



## Preface

Concerns regarding water availability, clean water, sanitation, and sustainable development have been voiced throughout the world, particularly against the background of vulnerabilities related to climate change. The United Nations proclaimed 2005-2015 as the *Water for Life International Decade for Action*, with the primary objective of promoting efforts to fulfill international commitments on water related issues. These commitments include the Millennium Development Goals to reduce by half, the proportion of people without access to safe drinking water by 2015, and to stop unsustainable exploitation of water resources. Two other goals identified at the 2002 World Summit on Sustainable Development also were adopted as part of the *Decade for Action*: halve, by 2015, the proportion of people who do not have access to basic sanitation; and develop Integrated Water Resource Management and water efficiency plans.

This book is a collection of 12 invited and peer-reviewed papers that address water and development issues identified under the United Nation's *Decade for Action*, with a specific focus on Southeast Asia. Most papers address an issue specific to a country. While a country-specific focus offers a needed perspective, many of the issues discussed in these papers transcend borders and are of region-wide concern. We believe these papers make a valuable contribution to the general literature on water resources and development, but we also hope the book will generate new dialogue between west and east. This book represents the inaugural publication under the auspice of the newly formed Center for Southeast Asia Environment and Sustainable Development at Buffalo State; we hope you find it both interesting and informative.

Samantha Jones' paper, *Land of a Million Elephants? A Review of Environment and Development Issues in Laos* is the lead-off for the book. This paper provides an extensive overview of environment and development issues being faced in Laos, by reviewing the trends in the key environmental resources in the country as they are shaped by their political, economic and social context. It begins with a brief contextual introduction to the physical geography, political and economic history of the country, followed by discussion which relies on available literature, to explore the mechanisms by which some of these tensions play out in the Laotian landscape. The challenge of preserving or exploiting forest is at the core of political debate



as regional imbalances, coupled with ethnic stratification, have led to political ethnic unrest and environmental degradation. In addition, inequalities emerge as a consequence of environment becoming increasingly commercialized with the progression of a neoliberal agenda in the country. It is argued that rather than forcing people to settle in the lowlands, investing in upland agriculture *in situ*, through rural extension and veterinary services could enable productive, diversified and sustainable smallholder systems to develop and facilitate settled upland cultivation systems. In addition, it is recommended that government adopt a more cautious approach to strengthen the monitoring and enforcement capacity of regulatory agencies to avert the environmental consequences of growth-oriented development policy. Furthermore, enhancing transparency and more effectively recovering timber royalties would reduce the 'leakage' from dwindling natural resources and lay a strong economic foundation for the government to achieve its poverty reduction goals.

The focus of the book moves geographically to Cambodia for the next four papers, the first being *Arsenic in Groundwaters of Cambodia* by David A. Polya and his colleagues. They note that chronic exposure to arsenic is resulting in thousands of excess deaths per year in areas such as Bangladesh and India and since 1999 it has been identified as a major concern in the groundwater of Cambodia. The paper reviews the distribution of arsenic in shallow aquifers of Cambodia, noting that concentrations can be highly variable within short distances, but at a larger (national) scale there are significant correlations with geography, geology, and depth that underpin informative spatial modeling. Unfortunately, the highest arsenic concentrations tend to be found at depths that correspond to many of the tube wells drilled over the past decade. The paper also discusses the controls on groundwater arsenic levels, noting that the arsenic is naturally-sourced from erosion of arsenic-bearing rocks in the Himalayan Mountains. The arsenic appears to be mobilized from aquifer sediments, particularly in the Mekong floodplain, through reduction processes driven by abundant organic matter. The paper wraps up by examining human exposure and health risks related to groundwater arsenic and suggests some intervention strategies to reduce risk. Based on sampling, arsenic intake from the combination of water and rice may exceed the maximum tolerable daily intake by 2-16 times.

Tom Murphy and his colleagues continue the theme of arsenic contamination in the third paper. Specifically, they addressed arsenic bioaccumulation in an arsenic rich area of Cambodia. Use of tube wells with arsenic rich groundwater is relatively new in Cambodia but in recent



years, arsenic toxicity has resulted in keratosis and related suffering. Relative to the consumption of arsenic in groundwater, they conclude that food is a much less important source of arsenic. Concentrations of total arsenic in rice were similar to those reported in Bangladesh ( $224 \pm 116 \mu\text{g}/\text{kg}$ ,  $n=16$ ). Rice in Cambodia had a very low proportion of inorganic arsenic (4.5%) which is among the lowest reported. Fish from natural wetlands had a higher content of total arsenic ( $4,335 \pm 1,306 \mu\text{g}/\text{kg}$ ,  $n=11$ ). Two samples from an aquaculture facility had much less total arsenic ( $224 \mu\text{g}/\text{kg}$ ) which was 20% inorganic. Analysis of snails indicated that the wetlands with the most arsenic in water and sediments had snails with the highest content of total arsenic, including higher proportions of inorganic arsenic and monomethylarsonic acid. The average content of arsenic in snails and clams in the natural wetlands was  $7,740 \pm 2,170 \mu\text{g}/\text{kg}$ ,  $n=17$ , of which  $5.4\% \pm 6.3\%$  was arsenate. The total arsenic content of water lily and lotus shoots was  $60 \mu\text{g}/\text{kg}$  with  $\sim 100\%$  as inorganic arsenic. The sampled commercial fish and rice complied with the Chinese, American and British food guidelines but much of the food collected from the wetlands would not satisfy these guidelines. These wetland foods are an important source of protein, iron and other nutrients to disadvantaged Cambodians. The dietary intake of these products as a percentage of the RfD for arsenic was calculated as follows: water, 4,400%; fish, 68%; rice, 29%; snails and clams, 4%; and lotus and water lily shoots, 2.9%.

