WATER & GREEN GROWTH

CASE STUDIES FROM ASIA AND THE PACIFIC

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CONTENTS

Forward	6
Integrated Urban Water Management: The Development of Beijing's Water Resources Management Approach	8
Innovating Pollution Control and Industrial Symbiosis to Realise China's "Circular Economy"	11
Water-Energy Nexus: Water Efficiency Interventions in Thermal Power Plants in India	14
Improvement of Flood Early Warning Systems: The Brantas River Basin Experience	17
LAO PDR's Urban Water Supply & Sanitation Strategy	18
The N-Park Condominium Water Saving Project: Stakeholder Engagement for Better Urban Water Management	20
Institutional Building and Policymaking for Water and the Environment	23
Water for Agriculture: A Case of South Asia	26
Green Growth through Water Allocation Policy: The Philippine Experience	28
The Taehwa River Ecological Restoration Project	30
Water for Green Growth in Sri Lanka: Climate-Smart Agriculture for Women Farmers	32
Infrastructure Development for Tajikistan's Water Resources	34
Bang Kachao: Preserving Bangkok's "Green Lung"	36
Community Engagement for Sustaining the Bung Khong Long Wetland	39
Biotechnology for Improved Water Quality and Agricultural Industry Growth	42
Improving Water Resource Management in the Aral Sea Basin	44
Large-Field Production Zones: A Sustainable Rice Production and Water Management Model in the Mekong River Delta of Viet Nam	47

FORWARD

Water is vital to human lives, as well as fundamental to all development issues.

Asia and the Pacific are facing serious challenges both in terms of the quantity and quality of water in sustaining its long term economic growth prospects and achieving sustainable development.

In addition to the challenges related with quantity and quality, water related disasters also pose serious challenges for the region's economic growth where the Asia-Pacific region is the most disaster-prone region in the world where almost 2 million people were killed in disasters between1970 and 2011, representing 75 per cent of all disaster fatalities globally

Green growth is a new paradigm to sustain economic growth by investing in eco-system and natural resources including water. Green growth attempts to transform the way our economy produces and consumes by restructuring the visible and invisible structures of the economy. Water is a critical component of the visible structures of our economy and a natural capital.

A workshop co-organized by ESCAP and K-water, on "Water and Green Growth" was held on Feb 23rd- 25th 2015, in which case studies were presented by participants from ESCAP member countries. This publication on the said case studies is being prepared primarily for distribution at the 7th World Water Forum in Daegu and Gyeongju, Republic of South Korea, 12-17 April 2015.

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Integrated Urban Water Management

THE DEVELOPMENT OF BEIJING'S WATER RESOURCES MANAGEMENT APPROACH

Case study drafted from materials provided by Fu Sun, Asia-Pacific Centre for Water Security, China

In contemporary China, rapid population growth together with national modernization and industrialization have led to a water crisis of both quantity and quality, especially in rapidly developing urban areas. Therefore, it is imperative to apply Integrated Water Resources Management (IWRM) specifically in urban areas for better coordinated, responsive, and sustainable water management practices, i.e. Integrated Urban Water Management (IUWM).

Located in the Haihe River Basin, one of the most water-scarce regions in China, Beijing is a typical case of water-scarce, fast-developing megacities to study and understand China's IWRM practice. The per capita water resources of Beijing was 118.6 m^3 in 2013, less than one tenth of the national average of 2059.7 m^3, which itself was only about one third of the world average. Despite the rapid growth of population and economy, the annual total water demand decreased from around 4.0 billion m3 in the 1990s to around 3.5 billion m^3 in the 2000s, implying the decoupling of socio-economic development and water resources utilization.

Current Status

Beijing's mindset and philosophy for dealing with the relationship between socio-economic development and water resources utilization and protection has changed significantly since the 1980s. Local laws, regulations, standards, policies, plans and programmes since then have gradually built an enabling environment to harmonize this relationship and tailor urban development to water availability.

Managing pressure on water resources

A city's population and its socio-economic activities constitute fundamental drivers of pressure on water resources. Since the 1980s, Beijing has started to regulate its population size, industrial scale, and structure in its master plans, five-year development plans, and even in the local laws, i.e. the Urban Planning Regulation of Beijing in 1992. Control of population size has been on the government's agenda since then. However, population has always grown at a higher rate than expected. In 2009, Beijing's population reached 18.6 million, which is higher than the 2020 target, i.e. 18.0 million, in the master plan. Regulation over industrial scale, structure, and layout has contributed to the decline in agricultural and industrial water demand since the 1980s. To reduce water demand and pollution, a series of catalogues of industries, production processes, products and equipment have been released to guide investments. Since 2013, a comprehensive water impact assessment has become mandatory in parallel with an environmental impact assessment prior to official approval of any new development programme or project.

Improving water use efficiencies

Water conservation has been promoted in Beijing since the 1960s. The Interim Regulation on Groundwater Resources Management in Beijing issued in 1981 established water conservation facility requirements. Water quota management has been applied to set benchmarks for major industries regarding their water use efficiencies, and water-saving and pollution-reducing technologies have been promoted by the government through publishing annual technology catalogs. Water-saving devices have also been promoted by government regulations both in public institutions and households. Economic instruments have long been adopted to encourage water conservation. For example, household users water fees have been collected since the 1960s, and have been raised 10 times in the last two decades in Beijing. Tiered water pricing has been introduced for household users since 2014. While for non-residential users, a similar penalty charge scheme has already been working since the early 1980s.

Diversifying water supplies

Since the 1980s, water resources development has reached beyond the traditional domain of surface water and groundwater, and unconventional sources, such as reclaimed wastewater and harvested stormwater, have been explored in Beijing. Wastewater reuse was first required in hotels and public buildings in 1987, and rapid development of large-scale, centralized wastewater reuse through upgraded wastewater treatment processes has occurred since 2001. In 2013, reclaimed wastewater increased to 803 million m^3, accounting for 22.1% of the total water consumption of the year. Stormwater retention and utilization has been studied since the 1990s and many demonstration projects have been implemented since the 2000s. The *Interim Regulation of Promoting Stormwater Resources Utilization in Project Construction Areas* enacted in 2003 required stormwater utilization facilities be designed, built, and operated simultaneously with the main project. According to 2010 statistics, 1,355 rainwater harvesting projects have been completed and could utilize 50 million m^3 of rainwater each year. Besides maximizing the utilization of local water resources, the Middle Route Project (MRP) for the South-to-North Water Diversion Project, started at the end of 2003, went into operation recently in December 2014 and could supply 1.2 billion m^3 of water to Beijing annually. Before the operation of the full route, the Beijing-Shijiazhuang stretch had already diverted more than 1.6 billion m^3 of water from Hebei Province to Beijing between September 2008 and April 2014. In addition to this multi-source water supply system, Beijing listed seawater desalination and deep groundwater utilization as strategic technology solutions in *Beijing's 12th Five-Year Plan,* and underground reservoirs and a reserve system for water resources security were also proposed.

Despite the rapid growth of population and economy, annual total water demand decreased from approximately 4.0 billion m^3 in the 1990s to around 3.5 billion m^3 in the 2000s, implying the decoupling of socio-economic development and water resources utilization.

Protecting aquatic environments

Beijing started to tackle water pollution issues in the early 1970s. For example, the 1972 Interim Regulation on the Management of Water Conservancy Projects in Beijing prohibited the discharge of hazardous wastewater into surface water bodies if it was not treated or not compliant with required quality levels post-treatment. Later, the "polluter pays" principle was adopted in the early 1980s, while the "permits for discharge of pollutants" policy was implemented in 1997. In order to improve the quality of the water environment, Beijing promulgated its first Discharge Standard of Water Pollutants (Trial) in 1985, three years earlier than the national standard of its kind, and furthermore Beijing's local standards were generally more stringent than their national counterparts. At the regional level, a compensation mechanism for water environmental protection was also introduced in 2014, which requires the monetary compensation of districts and counties in Beijing for their failure in achieving the water quality

requirements at transboundary monitoring sections or their wastewater treatment objectives.

Strengthening institutional arrangements

Due to its political significance, Beijing's water issues were always discussed and tackled at the national level and with the direct coordination of the central government. For example, a task force comprised of top leaders from local governments and state ministries was established in 1973 to solve the water supply issues in Beijing, Tianjin and Hebei Province in response to the serious drought. In 2001, a high-level coordination task force for the sustainable utilization of water resources in Beijing was established. At the local level, Beijing created a Water Resources Commission (WRC) in 1982 to integrate the management of surface water and groundwater resources as well as urban flood defense. The WRC was reestablished in 2000 to examine and make decisions on the key policies regarding water resource development, utilization, protection, and conservation and perform coordination among districts and counties, sectors, and industries. Beijing's WRC was decommissioned in 2009; however, well before that in 2004, Beijing Water Authority (BWA) was established, which is now responsible for water resources planning and management, surveillance of water and wastewater industries, water conservation, management and protection of urban rivers, reservoirs, lakes, and dikes.

Meeting challenges

With the diverted water from the MRP, it is expected that Beijing's water scarcity will be alleviated. As compared to the current water demand, the original water demand forecast for the MRP, which finally determined the diverted water quantity for Beijing, is quite a bit larger. Given that water supply is greater than demand, Beijing is now standing at a crossroads regarding how to allocate surplus water - either to support further urban growth in population and industries or to rehabilitate local water systems.

Reclaimed wastewater has met more than one fifth of the total water demand of Beijing. However, intensive energy input is needed to reclaim wastewater, especially for high-quality use. Between 2005 and 2012, energy used for the whole water industry in Beijing increased by 85.2%, while the quantity of supplied water, treated wastewater and reclaimed wastewater increased by 10.3%, 80.2% and 1.89 times respectively. So wastewater treatment and reclamation may contribute to a large proportion of the increase in energy demand. Since energy is also needed to divert water from the south to the north, the configuration of Beijing's water resources system should be evaluated and optimized in consideration of a water-energy nexus.

According to the *12th Five-Year Plan for Beijing's Water Resources Protection and Utilization*, Beijing will recycle 75% of its treated wastewater, up to 1.0 billion m^3 each year, among which 0.44 billion m^3 will be used for stream and lake augmentation, and another 0.35 billion m^3 for agriculture. The wide variety of pollutants in reclaimed wastewater, e.g. endocrine-disrupting chemicals and antibiotics, however, constitute concerns about their impact on aquatic and agricultural ecosystems.

According to the 12th Five-Year Plan for Beijing's Water Resources Protection and Utilization, the diverted water from the MRP will replace groundwater to meet water demand in order to conserve and protect local aquifers, which would be reserved for emergency use. Therefore, it is expected that Beijing will continue its tight regulations over water resources and urban growth. Considering the multi-source configuration of Beijing's water resource system, it is necessary to schedule the supply from different sources and allocate the water to various users with different requirements on water quality in an integrated, dynamic, and adaptive way. Therefore, comprehensive research that takes into account supply and demand balance, water quality constraints, operation costs, water-energy nexus, health and ecological risk, and so on is needed. Furthermore, such research should not focus on Beijing only but take a watershed approach to address the hydrological connections among different regions as well as the Beijing-Tianjin-Hebei integration strategy. ■

Central Park, Suzhou Industrial Park

Innovating Pollution Control and Industrial Symbiosis to Realise China's "Circular Economy"

Case study drafted from materials provided by Alan Thompson, Sino-French Water, China

Three decades of double-digit growth in China have had serious, officially recognized environmental impacts of a magnitude that, by some estimates, is the equivalent of 3% of GDP in 2004 – some 500 billion yuan (more than US$80 billion). However, due to the prioritization of commercial growth, implementation of reforms to reduce pollution has been slow, and environmental frameworks and knowledge insufficiently developed. However, in recent years China has introduced innovative new industrial parks to integrate environmental considerations with expanded industrial development.

Moon Harbor Square West, Suzhou Industrial Park

To reduce pollution in cities, new policies were introduced mandating that the most polluting industries be concentrated within specialised industrial parks. Although these parks offered good pollution control infrastructures and financial advantages, the policies had little success until the publication of the government's 11th Five Year Plan (2006-2010). The Plan promoted a more balanced approach to development and the concept of a "circular" economy, leading to increased standards, better controls, and monitoring.

New industrial parks contribute to national development objectives by allowing industry to focus on their primary activities, while leaving pollution control and monitoring to centralised and specialised facilities.

