealth of perspectives and initiatives in the region.

If you want to read this or previous issues of the Environment & Poverty Times on the net, please stop by at http://www.grida.no/publications/et – and tell your friends!

Enjoy reading!

Environment & Poverty Times No. 7

Published by GRID-Arendal
The UN House, Teaterplassen 3
PO Box 183
N-4802 Arendal
Fax: +47 37 03 50 50
www.grida.no
grid@grida.no

Chief Editor: Anne Solgaard
Editorial team: Rannveig Rivedal Nilsen, Janet Fernandez Skaalvik (GRID-Arendal), Stefanos Fotiou, Tunnie Srisakulchairak (UNEP Regional Office for Asia & the Pacific)
Editorial support: Laura Carlon, Sahon Flan
Copy editors: Harry Forster and Sheila Carrodus, Interrelate, Grenoble
Editorial Committee: Le-Huu Ti (UN Economic and Social Commission for Asia and the Pacific), David Molden (ICIMOD), Ermina Sokou (UN Economic and Social Commission for Asia and the Pacific), Michael Rock (Bryn Mawr College)
Cartography: Riccardo Pravettoni
Illustrations: Nieves Lopez

Special thanks to all contributors without whom this work would not have been possible.

Printed at Agderposten Trykk, Norway
February 2012. 6,000 copies

Also available online at
www.grida.no/publications/et/ep7

This publication was prepared as an outreach activity under East Asia Climate Partnership (EACP), which is South Korea's international development-cooperation project. Through the partnership with developing countries, it aims to share the green growth paradigm to the Asian region in order to have sustainable development while coping with climate change.