In *A Review of Cambodian Climate Hazards, Vulnerabilities and Responses*, Va Dany and her colleagues examine the delicate state of Cambodia and its ability to adapt to a changing climate. In reviewing the climate change literature the authors note that Cambodia will likely experience temperature increases, enhanced evaporation, and possibly more extreme rainfall events. Anticipated impacts will be in the form of floods, droughts, epidemics and storms. Each of these environmental impacts is explored as they affect Cambodia today, and as they may affect a future Cambodia. For example, changes in the Mekong basin hydrology, due only to climate change, will likely have a more significant impact on the Tonle Sap flood pulse, than a rise in sea level. The broader reaches of an environmental impact are also discussed. For example, the impact of increased flooding not only damages physical property and threatens lives, but it contributes to rice production loss, erosion, the pollution of water sources, the shortage of safe drinking water, and increases in disease. The authors note that Cambodia has a relatively low adaptive capacity due to poor infrastructure, technology, and socio-economics. Furthermore, the local people have a very poor adaptive capacity to environmental shocks due to



limited livelihoods, earning activities, and limited awareness. Recognizing these constraints, existing disaster risk reduction programs - focusing on early warning, emergency relief assistance, and community based disaster risk management – are discussed, along with recommendations to improve these programs.

The final paper that focuses on Cambodia is by Kim Irvine and colleagues in which they discuss *Integrated Water Resources Management – Opportunities and Challenges for Cambodia*. The paper begins by reviewing the general principles of Integrated Water Resources Management (IWRM), the conditions that are seen as essential for the implementation of IWRM, and the history of IWRM development. IWRM in the context of the Laurentian Great Lakes-St. Lawrence system is then examined. The Great Lakes-St. Lawrence system has some important parallels with the Mekong/Tonle Sap system in that both are transboundary waters and both experience competing water uses. Success stories of using IWRM principles (often termed an ecosystem approach in North America) for water resource management in the Great Lakes are examined as a backdrop for the Cambodian situation. It is concluded that Cambodia has established the basis for what could become effective IWRM. The legal framework has been established, but there still are challenges with respect to political will, commitment, and transparency. Effective capacity building is essential both for government agency staff and the public. Improved data collection techniques and monitoring plans are needed and more effective coordination between government agencies, donor countries, and non-Government Organizations also is needed.

Moving to Vietnam, Trinh Thi Long provides a comprehensive review of the *Water Environment in Vietnam*. The very impressive economic growth experienced in Vietnam over the past 15 years, fueled in particular by industrial development within 154 designated industrial zones, is discussed in terms of the pressures such development also places on the water environment. For example, the proportion of total water demand attributed to industry increased from 1% in 2001 to its current level of 16%. Issues of water demand and supply for agricultural and domestic uses also are discussed. Water quality challenges are illustrated through various interesting data sets, including nutrient, chemical oxygen demand, and dissolved oxygen data for the Mekong Delta. Water quality pressures are being felt in all parts of the Delta due to increased utilization of agrochemicals as well as urbanization. Vietnam also has concerns about upstream impacts on water quantity and quality; the impact of dam construction on the Mekong River and major tributaries is given special



attention. Finally, water resource management mechanisms in Vietnam are discussed, including the legal framework, responsible government agencies, and priority action plans. Vietnam's water laws are directed towards implementation of IWRM principles with the hope of balancing economic development and environmental well-being.

From Thailand, Thammarat Koottatep and Atitaya Panuvatvanich discuss work centered at the Asian Institute of Technology in their paper, *Constructed Wetlands for Effective Wastewater Treatment*. First, they provide an overview of different constructed wetland designs and then focus on the successes and challenges of wetland implementation through several case studies. Most interesting is the successful construction and operation of the wetland for the island of Phi Phi. This wetland is shown to effectively treat domestic and commercial waste (e.g. 94.4% for BOD; 99.6% for fecal coliform; 94.7% for grease and oil; 59.4% for total phosphorus) and at the same time has an aesthetic design of its cells (a butterfly fluttering on a flower) so as to attract people in the popular tourist destination of Phi Phi.