New industrial parks allow industry to focus on their primary activities, while leaving pollution control and monitoring to centralised and specialised facilities.

China now has many of these new industrial parks, some at the municipal level, such as Shanghai Chemical Industrial Park (SCIP), and others with national status, including Suzhou Industrial Park (SIP) and TEDA Tianjin. New industrial parks reflect the dynamics of the present Chinese economy – accelerated production mixed with new populations demanding an ever-greater level of environmental protection. The case studies of SCIP and SIP are presented here, demonstrating improved approaches to pollution control and a new concept of industrial symbiosis, which contribute to greater industrial efficiencies and improved environmental performance.

Shanghai Chemical Industrial Park

Shanghai Chemical Industrial Park was created in 1999 with the aim of becoming one of the world's top ten petrochemical platforms. As a municipal industrial park, SCIP was the target of large quantities of investment to produce ethylene cracker. From the outset, the park has promoted five principles – production, logistics, utilities, environmental protection, and government management – among the park's industries for integration with naptha chemical processes.

The park currently covers some 30km^2 and has an annual turnover of US$17billion (2013). Fundamentally, the park's industrialists understand the need for investment in environmental protection to safeguard business reputations and achieve ideals of cost and profit. For new industries looking to invest in the park, the first step in the process, which is uniformly applied, is an environmental impact assessment (EIA). If the assessment determines that the pollution generated is too great or too toxic to be treated, the industry is not provided the opportunity to invest in the park. Next, a plan is developed including necessary investments in assets and equipment, a plan which is approved by government regulators before operations can begin. Subsequently, the bureau monitors pollution levels from industrial processes. All liquid effluent flows are concentrated and directed to a processing plant that is jointly operated by the Park Committee. The plant provides continuous 24/7 monitoring of all individual

discharges and throughout the treatment process. Contingency procedures are in place for highly toxic discharges or accidents. To remain in production, complete compliance is required by park industrialists. In addition to monitoring within the park, ocean water quality is tested in the vicinity of the plant outlet twice each year.

The Shanghai Chemical Industrial Park is also considered a model of "industrial symbiosis" where the output or waste of one process or factory becomes the input to another. It is one of the few parks designed to operate in this manner, and it is estimated that 70% of total industrial investments utilise these "eco-chains" effectively. There are of course limits on how far these chains can extend, and they are at times impacted by market fluctuations and legal barriers. Additionally, this type of integration is not without risk. A problem with one link of the chain will inevitably affect those downstream, creating a systemic issue.

Suzhou Industrial Park

At the national level is the case of Suzhou Industrial Park, which, from its beginnings in the mid 1990s as an industrial city, remains a model for integrated economic development, urban planning, and environmental protection. The park has an area of approximately 300km^{2,} incorporates three townships with a population of eight hundred thousand people, and hosts 10,000 companies.

The need to build a high quality environment for employees living and working in the park is seen as fundamental for attracting investment, providing high quality services, and assuring strict environmental controls. The equivalent of US$20 billion has been used to establish an efficient and highly integrated urban setting with all major residential, commercial, administrative, educational, university, and recreational aspects. Environmental considerations have been and remain fundamental to the design and operation of the park's facilities. The basis is again the system of EIA requirements whereby heavy polluters are not accepted, and those in operation are continuously monitored and controlled remotely across each of a number of sub-zones 5-6km^2 in size.

The most symbiotic operation in the park is a system established between a wastewater plant, a cogeneration plant, and a sludge drying facility. The park's wastewater plants generate approximately 300 tonnes per day of wet sludge, which is difficult to treat. The parks power plant generates steam, the heat from which is used to dry the sludge, which is then utilised by the cogeneration plant as an alternative to coal. The sludge plant uses treated wastewater as cooling water, and the ash produced by the cogeneration plant is used in construction materials in the park. This manner and level of symbiosis is considered a first in China linking residential and industrial activities for greater efficiencies that have resulted in considerable water, coal, and carbon emissions savings.

Conclusion

China is focused on reducing pollution and improving energy efficiency for the industrial sector. As China seeks to expand upon the principle of a "circular economy" in coming years, one of the biggest challenges it may face is the uniform top-down planning process. The SCIP and SIP examples presented here characterize a significant change in the growth regime of China, and progress toward reducing the environmental impact of industry. They exhibit a certain level of symbiosis and how the effective planning of industrial parks can determine resource consumption patterns. Most notably, they demonstrate a development model that achieves environmental targets through application of environmental considerations at the heart of processes, rather than as downstream measures.

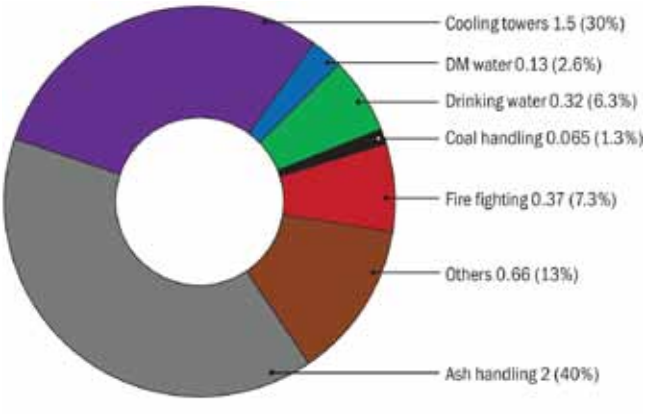
WATERENERGYNEXUS

Water Efficiency Interventions in Thermal Power Plants in India

Case study drafted from materials provided by Anshuman, Associate Director, Water Resources Division, The Energy and Resources Institute (TERI), India

Power generation capacity in India has increased dramatically, from 1,362 MW in 1947 to 199,627 MW in 2012, and new capacity continues to be added to fuel the country's rapid growth. However, with declining per capita water availability, growing water scarcity, and increasing and competing water demands, the linkage between water and energy has the potential to constrain the country's power sector. Improved policy frameworks, technologies, and management practices for water efficiency within the power sector are needed to meet the country's expanding development needs.

SPECIFIC WATER CONSUMPTION OF A COAL-BASED THERMAL POWER PLANT IN INDIA (M^3/MW)



Source: TERI, from http://www.energymanagertraining.com

As of 2012, thermal power plants accounted for 66% of India's total power generation, and approximately 88% of industrial water usage. Yet, while demand is increasing, industrial water productivity remains low. Recently, the Government of India announced a "National Water Mission" under the National Action Plan on Climate Change (NAPCC) with a specified goal of enhancing water use efficiency by twenty percent.

Water efficiency is critical for the power sector. 79% of new thermal and hydro power plants are planned for construction in water scarce areas, and insufficient water supplies are a risk to the power supply. For example, due to an acute water shortage in 2010-11, electricity generation from India's thermal power plants dropped by nearly 4.4 TWh, equivalent to the amount of electricity serving 1.3 million households. In 2007, one of the largest power plants in Maharashtra was forced to halt generation due to water scarcity caused by insufficient rainfall in the previous season. Pressures on water resources will only increase as demand for industrial uses and energy production is expected to grow at an estimated 4.2% per year. In addition, the impacts of climate change may further exacerbate the situation due to changes in precipitation, impacting water availability in surface and groundwater supplies.

Identified issues and targeted actions in thermal power plants

To further investigate the water-energy nexus, comprehensive water audits of some of India's largest thermal power plants were conducted. The audits examined water supply and distribution networks, calculated water balances, assessed overall and specific water consumption, characterized water quality, and detected system leakages and losses. The result was the identification of opportunities for water conservation, and recommendations for recycling and reuse of water to improve efficiency within power plants.

Twenty-five percent of thermal power plants in India continue to use "once-through" systems in cooling towers to dissipate heat from condensers. These systems require a continuous flow of water, and demand is 30-50 times higher than in "closed-cycle" systems where water is re-circulated and treated with clarified water to compensate for evaporation. Water reuse through closed-cycle systems with a high number of re-circulations and increased cycles of concentration (COC) can lower water consumption, as well as the associated cost of water.

About 40% of freshwater intake is used in the process of wet ash handling, during which a slurry is created from ash and water, and transported to nearby dykes for disposal. High levels of water loss (50-80%) are experienced during this process. Overflows

POTENTIAL WATER SAVINGS

81,000 m^3 per day
65.2 million m^3 per year
61% reduction in water usage

should be recycled and leakages eliminated to lower specific water consumption rates. With a 1% reduction in the ash water ratio, potential water savings of 60 m3 per hour could be realised. Power plants may also transition to a dry ash system that would eliminate water requirements for ash handling.

Effective recycling of wastewater could reduce freshwater intakes by 18% to 26%, and with low levels of otal dissolved solids (TDS), could be utilized in many processes, such as ash handling, coal handling, and recirculation. Furthermore, water audits revealed that power plants of 3,000 MW capacity could potentially save 17.9 million m^3/year of water and approximately 72 million rupees annually through the recycling of drain wastewater. As an example, the cost of implementing a 60 MLD water recycling and reuse system is approximately 130 million rupees (US$2 million), with estimated operation and maintenance costs of 17 million rupees (US$170,000). Implementing the recycle/reuse system is considered cost effective, with the payback period for implementing the system being less than 3 years.

Implementing the interventions identified above, the potential volume of water savings equals 81,000 m^3 per day, over 65.2 million m^3 per year, and a total reduction of 61% of total water usage. The cost benefits associated with the reduction of water usage offer a potential savings of 261 million rupees (approximate US$4.2 million) per year.

Comprehensive approaches needed for efficient water use

To reduce the power generation water footprint, focus must remain on the entire value chain, and include improvements to policy, technology, and management practices. Policy establishes benchmarks and set targets for water efficiency. To set benchmarks that are technically feasible, further investigations are needed to detail water balances and identify points of water loss. Technology largely determines levels of water use. Therefore, adoption of efficient systems and improving operational performance through automation, with the help of management information and centralized control systems is a key strategy. Although they are not yet widely institutionalized, regular, mandatory water audits should be internalized under corporate policy and as part of integrated industrial water management strategies, in order to optimize water use efficiency and realize the benefits of improved water productivity.

Anshuman. "Catalyzing Green Growth through Efficient Water Use in Industries: Case of Thermal Power Plant in India." UNESCAP and K-Water Conference on "Water & Green Growth". PPT. 2015.

The Energy and Resources Institute. Enhancing water-use efficiency of thermal power plants in India: need for mandatory water audits. New Delhi, 2012.

UN Water. "World Water Development Report 2014 - Water and Energy." 2014.

IDENTIFIED INTERVENTIONS	Potential water saving volume (million m^3/year)	Potential savings in cost* (in crore/year)
Potential saving if specific consumption of water in cooling towers is reduced from 2.5 to 1.5	21.9	8.7
Potential saving if water lost in ash handling is recycled (about 70 per cent)	20.6	8.3
Recycling wastewater from major drains of plant (adopting zero discharge)	17.9	7.2
Total (including plugging leakages and recycling township STP wastewater)	65.2	26.1

** At the rate of current cost of procurement of freshwater intake, 4 Rupees/m^3*

IMPROVEMENT OF FLOOD EARLY WARNING SYSTEMS

The Brantas River Basin Experience

Case study written with materials provided by Firman Sarifudin, Jasa Tirta I, Indonesia

The flood-prone Brantas River Basin is located in the province of East Java, in the Indonesian archipelago. The basin has an area of 12,000 km^2, covering 25% of the province, and is managed by the state-owned company, Jasa Tirta Public Corporation.

Floods cannot be entirely prevented in the Brantas River Basin. Therefore, approaches for flood prevention have shifted towards flood management. As such, the ability of communities to live in harmony with floods is a priority, and efforts are focused around community service and the empowerment of society. To meet these objectives, an early warning system is vital for reducing flood disaster risk as it affords people living in the basin time to evacuate and protect their property from the threats of an impending hazard.

To meet the disaster prevention needs of the region, an improved early warning system utilizing Global System for Mobile (GSM) technology through a community-based approach.

The existing flood forecasting and warning system of the Brantas River Basin consisted of observation, telemetering, flood analysis, and communication systems. The system was improved in the early 1990s and in the year 2000, but continued to face a number of hardware and technical problems that prevented its effective operation. To meet the disaster prevention needs of the region, an improved early warning system utilizing Global System for Mobile (GSM) technology was introduced through a community-based approach.

The community-based flood early warning system (CBFEWS) was developed with the participation of community members. It is designed to provide them and disaster risk management agencies with advance information that can be translated into disaster preparedness, prevention, and response measures to protect against injury and the loss of life. The CBFEWS connects the information and warning system directly to the community through its leaders. Local people also serve as observers generating water data and information that feed into the system. The provision of the CBFEWS also included flood hazard mapping, distribution of risk guides, awareness raising, capacity building, education and training, as well as institutional development.

With this comprehensive approach and depth of engagement, a sense of ownership over the new system has been created within the community. With a stake in flood management, the community contributes to the operations and sustainability of the system, and, most importantly, is better equipped to manage the risks of floods.

LAO PDR's Urban Water Supply & Sanitation Strategy

Case study written with materials provided by Noupheuak Virabouth, Department of Housing & Urban Planning, Lao PDR

Lao PDR's Seventh National Socio–Economic Development Plan (2011–2015) is viewed as the necessary thrust to graduate the country from its Least-Developed Country status by 2020. A key strategy of the plan involves identifying provinces and urban centres across the country with the highest potential for rapid growth, improving their planning systems, and providing them with efficient infrastructure and services. In 2005, Lao PDR's urban population numbered 1.4 million, equivalent to 25% of the total population. Estimates are that by 2020, the urban population will reach 2.5 million, equating to more than 33% of total population following an average urbanization increase of 0.5% per year. The net population increase in urban areas between 2005 and 2020 is projected at 1.1 million people. To meet new development objectives and the needs of a growing urban population, the national strategy for urban development for 2030 defines a number of areas for targeted urban water supply infrastructure development.

The current urban situation

Missing links in the road network, poor maintenance of water supply infrastructure, flooding and clogging of drains, and disposal of untreated waste constrain the productive capacity of urban areas, making urban centres less competitive and liveable. Inadequate urban infrastructure, poor management of urban services, and a weak regulatory environment also discourage private sector investment. Through the development of water supply and sanitation infrastructures, the Government seeks to reduce poverty, support economic growth, and improve geographical equity in urban social infrastructure.

Urban water supply sector development

The urban water supply sector has the vision of "Safe, Reliable Water Supplies and Healthy Environment for All", and a mission to "Provide Customers with Sustained, Clean and Safe Piped Water at a Fair Price".

Since 1963, substantial financial support for infrastructure development has been provided for urban water supply infrastructure through loan and grant funds primarily from multilateral and bilateral financiers. To date, more than US$250 million has been invested in the improvement of urban water supplies, which, at the end of 2014, included 104 water supply systems serving 90 towns, with an urban coverage of approximately 63%. In order to better secure water resources for urban citizens, as well as meet objectives under the seventh Millennium Development Goal and the current national development plan, the Ministry of Public Works and Transport has prepared an urban water supply and sanitation strategy. The strategy sets a target to provide 24-hour access to safe drinking water to 67% of urban population by the year 2015, 80% by the year 2020, and 90% by 2030.

To realise these targets, the plan includes upgrading and rehabilitation of existing systems to further expand services to reach higher coverage in existing service ar-

eas; the development of new systems for approximately 30 district towns remaining, and maximizing coverage in these new service areas; expansion of water supply systems to emerging towns; and ensuring water is safe from source to tap through the implementation of Water Safety Plans.

Challenges

The three main constraints to the development of the urban water supply sector include:

(i) Insufficient funds to expand coverage and/or improve service levels due to lack of revenue arising from low efficiency levels; limited self financing capacity; and a reliance on overseas development aid (ODA) and private funding.

(ii) Weak sector planning and implementing capacity of responsible authorities at the central, regional, local and community levels; low capacity with PNPs and private operators; and a lack of qualified engineers and technicians.

(iii) The absence of a so-called "enhancing environment" due to inadequate institutional and legal frameworks.

Implementation of the urban water supply strategy will require on average US$40 million annually, posing a huge financial challenge. Other barriers include sector effectiveness, sustainability and equitability. The capacity of the water supply state-owned enterprises should be developed and human resource development should enhance absorptive capacity and manage public-private-partnerships effectively. Tariffs, cross-subsidies and other mechanisms need to be utilized effectively to ensure the poor are not disadvantaged, yet economic viability of systems is ensured.

Moving forward

In order to successfully realize and implement the urban water supply and sanitation strategy, four programmes and twelve priority projects were identified, including: Improvement of organisational structures and human resource development; Preparation and revision of legislative documents and technical standards related to development, management and regulation of water supply and sanitation; Development of water supply and sanitation infrastructures; and Improved efficiency of water supply operations.

The urban water supply and sanitation strategy outlines 10 specific goals:

1. **Appropriate legal framework**
2. **Appropriate institutional framework, raising the status and boosting the capacity of the sector organization**
3. **Appropriate regulatory system for higher efficiency**
4. **Water supply and urban sanitation integrated with urban development**
5. **Expand the water supply and sanitation development and service delivery to small towns in rural areas**
6. **Strong, efficient, sustainable, customer-oriented public water supplies**
7. **Active participation of the private sector in water supply, sanitation development and service delivery**
8. **Adequate, competent staff for the development and management of the sector**
9. **Promoting gender mainstreaming in the water supply and urban sanitation sector**
10. **Promoting development and use of appropriate techniques and technologies.**

Development partners are expected to continue to support water supply and wastewater infrastructure development, bolstering the national budget and private sector investments. Through on-going efforts under the national plan, water infrastructure targets for the urban areas of Lao PDR can be expected to contribute significantly to the country's overall social and economic development goals. ■

The N-Park Condominium Water Saving Project

STAKEHOLDER ENGAGEMENT FOR BETTER URBAN WATER MANAGEMENT

Case study drafted from materials provided by Ngai Weng Chan, School of Humanities, Universiti Sains Malaysia

Malaysia is "rich" in terms of water resources but, despite an average annual rainfall of 3000mm, the country is often plagued by serious water problems.

Traditional economic growth models often lead to water catchment destruction, water pollution, water wastage, high levels of non-revenue water, low tariffs, poor awareness, and public apathy towards water conservation. Furthermore, water problems are exacerbated by poor institutional arrangements, inter-state disputes, state-local government disagreements, and ineffective privatization.

Non-green growth approaches and mismanagement are fundamental reasons contributing to Malaysia's water problems. Traditional methods for solving water issues are top-down technical solutions that ignore broader green growth principles as well as the human side of water resources management. In order to successfully address water problems and ensure future water security, it is imperative that Malaysia follows a path towards a green growth economy. Greening the water sector via both technical as well as human dimensions is vital to sustaining water security, and requires engagement and partnership amongst relevant stakeholders.

Piloting a smart-partnership approach to greener water management

The N-Park Condominium, comprising 965 units in Penang State, is the first condominium in Malaysia to pilot a water-saving project. Carried out between August 2009 and December 2010, this smart-partnership initiative engaged relevant government, non-government, private sector and community stakeholders. Funded by the Malaysian Government, and jointly implemented by the Department of Irrigation and Drainage (DID), Water Watch Penang (WWP) and N-Park Management Corporation (NPMC), with support from Perbadanan Bekalan Air Pulau Pinang Sdn Bhd, the project involved three main components:

(1) Installation of a rainwater harvesting system comprised of six 10,000 litre capacity tanks, on the roof of a parking block. Harvested rainwater is used for non-drinking purposes such as gardening, washing floors and toilets, washing cars and flushing toilets. (2) Fitting all the common area toilets with water-saving dual-flush cisterns, push-flush urinals, and automatic push-taps. (3) Engagement of residents from 100 apartments in a water-saving activity in which residents compete against one another to reduce their own water use.

Project implementation

The project kicked off with the official inauguration on 21st August 2009. On 31st October 2009, the Rainwater Harvesting Project was launched. Meetings and discussions between project implementers are held every month to exchange information and address issues that arise. Participating residents are provided with advice and assistance from two water auditors. Results of the project showed that the rainwater harvesting system was the most successful component of the project as the water was used for gardening, cleaning common areas, and for flushing toilets in common areas. The water-saving equipment also resulted in substantial water savings. Between these two project components, water usage was reduced in the condominium's common areas by 37.38% in May, 36.51% in July and 12.00% in September of 2011, resulting in an average monthly water savings of 28.63%. This translates to US$387 in savings per month. Over a six-month period, the condominium saved 8,409,400 litres of water, or the equivalent of US$2,324.

Education and awareness raising for behaviour change

Education and awareness concerning water conservation and the water situation in Penang was an important aspect of the project. Volunteer trainers continually engaged participants to increase knowledge and instill a sense of concern for water in support of creating a water-saving community in N-Park.

One of the major challenges faced by the project was that of changing people's water use behaviour. Informational programming for participants involved a talk or lecture on general concepts and background on the topic. Selected speakers were skilled at maintaining participant interest and incorporated stories, pictures, video clips and music into their talks. This was followed by an open discussion and question and answer session. Additional communication strategies and tools included video documentaries, drama, exhibitions and a water painting competition to increase awareness of water issues. However, many people who are accustomed to a fixed way of life were reluctant to change their water use patterns, leading to some participant withdrawals.

Rainwater catchment tank

Another significant challenge was that of different cultural practices (nearly 50% of the total 100 participants were university students from foreign countries). It was found that some participants from arid countries liked to listen to the sound of dripping water and would leave the tap dripping the entire day.

The barrier of cheap water

Exacerbating these issues is the low cost of water. Penang's water tariffs are extremely low compared to other parts of the world, which may be a reason for overuse and the generally apathetic attitude towards water conservation. Water costs only US$0.10 per cubic metre for domestic consumers, and many participants mentioned that their water bills were already very low, some paying only US$0.70 per month. Hence, some felt that attempts to save water were a complete "waste of time."

Overall, it was found that apartment residents needed attractive incentives before they would become involved in water conservation. Many were very busy with their work and personal/family life, leaving little

time to take part in the project or expend effort to save water. Others did not connect with the idea that their water savings would benefit the environment or their children, and many viewed water conservation as an investment, finding the rewards unattractive.

The challenge of funding sustained efforts

Responses from people linked to the project were varied, but the general opinion was that the project would never have taken off without government support. The Federal Government provided the initial capital to install the rainwater harvesting system, the water-saving fittings and the funds to run the project. However, the initiative's implementation was shared by multiple stakeholders, including NGOs, and the public, leaving a question on how to sustain such efforts after government funds are depleted. Overall, the non-governmental stakeholders generally expected the government to continue funding the project, believing that such projects are the responsibility of the government and that it is the their responsibility to manage water supplies and educate the populace. However, NGOs believe that continued funding could be obtained from private sector entities connected to the water business, such as water service providers and wastewater companies. Corporate social responsibility (CSR), an increasingly important component of the portfolios of international organisations and multi-national companies, could also potentially provide necessary external support.

Despite challenges, a promising model

The N-Park Water Saving Project was a successful pilot, achieving water savings of nearly 30%, inclusive of all three project components. Rainwater harvesting demonstrated the greatest promise and saved more water than could be utilized. The installation of water saving devices in the common area toilets was also successful in achieving project objectives, while resident participants became more water conscious through an awareness of the many advantages of water demand management, rainwater harvesting, and available water saving devices. Co-benefits of the project included strengthened ties between neighbours and a greater sense of harmony amongst different ethnic groups.

Over a six-month period, the condominium saved 8,409,400 litres of water.

Potential for replication

The successful N-Park project has proven that water demand management through smart partnerships between government, the private sector, NGOs and local communities is feasible. It has demonstrated best management practices for improving the water sector via both the technical as well as the human dimensions of sustainable water resource management. These practices can be publicized and replicated in residential, service, and public facilities across the country, leading to a more environmentally-friendly water sector that supports the broader objectives of green growth. ■

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Traffic along the Ayeyarwady River
Photo credit: Jason Eppink

Institutional Building and Policymaking for Water and the Environment

Case study drafted from materials provided by Khin Ni Ni Thein, National Water Resources Committee, Myanmar

Myanmar has recently opened up after years of isolation. An underdeveloped country of 677,000 sq km with a population of 50 million, Myanmar faces a number of water challenges. With rapid development of special economic zones and agriculture expansion, water and energy demands are increasing in an unprecedented manner. In addition to providing basic infrastructure and services to the nation's population, new economic activities are heavily dependent on the availability of water resources, requiring the country to develop new institutional frameworks and policy measures.