The following paper, *People's Participation in Wastewater Management: A Case Study of Phi Phi Island*, by Kannapa Pongponrat provides a good complement to Koottatep and Panuvatvanich's work. This paper describes the tragic event of the 2004 tsunami that destroyed Phi Phi's existing wastewater treatment system and led to the innovative design of the constructed wetland described by Koottatep and Panuvatvanich. Pongponrat, however, focuses on people's participation and perception of the process of wastewater management in their community. Through interviews and questionnaires a number of institutional-based constraints (e.g. unclear development plans, no consistent monitoring or auditing process, confusion resulting from overlapping agency mandates and regulations) and local people-based constraints (e.g. lack of information dissemination, lack of a strong local leader, limited personal time) were identified as challenges to effective participatory planning and management. Recommendations are provided to improve community participation in wastewater planning and management, including: the development of a clear blueprint of action; clear rules and regulations for wastewater management; and establishing a joint government/citizen group to coordinate decision-making, implementation, monitoring, and assessment. Parallels are drawn with the island of Samui which has effectively implemented community participation in wastewater management.

Ratchadawan Ngoen-klan and colleagues begin their paper, the *Epidemiology of Liver Fluke Parasites in Southeast Asia* by reviewing the life cycle of the liver fluke from human excretion to the first intermediate



host (*Bithynia* snail), second intermediate host (cyprinoid fish), and final intake by the reservoir host (human, cat, or dog). Generally, humans suffer from the parasite by eating raw (including fermented) or improperly cooked fish that are characteristic of several popular dishes in Southeast Asia. Health impacts range from mild symptoms including gastro-intestinal upset to moderate/severe conditions including cholangitis and obstructive jaundice, and most critically, cholangiocarcinoma. The most effective treatment for liver fluke infection is praziquantel. The prevalence of infection in Thailand, Lao PDR, Vietnam, and Cambodia subsequently is discussed. Liver fluke infection is reasonably well-documented in Thailand, Lao PDR, and Vietnam, but only a few studies exist for Cambodia. Liver fluke infection depends on two intermediate hosts and as such, there are environmental constraints to the distribution of infection. Fecal contamination in Thailand, for example, generally is greatest with the runoff of the early rainy season, and this represents the time of greatest potential for infection. Because the host snail species tend to be found predominantly in northeastern, northern, and central Thailand, liver fluke infection in southern Thailand is constrained.

The paper by Indrawan Prabaharyaka and Vincent Pooroe, *Participatory Urban Water Supply in Jakarta Sum Area*, seeks to offer an alternative approach to water supply management in the context of Indonesian urban poor settings where socio-economic gaps have created a discrepancy in access to water. Jakarta, Indonesia's capital, along with its slum areas are examined in terms of their access to a piped network because they have been affected by changes in the government's water regulation and privatization in the last decade. Using a community-based water supply project in Penjaringan, one of Jakarta's slum areas, as a case study, water is found to be related to poverty in that urban poor suffer a higher price of water due to a limited connection to the piped network. This project works in partnership with a local community, government, and private water operator, and community-based organizations. As a result, this paper serves as documentation of challenges and opportunities for further research and solutions on practical urban water supply issues.

The theme of drinking water quality is carried on by Mollah and his colleagues in their paper, *Drinking Water Quality and Health Impacts of Flooding in Dhaka, Bangladesh*. We recognize that Bangladesh technically is not considered Southeast Asia, but the commonality of the challenges related to clean drinking water made this paper a natural fit for our book. Using interviews and surveys an epidemiologic study is undertaken for the slums of Dhaka, Bangladesh. Dhaka is a flood prone city that experiences



stagnant water and drainage problems (inundation). Diarrhea is epidemic in the city slums during yearly flood periods. Disability Adjusted Life Years (DALYs) were used as one of the indicators for measuring aggregated health losses. Slum communities were selected as representative of two water inundation categories - the duration and type of inundation. Each category is further broken down into a series of subcategories. The authors provide a detailed methodology, as well as a detailed analysis of inundation conditions and disease burden in their paper. By way of example, disease burden is shown an average of 305 (range 173 – 843) times higher in inundated locations as opposed to non-inundated ones. The type of inundation is also an important factor. The study findings have suggested that poor drainage may be more problematic when the inundation is ‘persistent’ - persistently not-drained water can be severely contaminated by dweller’s unfavourable sanitary behaviors such as open-field defecation. On the other hand, the duration of inundation condition does not matter if inundation type is ‘heavy rainy’, as rain water can flush such contaminated water in a short time. Another conclusion drawn from this study is that household level water treatment is a paramount necessity for the poor urban communities in Dhaka, Bangladesh, and that the simple intervention of adding a chlorination tablet into drinking water can achieve more than a 14 fold health gain associated with diarrhea.

Mustafa and Ibrahim’s paper *Brackish Water Aquaculture in Malaysia – An Overview* provides an important summary about a growing industry that is providing both food security and a lucrative source of income for local people. Land space used by the industry has increased from 900 ha in 1974 to 13,200 ha in 2004. By 2006, aquaculture production reached 212,067 tons, with a value of \$3.83 million USD. Prawn aquaculture, and particularly tiger prawns, forms an important part of the industry. However, there are a number of challenges facing tiger prawn aquaculture, including development of production practices that minimize harm to the environment (especially mangrove swamps), appearance of new diseases, marketing and financial risks.

*Sincerely, the Editors:*

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