MYANMAR'S DEVELOPING WATER POLICY FRAMEWORK

i. Myanmar Environmental Law (2012)

ii. National Water Policy (drafted in 2013, published in 2014)

iii. National Water Framework Directive (drafted in 2013, undergone 5 cross-country public consultations in 2014, and to be finalized in 2015)

iv. Myanmar Water Law (drafting process began in 2013)

v. Myanmar IWRM Strategy (2013-14 sponsored by the Dutch Government)

CAPACITY DEVELOPMENT PROGRAMMES

i. Hydroinformatics Centre (2014, supported by the World Bank)

i. Stakeholders Forum (2015, supported by the World Bank)

i. Capacity Building Process (begins in 2012)

i. Political space for NGOs, such as the establishment of River Basin Organizations and Water Mothers and many other Environmental NGOs and Water NGOs

Water Management Challenges

The country's biggest river basin, the Ayeyarwady River Basin, covers 61% of the total land area of Myanmar and sustains 26 million people. It flows almost entirely within the country, providing the most important commercial waterway. However, the river basin has lost more than 60% of its original forest cover and is under heavy pressure from agriculture, which, as of 2009, utilised more than 90% of the surface water. Compounded by the influences of the recent opening and a lack of fair water allocation, major social issues and conflicts have arisen from an accumulation of historical discontent and unfulfilled commitments, resulting in mistrust among various stakeholders, including the government. To address these issues, the government has turned its focus toward the establishment of an overarching national sustainable water policy framework.

Institutional and Policy Developments

The new government, in power since March 2011, held a forum in November 2011 in which the nation agreed to align the future development of the country with green economy and green growth principles. Subsequently, institutional structures were created. In 2012 the Ministry of Forestry was replaced by the Ministry of Environmental Conservation and Forestry, and in 2013 the National Water Resources Committee and the Expert Group (now Advisory Group) were established.

Based on the four pillars of sustainable water use – standards and compliance; information and decision making; services and products; and education and training – several policies were drafted, supported by a number of capacity development programmes (see sidebox for an overview).

The National Water Resources Committee (NWRC), looking for solutions to meet increasing water, energy, and food demands for a Myanmar in transition, identified the impacts of changing consumption patterns, climate change, population growth, and the rapid increase of economic activity. Anticipating that these

factors will increase water demand by 100% or more, and energy demand by 80 to 100%, the NWRC has begun working with water-related government ministries and civil society organisations.

The drafting of primary and secondary legislation has begun with comprehensive water law processes identified in national water framework directives. Development of regulations establishing drinking water and effluent standards, and planning for practical implementation of principles is underway.

Decision support systems enabling people-centered approaches to policy development and decision-making through engagement with civil society are being formed, in part through the support of the World Bank. NGO participation is to be used to promote a neighbor-watch-system for monitoring, policing, enforcement and sanctioning with the objective to improve gross national happiness. As an example of current collaboration between the government and civil society, NWRC is working with civil society groups to implement integrated water resources management (IWRM) principles within the Ayeyarwady River Basin, where riparian communities have expressed differing needs and priorities requiring mediation and reconciliatory actions.

Difficult decisions are anticipated in the near future, possibly with the need to resolve a series of conflicts that may create crisis and instability. Myanmar recognises that the national water budget is limited and that the country is also environmentally constrained. Although challenging, implementation of an IWRM system that provides good water governance and addresses the interlinkages between water, energy and food security is seen as a means to help face these issues and avoid serious unintended consequences.

WATER FOR AGRICULTURE

A CASE OF SOUTH ASIA

Case study drafted from materials provided by Golam Rasul, International Centre for Integrated Mountain Development, Nepal

The countries of South Asia face a common challenge of sustainable water management at the water-food-energy nexus. The South Asia mainland, comprised of Bangladesh, Bhutan, India, Nepal and Pakistan (island states include Sri Lanka and the Maldives), faces a food-energy deficiency of 51%. Yet, with increasing populations and prosperity, the food production requirement is expected to double in the next 25 years, increasing water demand for irrigation by an estimated 70%. Food productivity must be increased, but already just 3% of the region's land area supplies food to 20% of its population. Approximately 90% of water is used for agricultural production, 70-80% of which depends on groundwater irrigation. At the same time, 20% of the population lacks access to safe drinking water.

Water stress is growing in the Indian sub-continent not only due to food production demands but also to meet increasing water demand for hydropower and bioenergy. The government of India is anticipated to construct 292 hydropower plants by 2030, while Pakistan is planning to utilize 60,000 MW of untapped hydropower potential. In terms of bioenergy, India is targeting 20% biodesel blending to produce 13 million tons of biodiesel annually from 11 million hectares of land. By 2020 Pakistan will have 10% ethanol blending, increasing ethanol production from 0.2 million tons in 2006 to 4.3 million tons in 2020.

Unsustainable policies and pricing create challenges for effective management. Current water management strategy is centred on expansion of irrigation to promote food production. Under this approach, water for irrigation is often provided free of cost or is highly subsidized, as is the energy used to pump water, leading to water overuse. In the south of India, the subsidy for irrigation amounts to US$579 million annually. In the Indian subcontinent, in part due to electricity subsidization that results in some farmers paying nothing or the likes of 10% of costs, the share of agriculture in electricity consumption has dramatically increased.

The environmental, social, and economic consequences of poorly-designed subsidization schemes are great. Groundwater supplies have been over-exploited, and productive land compromised due to waterlogging and salinization. People bear the social costs of arsenic contamination and waterborne disease, and farmers are economically tied to the rice-wheat system. As water resources continue to be exploited, subsidies must be better managed to enable more sustainable water management practices.

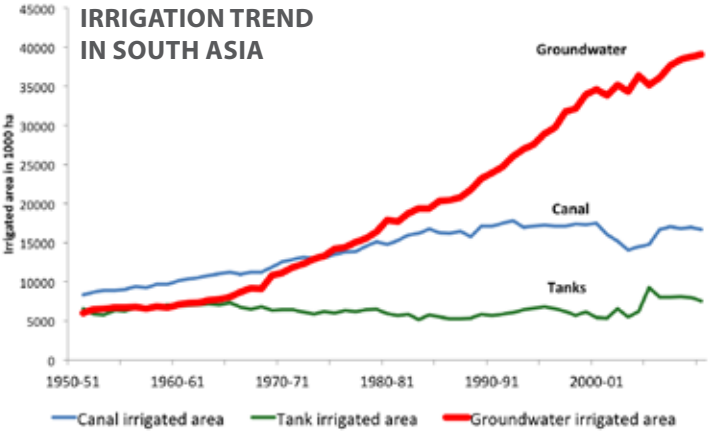


Photo credit: CCAFS

Meeting the challenges

Technological, institutional and policy support options are available to meet the challenges of subsidization at the water-food-energy nexus. Improvements to irrigation water efficiencies can be realised through the use of micro-irrigation and reducing water demand. With institutional options, farmers should be trained to manage irrigation effectively and efficiently.

Increasing the productivity of irrigated rice by changing the management of plants, soil, water and nutrients under an evolving set of practices and principles known as System of Rice Intensification (SRI), could deliver significant water and energy savings. It is estimated that adoption of SRI over 25% of the rice growing area in India would enable 20 billion m^3 of water and 632.61 million kWh of energy to be saved.

Most importantly, better understanding of the dynamics that exist at the water-food-energy nexus is required on behalf of governments to develop necessary policy frameworks. Incorporation of green growth principles can be a tool for correcting policy distortions, rationalization of water and energy pricing, and creating positive incentives for the adoption of water saving technologies and practices. With the application of new policy, technologies, and institutional measures, South Asia can be positioned to better meet its pressing development needs.

Photo credit: Michael Foley

GREEN GROWTH through WATER ALLOCATION POLICY

THE PHILIPPINE EXPERIENCE

Case study drafted from materials provided by Maria Arlene C. Diaz, National Water Resources Board , Philippines

Although "water and green growth" is a recently introduced concept, the underlying principles have long been at work in the Philippines. The 1976 Water Code of the Philippines – a law that governs the ownership, appropriation, utilization, exploitation, development, conservation and protection of water resources – as well as other water polices formulated and implemented by the National Water Resources Board (NWRB), establish the country's fundamental codes for sustainable water resources development and management.

The Water Code of the Philippines

The Water Code specifies that the preference in the use and development of water shall consider current usages and be responsive to the changing needs of the country. It also defines the extent of the rights and obligations of water users, including the protection and regulation of such rights. Water rights are a privilege granted by the government to appropriate and use water according to a water permit. The measure and limit of appropriation of water is beneficial use, which is defined as the utilization of water in the correct amount during the period that the water is needed for producing the benefits for which the water is appropriated. The rights of a water permit holder shall continue to be valid as long as water is used beneficially. Securing water rights provides stability. However, rights may be subjected to modification or cancellation by the NWRB, after due notice and hearing, for violations of water permit conditions, in favour of a project with greater beneficial use, or for multi-purpose development. For cancellations due to the latter reason, a water permit holder who suffers shall be duly compensated by the entity/person in whose favour the cancellation was made. Another case of reallocating water allowed by law is the lease and transfer of water rights in whole or in part. These provisions of the Code offer the framework for maximization of water's economic and social benefits.

The current water allocation system recognizes the environment as a legitimate water user through the provision of environmental flow in the allocation of surface water. The Code establishes minimum streamflows for rivers and streams, and minimum water levels for lakes that shall be considered in the allocation and appropriation of water resources for conservation and protection of waters and related resources. Currently, the required minimum environmental flow for rivers and streams is 10% of the 80% dependable flow, which is to be released at all times to meet environmental requirements and protect downstream fisheries. Other criteria for establishing environmental flows are not yet considered due to the absence of data and information needed for estimation.

In regard to groundwater allocation, safe yield is the basis for allocation. However, a 10% aquifer-mining yield is allowed for areas where existing appropriation has already exceeded the mining yield until such time that alternative surface water sources become available. Groundwater withdrawals would then be reduced accordingly and limited to safe yield. An additional environmental consideration stipulated in the Code's Implementing Rules and Regulation is the submission of an Environmental Compliance Certificate or a Certificate of Non-Coverage from the Department of Environment and Natural Resources indicating that the proposed project will not cause significantly negative impacts to the environment and that the proponent has committed to implement its approved environmental management plan.

Other water allocation policies

The water allocation system in the Philippines is also guided by water policies formulated by the NWRB through Board Resolutions, which aim to integrate current issues and new challenges into the water allocation system.

At present, groundwater critical areas identified in the Philippines are considered in need of urgent attention. Two out of the nine identified groundwater critical areas are now under moratorium, which halts the development of groundwater and prevents more permits from being issued to avoid further aquifer degradation. To meet water needs, development of surface water or connection to existing water service providers is encouraged in these areas.

The booming golf course industry in the Philippines has been identified as one of the major users of water. Meeting the high demand for water for this industry in groundwater critical areas adds more pressure on already scarce resources. Although the golf industry brings tourism benefits, the use of water to irrigate thirsty greenery has created growing concern, which have led to the formulation of a water allocation policy for golf courses in critical areas. The policy revised existing water standards for irrigating golf courses in consideration of turf grass water requirements and climate factors. Based on the revised standards, the policy reduces water allocation within two years. Implementation of water conservation measures and programmes is likewise required to meet efficient water use requirements.

Recently, policy granting water rights for hydropower projects has been revised to support the government's thrust to harness and maximise renewable energy to meet the country's increasing energy demand. The revised policy aims to increase water allocation to maximize the optimum rated power capacity of hydropower plants, without negatively affecting river ecosystems or the environmental integrity of the river. Additional requirements and conditions are imposed for project applications requiring flow capacity of more than 80% of the dependable flow, including submission of environmental assessments and sustainability plans, as well as the installation of gauging stations to measure reservoir inflows and outflows. This policy is currently being piloted for one hydropower project.

Challenges to be met

The mainstreaming of green growth strategy within the current water allocation system of the Philippines is well on its way due to the alignment of existing laws and policies. However, implementation of these policies has not been fully achieved. Limited data and information and lack of decision support tools hamper the effective policy implementation and monitoring of policy effectiveness. Information is necessary in making efficient choices on allocation and in seeking equity among various sectors of water users. Although comprehensive and sophisticated analytical tools are now available to support decision-making on allocation and management of water resources, the use of these tools is difficult and limited without sufficient and reliable data. Strict enforcement of laws and policies on violations of water permit conditions and illegal water users is another concern, which calls for active and sufficient monitoring. Although some initiatives are already underway to address the gaps in water-related data and information, the greater challenge is to ensure full cooperation of data generating agencies and financial support to continue and sustain such initiatives.

Another major challenge for the Philippines to mainstreaming green growth principles within the water allocation system is linking basin development and management planning to the allocation process. This requires key policy changes in the water allocation system, in order to account for immediate to medium-term competing water requirements within the basin and between sectors. It also requires regular review of sectoral allocations and priorities in light of the changing environment. This reform is a major and important step towards green growth and water security that requires strong advocacy, political will and resources. ■

The Taehwa River
ECOLOGICAL RESTORATION PROJECT

Case study drafted from materials provided by NamSoo Lee, K-water, Republic of Korea

The Taehwa River flows through the metropolitan city of Ulsan, located in the southeast of the Korean Peninsula. Originally a farming and fishing community, in 1962 it was designated as a special industrial zone. Its status changed again in 1997 when it was designated a metropolitan city. As the area developed over the years, low levels of environmental awareness and insufficient flows resulted in high levels of river contamination from poorly treated industrial wastewater and domestic sewage. The river water quality deteriorated significantly, resulting in massive fish deaths in 1992 and again in 2000. Exacerbating the dire situation, unplanned riverbank developments added to the environmental deterioration of the river and its surroundings.

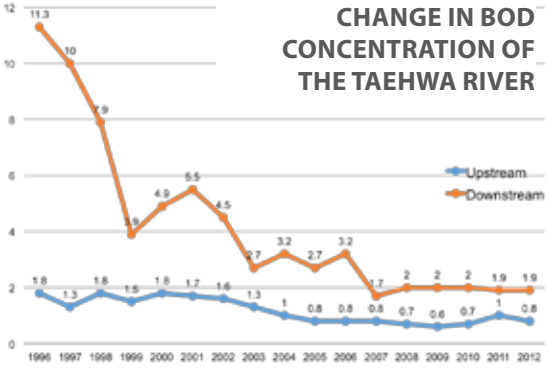
The Taehwa River recorded its worst biological oxygen demand (BOD) level in 1996 at 11.3 ppm. The following year, Ulsan begins its full scale Taehwa River Restoration Project under its 1st Environment

Awareness of the severe river pollution was raised to national levels in 2000 when massive fish deaths were televised across the country.

In 2012, the river was selected as one of South Korea's twelve eco-tourism sites.

Improvement Medium-Term Comprehensive Plan. Awareness of the severe river pollution was raised to national levels in 2000 when massive fish deaths were televised across the country.

The 2nd Environment Preservation Medium-Term Comprehensive Plan, 2004-2008, was adopted in 2003 with 2004 declared as the founding year of a new ecological city of Ulsan. In conjunction, a number of programmes were initiated to support a river restoration project, including the establishment of the Taehwa River Water Quality Improvement Team and the formation of the Taehwa River Citizen Watch Group. Through implementation of Phase I and II of the Taehwa River Master Plan, 2005-2014, water quality in the river improved significantly.



The basic concept of the Taehwa Master Plan was 4-fold: "Safe and clean river", "Ecologically healthy river", "Familiar and close river", and "Historical and future river", each with its own focus activities, and undertaken through the organization and participation of local stakeholders.

Water quality improvement activities included the removal of debris, contaminated sediment, and sludge. Concrete structures along the riverfront were replaced with natural revetments for flood protection, and green lawns and walking paths were introduced in formerly deserted areas along the riverbanks. To further encourage people to engage with the river, observatory towers and a tourist pavilion were constructed. In 2011, the success of project efforts became evident when the Taehwa River's water quality achieved 1b status at 1.9 ppm BOD, the best among South Korea's rivers. In addition to improving water quality, the riverbank redevelopment efforts paid off when, in 2012, the river was selected as one of South Korea's twelve eco-tourism sites.

Photo credit: Johanan Ottensooser

WATER FOR GREEN GROWTH IN SRI LANKA

Climate-smart agriculture for women farmers

Case study drafted from materials provided by Kusum Athukorala, SLWP, Sri Lanka

North Central Province of Sri Lanka is an area subject to oscillating flood and drought occurrences, further exacerbated by the effects of climate change. Local farmers face the challenge of increasingly unpredictable weather patterns, compounded by the ill effects of poor soil and water management. The overuse of fertilizer and pesticides has led to major human health and soil fertility issues, and the area is the epicenter of a chronic kidney disease epidemic, which is exacerbated by toxic agriculture practices. To meet the sizeable and numerous challenges faced within this region, the "Jalavahini Empowerment for Women Farmers" extension programme has demonstrated that women have a vital role to play in ensuring food security through the application of sustainable growing practices and management of water resources within home gardens.

Conducted between 2012-14 by NetWwater and Brandix Lanka Ltd, the programme was an unusual alliance of civil society and corporate social responsibility that served to address a common interest in water

security. The pilot project involved 50 women farmers from two farming communities to work towards improving local food security.

Women, many involved in home gardening, have a key role to play in both domestic water use and food security. However, knowledge transmission systems in the region are weak, resulting in the loss of traditional agricultural knowledge, and many farmers become dependent on commercial companies who promote their own products. However, through the programme's activities, these women were given practical exposure, technical knowhow and training in water management practices and sustainable production of essential food crops.

Given access to knowledge and resources, they can act as catalysts for more sustainable practices, as well as generate new small enterprises based on the production of high value crops. Compared to commercial agriculture, fewer inputs and resources are needed at the household level. However, home gardens suffer from low productivity levels and the overuse of fertiliser and other toxic elements.

Women have a vital role to play in ensuring food security through the application of sustainable growing practices and management of water resources within home gardens.

Under the new programme targeting women were introduced to micro-level rainwater harvesting techniques and water saving systems for promoting soil and water conservation measures. Organic farming methods were introduced and training was provided in the cultivation of special high value crops such as turmeric, ginger, medicinal herbs and aloe vera. The participating women learned business management skills such as keeping records of cultivation costs, labour inputs, marketing and major challenges. Following training, regular visits from programme staff addressed issues that emerged, and prolonged communication and troubleshooting via post and telephone was included as an additional support measure.

Overcoming natural disaster

The programme experienced a signficant setback in November/December 2014, when an unusually heavy monsoon rain event occurred that, due to constant inundation, overflowed irrigation reservoirs, damaged fields and home gardens, and caused heavy flooding. The local population suffered heavy financial losses and a severe psychological setback. The event was followed by the Presidential election in early January 2015, causing farmers to feel overworked, stressed, and demoralized.

Resurgence was difficult, and placed a heavy demand on the project team to provide mentoring and encouragement to revive the home gardens and, to an extent, production of high value crops. Access to planting material and seeds is limited, and poorer households could not afford a second investment, while others turned back to inorganic fertilizers to compensate for the loss of fertility in home gardens. Positively, the rural tradition of "attam", labour exchange, was revived.

Despite setbacks, the capacity building programme produced a number of positive results, including the empowerment of local women to apply more sustainable and climate-smart agricultural practices. The establishment and formalization of new enterprises based on high value crops has the potential to offer new income streams. To build upon the progress made under the programme, continued mentoring and support is necessary from local agricultural extensions to expand knowledge and practices in line with green growth objectives.

Infrastructure Development *for* TAJIKISTAN'S WATER RESOURCES

Photo credit: Roderick Eime

Case study drafted from materials provided by Said Sharipov, Ministry of Energy and Water Resources, Republic of Tajikistan

More than half of Central Asia's water originates from the territories of Tajikistan, flowing from mountainous regions that cover 93% of the country. With such rich water resources, the state is currently seeking to improve and expand its infrastructure as a key to ensuring health and prosperity for its population while improving the overall socio-economic status of the country.

In addition to supplying domestic drinking water, the water resources of Tajikistan are in demand to generate hydropower for national electricity grids, provide irrigation for the country's sizable agricultural sector, support healthy fisheries, enable recreational activities, and, more recently, serve as tourist attractions. The many demands on water resources contribute to the complexity of Tajikistan's water infrastructure system.

The current status of water infrastructure

Hydropower development in Tajikistan plays an important role supporting sustainable development of all spheres of the economy. Hydropower resources are uniquely plentiful in the country, which has one of the highest hydropower capacities of the world – eighth in the world for total potential and among the top for unutilized potential. Tajikistan could potentially produce 527 billion kilowatts of power per hour, but at the moment is only realizing 5% of its total potential.

Irrigation is extremely important for Tajikistan as more than 90% of the country's agricultural products are produced with the help of irrigation systems. The sustainability of the agro-industrial sector is reliant on the efficient operation of highly complex irrigation and drainage infrastructures, including hundreds of different types of water intake systems; 384 pumping stations of various types and capacities; irrigation channels of different sizes with a total length of 26,193 km (including 6,042 km of inter-farm channels); 6,264 km of drainage networks (including 2,314 km of inter-farm); 1,823 units of reclamation, irrigation and monitoring wells; 374 transformer substations; 145.6 km of transmission lines; ten reservoirs for irrigation and energy purposes; over 26 km of irrigation tunnels; and other supporting infrastructure.

Water infrastructure for industry typically has

a lifespan of 30-50 years. Therefore, only newly constructed industrial operations are provided with modern water supply systems. However, under the state's latest strategy for industrial development, increased water infrastructure systems will be constructed to support growing industrial needs.

Aging water infrastructure has become more costly to operate and maintain, and municipalities often defer maintenance in order to allocate funds to more pressing needs. Therefore, some pipes are replaced only when they break. The second phase of the government programme, "Clean water and sanitation for Tajikistan", is underway; however, direct infrastructure costs continue to escalate for building, replacing, or improving water treatment plants; laying or replacing pipe; maintaining aging dams; and accessing new water sources. The territory's uneven relief creates additional challenges for creating safe and durable water infrastructures. Indirect costs are also increasing for electricity used to pump water, and for new equipment necessary to meet government regulations for contaminant treatment.

Areas of new focus

Fisheries are becoming an increasingly important component of Tajikistan's water development planning, and state programmes to develop the fishing industry will be implemented in coming years. With its 957 rivers and more than 1,300 natural lakes and ponds, Tajikistan is also an attractive destination for tourism and recreation. International tourism from outside the former Soviet countries is relatively new and has begun to develop only over the last few years, leaving many attractive locations yet to be discovered by foreign visitors. However, despite underdeveloped infrastructure, tourism in natural water areas is expected to grow.

Another important sphere requiring development focus is disaster prevention through the construction of resilient water infrastructure. The territory of Tajikistan is located in an active seismic zone, which increases the risk of flooding and potential human casualties.

Conclusion

Tajikistan's existing infrastructure requires updating to improve efficiency and effectiveness of water use for socio-economic development, pollution prevention, and disaster resistance. In response, the state is undergoing significant efforts to improve the management of projects and programmes according to a newly established system of water resources management. To meet current infrastructure challenges and develop new aspects of Tajikistan's water resources, the country aims to acquire new sources of financing, increase the number of highly-qualified specialists within the sector, and foster water-consciousness among the population. ■

Takistan has **957 rivers** and more than **1,300 natural lakes and ponds.**

90% of the country's agricultural products are produced with the help of **26,193 km of irrigation channels .**

Photo credits: Left - Lee Hughes
Right - Luigi Guarino

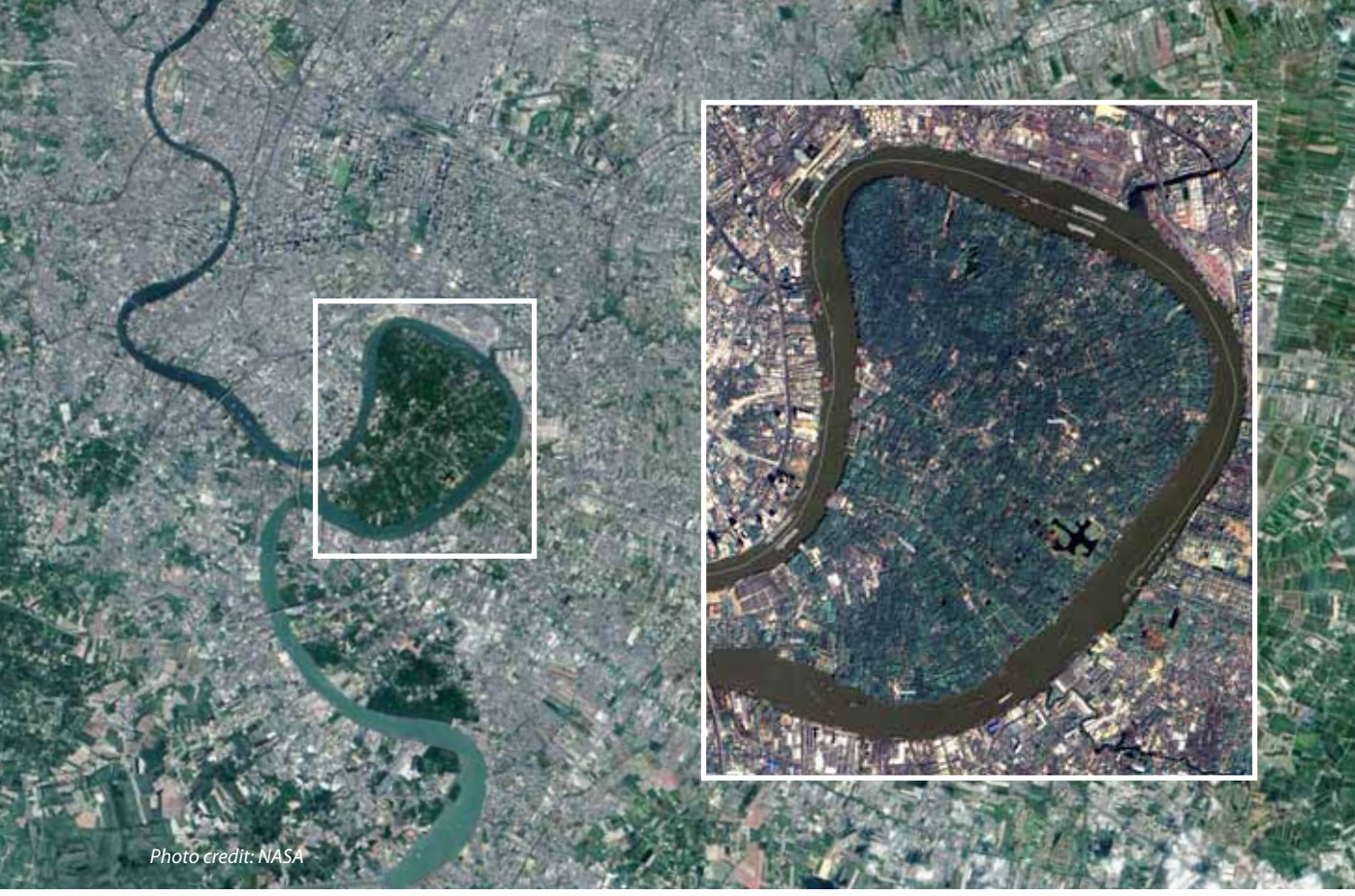


Photo credit: NASA

Bang Kachao: Preserving Bangkok's "GREEN LUNG"

Case study written with materials provided by Ampai Harakunarak, Expert, Thailand

Just a few kilometers from the congested downtown of Bangkok, nestled within a curved section of the Chao Phraya River, is an unexpected green space of over 24 square kilometers. Known as the "Green Lung of Bangkok", Bang Kachao Green Area is an urban oasis set in the middle of a rapidly expanding megacity. This forested and farmed area is home to over 600 species of flora and fauna, and stands under threat as the last remaining green belt of the Greater Bangkok Metropolitan Area.

Green destination for urbanites

Originally a settlement for a small group of ethnic Burmese Mons, known for their agricultural lifestyle and skills, Bang Kachao remains agricultural and rural, encompassing many old orchards and decorative plant gardens. Viewed as a "breathing area" for a congested and polluted city, it is a destination for residents of Bangkok and nearby provinces, as well as many tourists. Visitors and locals spend time relaxing at the Sri Nakhon Khuean Khan Green Area and Eco-management Centre, or cycling on a network of narrow sidewalks elevated two meters above the flooded marshland.

A rich environment

The area supports rich ecosystems and productive agriculture. The banks of Bang Kachao are lined by mangrove species, and three aquatic environments exist – freshwater, saltwater, and brackish water – due to tidal effects from the nearby Gulf of Thailand. Inner reaches of Bang Kachao are dominated by freshwater swamp forest and traditional agricultural landscapes. Agriculture remains the largest source of income for Bang Kachao residents, who mainly produce mangos, bananas, coconuts, and rose apples in vernacular orchards of ditches and dykes built into the flooded marshland. The agricultural land is designed to maintain soil and ecosystems and is sustained by the seasonal inundation of natural and man-made water canals connecting the Chao Phraya River to narrow ditches within orchards and gardens.

Current Land Use in Bang Kachao

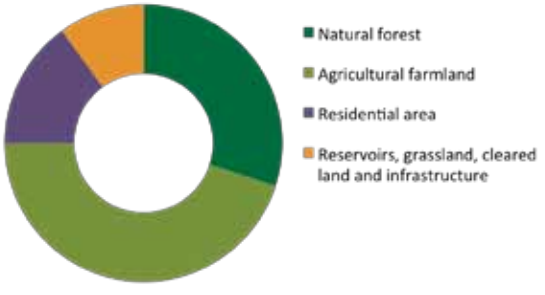


Photo credit: Sivakrit Saravit

SPECIES DIVERSITY - The Bang Kachao Green Area is renowned for its birdlife and some other rare and new species are found, including Pink-necked Green Pigeon *(Trenon vernans)*, Stork-billed Kingfisher *(Pelargopsis capensis)*, Fairy Pitta *(Pitta nympha)*, nipa palm *(Nypa fruticans)*, and the semi-aquatic freshwater earthworms of the genus *Glyphidrilus Horst*. A local variety 'Nam Doc Mai' of mango *(Mangifera indica)* is grown in Bang Kachao commercially and destined for export markets.

Threats from encroaching development

This unique area of Bangkok has been preserved from development largely due to the initiative of the local community. However, urbanization and industrialization of surrounding Bangkok and Samut Prakarn have resulted in encroachments and migration into the Bang Kachao Green Area. As Bangkok's residents gain affluence, and population density has reached more than 5,000 persons per km^2, land speculation for housing developments and new infrastructure has increased drastically. The ongoing expansion of the city has resulted in growing pressure to convert agricultural lands and natural habitats to residential or business developments, and despite tight building regulations at district and provincial level, land use change in Bang Kachao has become a major threat to ecosystem integrity and biodiversity. Ongoing encroachment has reduced green areas from 85 percent in 1990 to approximately 72 percent in recent years.

Additionally, gradual changes towards commercial agricultural methods using various fertilizers and

pesticides are posing risks to aquatic and forest ecosystems. The area also faces the problem of diminished agricultural products mainly due to decreasing available freshwater and farmland. The former is generally caused by saltwater intrusion from the Chao Phraya River and polluted drains from local residents into freshwater orchard ditches, whereas the latter is caused by land use change and land speculation.

Conservation efforts

Bang Kachao was designated as a conservation area in 1977 by Cabinet decision. In 1992, the Sri Nakhon Khuean Khan Green Area and Eco-management Centre, a biodiversity preservation featuring trees, lakes, and shaded pavilions, was established and is now under the management of Thailand's Royal Forestry Department. Currently, the Bang Kachao Green Area is under strict local planning codes that prohibit certain categories of land development such as high-rise buildings and commercial factories.

Although conservation efforts have largely managed to maintain Bangkok's Green Lung in the face of development, many current policies, strategies and regulations are potential barriers to sustainable management practices. The Bang Kachao Green Area is controlled by six sub-districts, each with their own constituencies, resources and interests. Coordination among these local administrations has been limited, resulting in a lack of clear vision for the area presented by local authorities. This lack of coordination also presents significant challenges for cross border issues, particularly the management of the canal and ditch systems and other basic infrastructures.

Furthermore, weak linkages between local governments and community-base conservation groups have resulted in several issues. Community-based conservation information and efforts have not been effectively communicated with local governments or translated into local development plans. The most recent city and township plan issued by the Samut Prakarn Province has been criticized for limited consultation with relevant and affected stakeholders.

Ongoing encroachment has reduced green areas from 85 percent in 1990 to approximately 72 percent in recent years.

To continue conservation efforts, both government and community sectors, with support from business and research communities, have been engaged to facilitate and implement the conservation of the Bang Kachao Green Area in order to prevent it from turning into another urban expansion zone. Due to its importance to local livelihoods, as a major green area on the outskirts of Bangkok, and as a tourist attraction with an emphasis on the traditional cultural landscape, Bang Kachao is a high profile area with Royal interest and support from different public and private initiatives. For example, an environmental group organized by the Green World Foundation Thailand, comprised of 200 academics and 150 members of the public, conducted a BioBlitz survey, an intense biological survey of both plants and animals. The survey found a total of 675 fauna and flora species, which will be included in a biodiversity database established to raise awareness on conservation as well as to be used by practitioners and decision-makers. A number of academic and research institutions have also joined hands to develop an integrated management plan. In addition, a project under "Sustainable Management Models for Local Government Organizations to Enhance Biodiversity Protection and Utilization in Selected Eco-regions of Thailand" is being developed by the Biodiversity-Based Economy Development Office, in close collaboration with the Department of Local Administration and other concerned agencies, with technical support from United Nations Development Programme, with potential financial support from the Global Environment Facility. The new initiative will strengthen the local development plans and activities with guidance on biodiversity conservation. ■

COMMUNITY ENGAGEMENT

For Sustaining the Bung Khong Long Wetland

Case study drafted from materials provided by Janya Trairat, Department of Water Resources, Thailand

The wetland of Bung Khong Long, located in the northeast Bungkan Province of Thailand bordering Lao PDR, covers approximately 22 square kilometers (11,2318 rai) and encompasses 18 villages in two districts. With rich biodiversity found in both permanent fresh and intermittent fresh lake habitats, the wetland is designated a "Ramsar site", appearing on the Ramsar Convention's List of Wetlands of International Importance. The site supports nationally vulnerable and endangered fish and birds and is important for some 33 species of wintering migratory waterbirds.

The local population depends on the natural resources found within Bung Khong Long's ecosystems to meet daily needs and sustain their livelihoods. Importantly, the wetlands are a vital spawning ground for a number of endemic fish species supporting the subsistence fishing industry. Although the wetlands enjoy international status, many challenges to sustaining this natural area are faced at the local level.

Land intrusion into the wetlands, flooding in irrigation areas, deforestation from the development of rubber plantations, and pollution from solid waste and wastewater, are some of the challenges to be faced in safeguarding the area's delicate environmental balances. In addition, competing interests have generated a number of local conflicts.

Ms. Kandaporn Chaipakdee has been working with stakeholders from local communities in the Bung Khong Long wetland area to conserve and rehabilitate natural areas using a process comprised of three parts: "knowledge sharing and capacity building for local communities", "GIS for research, mapping and database development" and "preservation, central and local regulation, reduced agricultural chemical use and building awareness". Community participation is essential to the process, which aims to resolve conflicts among stakeholders so that all may realise the benefits of sustainably managed wetlands.

To effectively engage with communities, Ms. Chaipakdee employs participatory strategies of networking, awareness raising regarding regulations, and utilisation of local knowledge. Recently, communities participated in the rehabilitation of local forests, an example of a successful outcome from the engagement process. For her work within the wetlands Ms. Chaipakdee earned the 2014 "Award for Woman of Excellence" on National Environmental Conservation from Thailand's Ministry of Natural Resources and Environment.

Biotechnology

FOR IMPROVED WATER QUALITY AND AGRICULTURAL INDUSTRY GROWTH

Case study drafted from materials provided by Sukanlaya Chan, Best Care International (Thailand) Co.,Ltd.

Major Challenges and Goals

Utilize biotechnology to improve the critical wastewater situation in the Sam Kway Puak and Pho Huk–Bua Ngarm Canals of Thailand's Nakornpatom and Ratchburi Provinces.

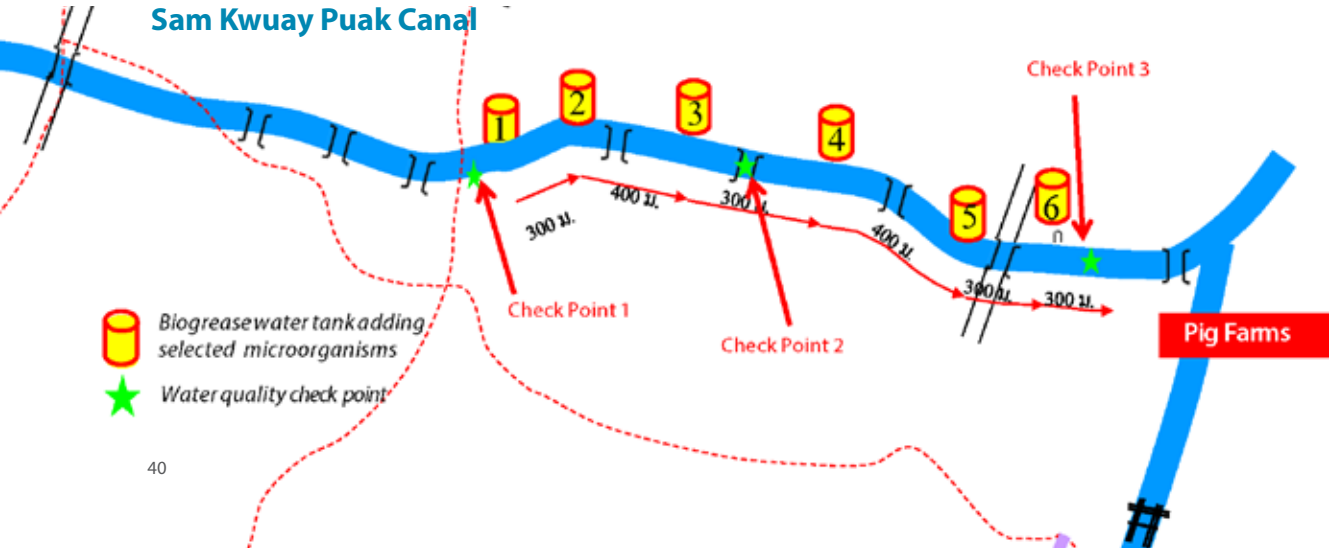
Educate, create a sense of responsibility, and stimulate participation among stakeholder communities.

Implement actions leading to improved natural water resources to support sustainable growth of the regional agricultural industry.

The goal of Thailand's central regional agricultural group, including Nakornpatom, Kanchanaburi, Rachaburee and Suphanburi Provinces, is to become the centre for production and exportation of high-quality agricultural products. To achieve this goal, clean and plentiful water sources are essential.

The central provinces are mainly supplied with the water flowing from canals within the Tar Jean River and Mae Klong River Basins. However, pollution and untreated wastewater from nearby communities, landfills, livestock farms, and industrial factories are discharged into these public water supplies, seriously impacting the water quality. According to data issued by environmental authorities, the water quality of the public waterways ranged from very poor to critical.

Two critical public water sources were identified as the focus for this initiative – 1) the Sam Kway Puak Canal (Tar Jean River Basin in Nakornpatom Province), a main canal supplying water for agricultural areas comprised



A **clean start** for polluted waterways.

Micro-organism technology improved water quality. Here, the Sam Kway Puak Canal after two months treatment., and community-grown crops in a restored waterway.

BOD, COD, and SS counts

↓ more than 50%

Dissolved Oxygen

↑ more than 70%

Community Engagement

↑ Highly positive community engagement through cooperation in waste management and wastewater treatment prior to discharge into public waterways.

✕ Effectively eliminated odours and floating sludge, improved water appearance, and, most importantly, enabled the return of several important fish species.

of pig farms, landfill sites, and industrial factories, and 2) Pho Huk - Bua Ngarm Canal (Mae Klong River Basin in Ratchburi Province), which courses through heavily populated communities and connects to Damnuen Saduak Canal.

Implementation Approach

1. Survey and identify point sources of discharged wastewater.

2. Install continuous drip apparatuses dispersing selected microorganisms. Automatic interval dripping controlled by solar PV-powered technology.

3. Educate people on aspects of solid waste and wastewater management, and encourage a sense of environmental responsibility.

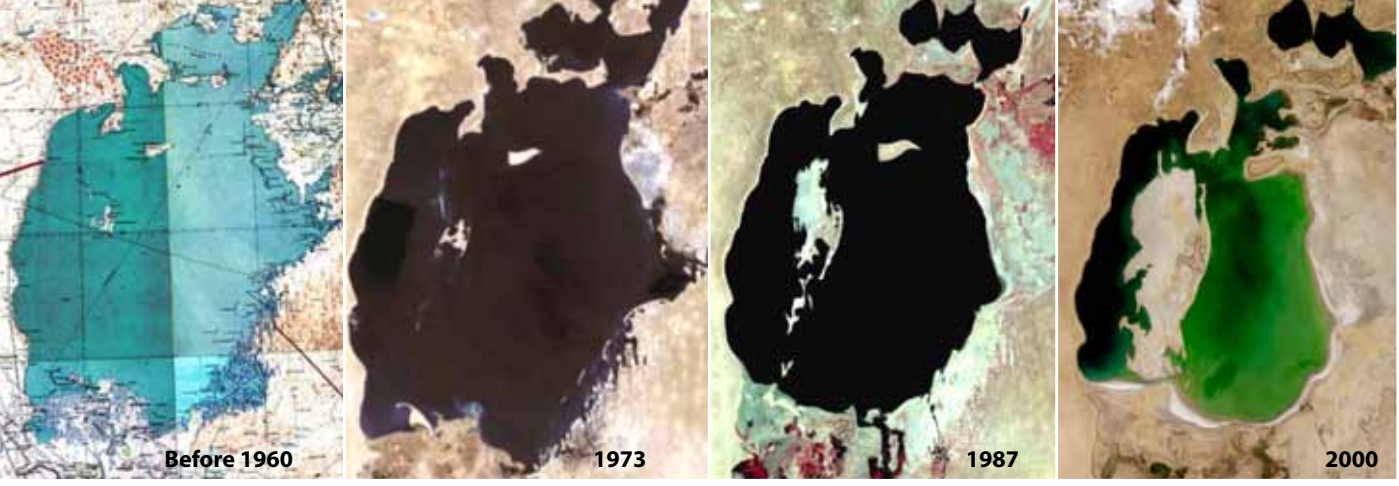
4. Generate scientifically accurate data on both physical and chemical characteristics of water sources before and after project implementation.

SUSTAINABILITY REQUIREMENTS

-Continued financial support
-Environmental regulation enforcement
-Public and private sector alignment

Programme Results

Following programme activities and treatment with biotechnology, the Sam Kway Puak and Pho Huk-Bua Ngarm Canals experienced considerable improvements in water quality. Floating sludge and odors were eliminated, while water clarity was increased. Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Suspended Solids (SS) were reduced by more than 50% while Dissolved Oxygen (DO) was up more than 70%. Issues of waste management and wastewater treatment were positively addressed through community engagement that will help prevent future pollution of public waterways. ■



Improving Water Resource Management in the Aral Sea Basin

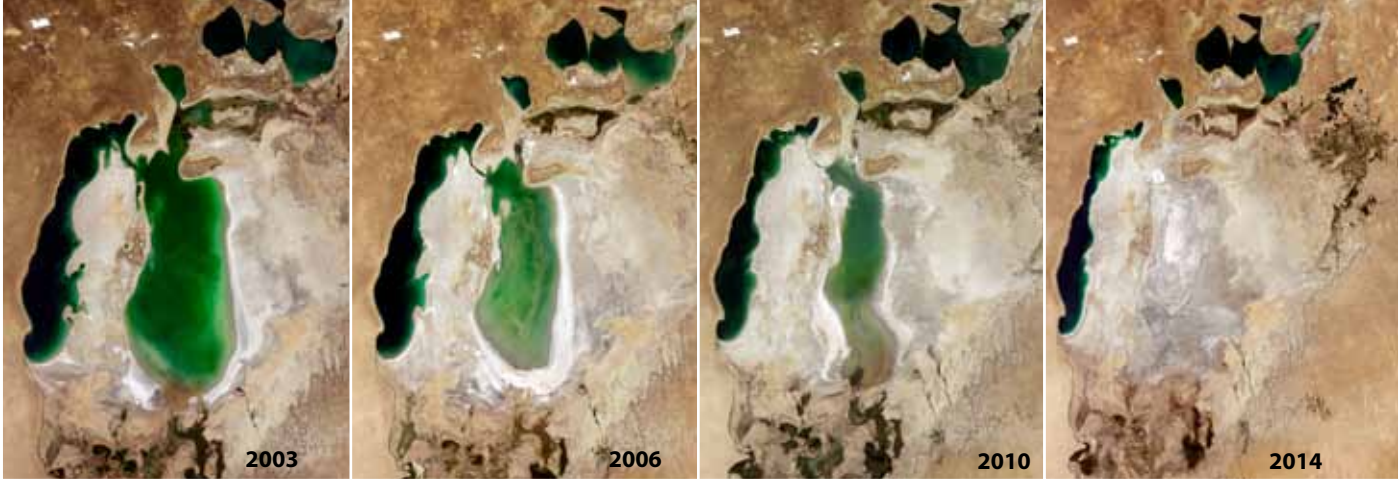
Case study drafted from materials provided by Vadim Sokolov, GWP CACENA / Scientific-Information Center of the ICWC, Uzbekistan

The dramatic shrinking of the Aral Sea is a well-known environmental disaster that affected millions of people living in the surrounding region. It is a place where processes and phenomena of the area are magnified and manifest more complex behaviours due to excessive human pressure that radically distorted environmental systems and the influence of climate change. Evolutionary changes take place within a short period of time; changes which, under other conditions, could take centuries. Desertification processes, including loss of vegetation cover and further aridization of climate conditions, have inevitably led to changes in biodiversity, species composition, and abundance of indigenous symbiotic biological communities.

Over the last decade, the Scientific-Information Center of the Interstate Coordination Water Commission of Central Asia (SIC ICWC) has carried out field observations of the Amudarya River Delta and dried seabed of the Aral Sea, now known as the Aralkum Desert. Monitoring of lake systems and wetlands has been performed, and hazard-prone areas and unstable ecological zones identified. Based on research results, an engineered system of well-regulated wetlands is proposed to serve as a key component of a broad and complex programme to mitigate the environmental damages experienced in the Aral Sea Basin. The system is designed to guarantee delivery of water that is critical to the prevention of damage to flora and fauna, as well as supporting the wellbeing of the local population.

Linkages between people and environment

The people of Central Asia, who predominantly live in rural areas, have strong associations with climatic conditions and natural landscapes, and recognise linkages between land, water and biological resources. People in this arid zone are drawn to the earth; rural residents generally possess a strong desire to cultivate their own land, even small plots, and the urban populace tends to

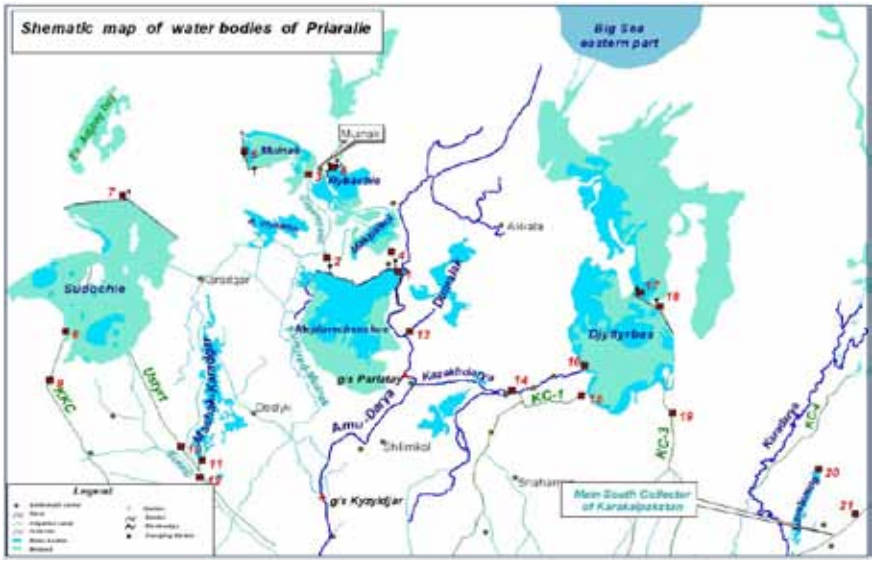


grow gardens and tend horticultural plots. On one hand, there is a line of support for the public to be involved in growing solutions for food security through the promotion of a large number of small private businesses. On the other hand, this approach cannot be properly regulated by national legislation, possibly leading to improper use of natural resources and land, and resulting in significant degradation.

An example of degradation is found within the region's forest areas. Human influence is the major factor causing negative impacts to the forest area, structure, and species composition, and leading to soil degradation, water pollution, and overall loss in vital social benefits derived from forests. Afforestation offers an opportunity for increasing productivity of the natural landscape and mitigating the consequences of past disasters caused by both anthropogenic and natural influences.

Water management for green growth

The most important task now for Central Asia is to reduce the devastating impact of the Aral Sea crisis on the environment and the livelihoods of millions of people living in the region. To confront pressing environmental circumstances, Central Asian countries view "green growth" as a balanced and comprehensive instrument supporting the protection and sustainable use of natural resources for future economic growth in the Aral Sea's coastal zone of Priaralie. Well-designed and fully funded measures should aim to improve water resource management systems in order to maintain the existing



Measures for improvement of aquatic ecosystems and environmental conservation within the Aral Sea disaster zone:

- Reaching agreement among riparian states on minimum obligatory volumes of water releases for in-stream and environmental needs in order to sustain ecosystems restored in the Amudarya delta.
- Overhaul of long-term water regulation practices in transboundary watercourses.
- Performance of systematic environmental monitoring, projection of environmental development, and elaboration of concrete measures to prevent further degradation.
- Supply of national hydro-meteorological services and basin water organizations with modern equipment for accounting and forecasting of water resources, and monitoring of environmental changes and sanitary-epidemiological conditions.
- Improvement of the water regime and quality management system for delta ecosystems, including regulation of water exchanges between lake systems and water discharges ensuring self-cleaning capacity of lakes and wetlands.
- Creation of favourable thermal regimes for fish and biological habitats.
- Application of modern chemical and biological methods of wastewater treatment.
- Implementation of land reclamation, afforestation, and agronomic measures to ensure environmental stability.
- Obligatory and independent ecological evaluation of new water-use projects.

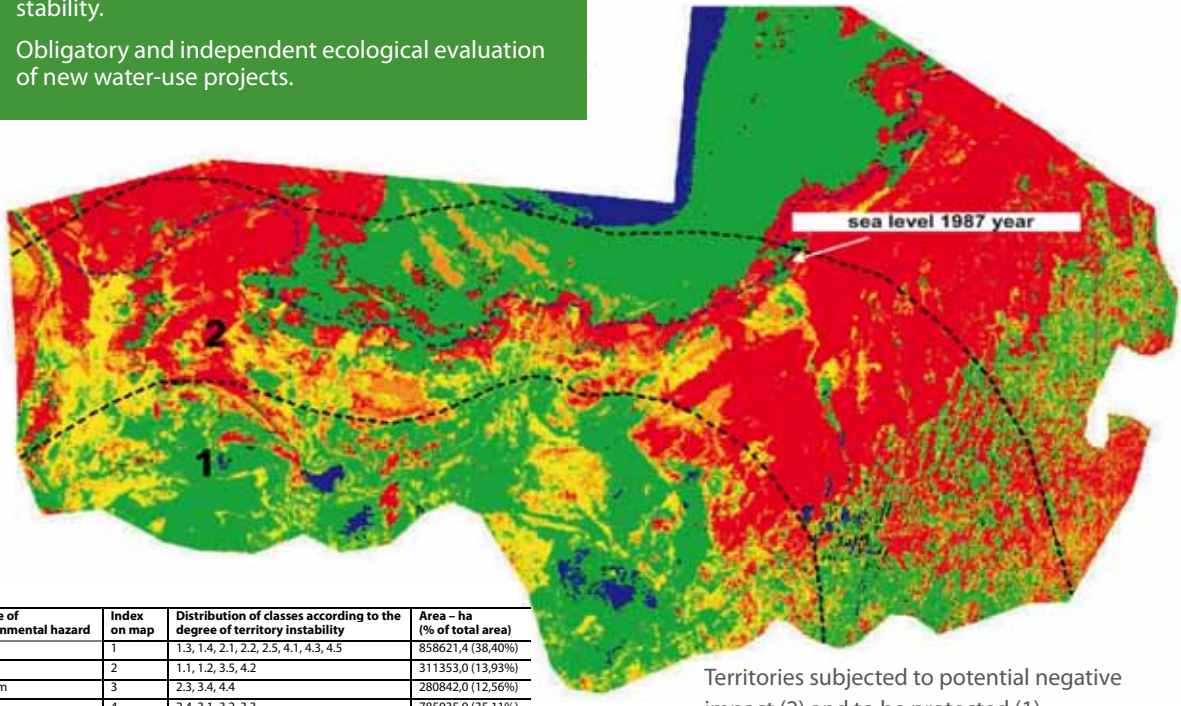
fragile ecological balance, which is critical to the preservation and restoration of biodiversity, and for combating desertification. Creating the necessary mechanisms and incentives to improve the quality and standard of living, while ensuring the economic and rational use of water resources, can enable the population in Priaralie to enjoy a decent living standard and gain access to new income-generating opportunities.

Assessment of the social-economic damage under the influence of the Aral Sea level lowering for South Aral Sea coast. Tashkent. August, 2001, p80.

Dukhovny V.A. and Joop de Schutter. Water in Central Asia: past, present, future. Taylor and Francis, London, 2011.

http://www.cawater-info.net/aral/data/satellite.htm

Multi-year observations resulted in proposed ecological zoning for economic planning and development, especially for agricultural sector.



Degree of environmental hazard	Index on map	Distribution of classes according to the degree of territory instability	Area – ha (% of total area)
No	1	1.3, 1.4, 2.1, 2.2, 2.5, 4.1, 4.3, 4.5	858621,4 (38,40%)
Low	2	1.1, 1.2, 3.5, 4.2	311353,0 (13,93%)
Medium	3	2.3, 3.4, 4.4	280842,0 (12,56%)
High	4	2.4, 3.1, 3.2, 3.3	785035,0 (35,11%)

Territories subjected to potential negative impact (2) and to be protected (1)

Large-Field Production Zones

A SUSTAINABLE RICE PRODUCTION AND WATER MANAGEMENT MODEL IN THE MEKONG RIVER DELTA OF VIET NAM

Case study drafted from materials provided by Dang Kim Khoi, Institute of Policy and Strategy for Agriculture and Rural Development, Viet Nam

Viet Nam's rice production sector is considerable, contributing 7.8% to the nation's GDP, covering 15.7% of agricultural land, and providing sustenance to 9.27 million farming households. The rice industry, comprised primarily of small-scale farms, faces a number of challenges to maximising productivity, assuring environmentally sound practices, and maintaining prosperous livelihoods. This case study examines improved production practices introduced by Ang Giang Stock Plant Protection Company (AGSPP), a private company formed in 2004 with five main business sectors: seeds, pesticides, packaging, rice for export, and tourism.

Competing demands on water resources present a number of challenges to effective and sustainable management. Rice production is disaster prone, with one of the largest risks posed by pests. However, the overuse of pesticides by individual farmers has resulted in the pollution of shared waterways. Rice plots tend to be small-scale and scattered, posing challenges for directing and controlling water flows for irrigation. The difficulties of inadequate water infrastructure, compounded by insufficient knowledge of best practices, has resulted in water overuse and increased greenhouse gas emissions. Furthermore, farming schedules and water withdrawals lack coordination and are the source of conflict between rice farmers and other water users.

As a response to the many issues faced by small farmers within the rice industry, AGSPP establishes larger-field production zones that consolidate small plots of land into larger areas, supports coordinated production, and enables cost sharing of water infrastructure. Farmers are organized into production teams and can take advantage of 120-day interest-free financing for seed, fertilizer and pesticide inputs, they are provided with production, harvesting and transport support, and are offered free drying and 30-day storage for their rice.

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The close linkages between the company and farmers create advantages of coordinated production and economies of scale, resulting in more sustainable production processes at lower production costs. Production becomes more competitive through a shortened and strengthened rice value chain that also maintains the autonomy of farmers to make the business decisions of when to sell their rice and at what price.

Challenges to applying the large-field model to sustainable rice production

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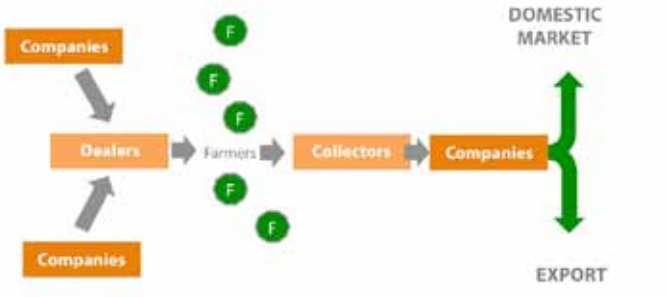
Conclusion

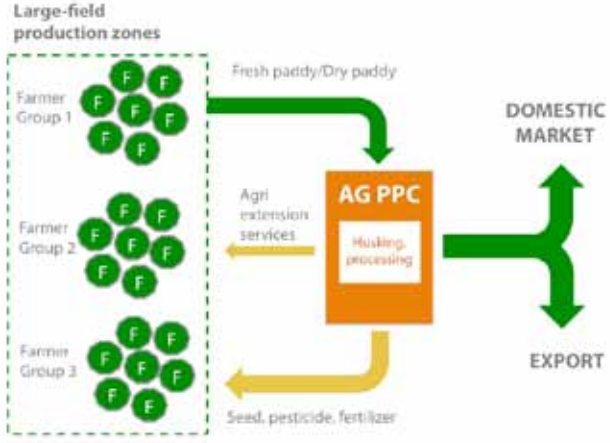
Presently, AGSPP has a total manpower of 2,000 people from 800 farming families. The company has branches selling its products in 40 provinces and Cambodia and operates four factories with a total capacity of 380,000 tons. The company's model has demonstrated the potential to better production practices, improve resource management, and reduce inputs resulting in increased profits for both the company and its partner farmers. With the appropriate measures, the large-field production zone approach can increase the productivity and sustainability of the nation's rice industry as a whole.

SHORTENING AND STRENGTHENING THE RICE VALUE CHAIN

Current Situation



The Large-Field Production Zone Model



WATER AND GREEN GROWTH

Extracted from the concept Note prepared from ESCAP & K-water Workshop, Feb 23rd - 25th 2015 for ESCAP's Workshop in preparation for the 7th WWF

Water underpins agriculture and food production, which is the main source of GDP for many developing and under developed countries. Water will have direct linkage with long term prospect of economic growth, necessary to reduce poverty and job creation

With rapid economic growth and accelerated urbanization in Asia and the Pacific, demands for water increases with huge pressure on supply of water. Waste water in the region is generally released untreated into the natural systems, polluting the natural waterways, further increasing the pressure on water supply. Concurrently the region is also worst affected by disasters, further exacerbated by impacts of climate change.

Green growth is a new paradigm to sustain economic growth by investing in eco-system and natural resources including water. Current paradigm of maximizing short term GDP at the expense of the well-being of people and the planet is undermining long term prospect of economic growth of many developing countries of the region. Green Growth is an attempt to reconcile short term policy focus on economic growth with the long term policy goals of environmental sustainability by closing the time gap between the short term economic efficiency with the long term ecological efficiency, thus ensure long term economic prospect critical for poverty reduction can be sustained

Green growth attempts to transform the way our economy produces and consumes, by restructuring the visible and invisible structures of the economy. Water is a critical component of the visible structures of our economy. Applying green growth approach means "investing in long term water resource management" and "improving economic and ecological efficiency of water supply and demand" so that water can continue to support rather than to limit long term economic growth prospect critical for poverty reduction and job creation.

These will include improving ecological efficiency of water resource management through IWRM and improving economic efficiency of water supply and demand through water-energy-food nexus related with man-made water system, agriculture, sanitation and hydropower Applying green growth approach will also focus on balancing the role of public and private sector as the public sector plays a critical role in setting up long term goals and strategies of water resource management while private sector is focusing on short term economic efficiency of water supply and demand

By linking green growth with water resource management, Asia and the Pacific countries can sustain their long term economic growth prospect, support rapid urbanization and drive agricultural and industrial development while improving their resilience to water related disasters and be better prepared for water shortage and drought, and improve their sanitation, critical for the well-being of people of the region. Green growth is a concept that can steer the region to sustainable development.