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Research Partnerships for Sustainable Development in Southeast Asia

Highlights of the NCCR North–South Program
in Southeast Asia, 2005–2009



Message from the Regional Coordinator

“Research partnerships are a key instrument for sustainable development in Southeast Asia”

The Southeast Asian countries have shown high rates of economic growth in recent years. At the same time, the region has undergone drastic changes as a consequence of the worldwide ecological, social and economic dynamics. While renowned as one of the richest regions in terms of the variety and quality of its environment, the (partly uncontrolled) economic development has placed increased pressure on its natural resources. Deforestation, soil degradation and pollution of water resources have emerged as the key environmental and public health issues. Given the continuing rapid expansion of the population, the more vulnerable groups face a growing risk of marginalization; the distribution of wealth remains one of the most important social challenges in the region. In order to be able to cope with such rapid and drastic changes, new knowledge and increased research capacities towards more sustainable development are required.

Since 2002, the NCCR North-South program has provided a unique platform for research partnerships. More than 40 researchers from Switzerland and Southeast Asia have conducted joint research related to the core issues of the region, namely (i) environmental sanitation and health, (ii) livelihood and environment, and (iii) innovative urban planning. This publication presents the research highlights, the main achievements in terms of capacity building and education, and the regional impact of the NCCR North-South partnership network in the second phase of the program (2005-2009). The NCCR North-South adventure will continue for another four years until 2013, during which time the network of research partnerships will be consolidated and prepared for continuing activities beyond the lifetime of the program. Our vision beyond 2013 is to become a regional hub of research excellence for sustainable development.

Dr. Thammarat Koottatep

Asian Institute of Technology (AIT)
Regional Coordinator, JACS Southeast Asia



Message from the Regional Advisory Board

“Striving for excellence in research for sustainable development requires trans- and multidisciplinary knowledge and actions”

My involvement in the NCCR North-South program started in 2001, when I had the great privilege to participate in the preparatory phase of the program. In two workshops conducted in Switzerland and Vietnam, the core problems of unsustainable development in Southeast Asia were critically discussed, with a focus on the urban/peri-urban and the highland-lowland contexts. An important finding of this pre-synthesis project was the necessity to conduct inter- and transdisciplinary research on integrated environmental management as a means to improve living conditions in Southeast Asia. As the Chairman of the Regional Advisory Board of JACS SEA, I highly congratulate the NCCR North-South team for their great scientific achievements which contribute towards sustainable development in the region. I sincerely wish the NCCR North-South continued success in producing scientific excellence on sustainable development through global research partnerships.

Prof. Dr. Chongrak Polprasert

Director of the Sirindhorn International Institute of Technology (SIIT)
Chairman of the Regional Advisory Board (RAB), JACS Southeast Asia



Message from the Main Swiss Partner

“Research partnerships for the benefit of millions of people in Southeast Asia to lead a healthy and productive life”

The lack of adequate environmental sanitation has been identified as one of the main issues related to sustainable development in Southeast Asia. According to the latest statistics, about one third of the population has no access to improved facilities. The consequences are dramatic: high morbidity and mortality rates (mainly among children under five) due to excreta-related diseases and major negative impacts on the countries’ economies. A recent four-country study examining the major health, water, environmental, tourism and other welfare impacts associated with poor sanitation in Southeast Asia has shown that the annual per capita losses range from 9 US\$ in Vietnam to a high of 32 US\$ in Cambodia. Through the NCCR North-South it was possible to strengthen existing, and establish new, research collaborations between partners in Switzerland and in Southeast Asia to find new ways how to improve the situation for the large proportion of the population still deprived of leading a healthy and productive life due to the lack of improved sanitation.

Roland Schertenleib

Former member of the directorate of Eawag
Head of the Institutional Partner Eawag/Sandec

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Research Partnerships for Sustainable Development

The NCCR North-South program focuses on processes of global change and their significance for sustainable development. Research focuses on four core themes, with case studies undertaken in nine different regions of Asia, Africa, Latin America and Switzerland.

The NCCR North-South is one of twenty National Centers of Competence in Research (NCCR) implemented by the Swiss National Science Foundation. The program was launched as a 12-year program in 2001, with the aim to establish the foundations for advanced research in sustainable development, in the North as well as the South. The overall goal of the NCCR North-South is to contribute to sustainable development through partnership research, capacity development and societal empowerment in developing and transition countries, while developing a formal institutional network between these countries and with Switzerland.

Research approach

NCCR North-South research is conducted in a framework that combines and adapts the methods of traditional scientific disciplines to meet the needs of a changing world. Scientists from the social, natural and engineering sciences work together as teams to define new fields of interdisciplinary research capable of addressing the complex issues of sustainable development.

NCCR North-South research is carried out in partnership between researchers and research institutions in Switzerland and their counterparts in eight regions (so-called Joint Areas of Case Studies, or JACS) outside of Switzerland, each with its own Regional Coordination Office (Figure 1).

A ninth partnership region, the Swiss Alps, was created in order to facilitate the exchange of knowledge and experience between North and South.

Phase 1 in a nutshell

In phase 1 of the program (2001-2005), the focus was on disciplinary and inter-disciplinary research on 30 core problems of global change. A joint definition of these core problems was carried out by the Northern and Southern partners at the beginning of the NCCR North-South. In addition, program structures capable

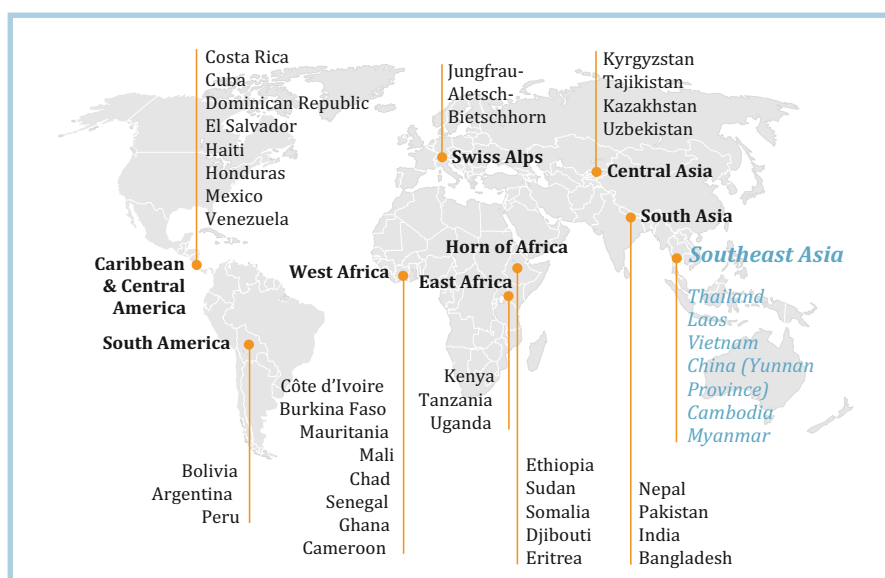


Figure 1: The NCCR North-South partnership network (www.north-south.unibe.ch)

of promoting integration and testing of research results were developed.

NCCR North-South in Phase 2

In phase 2, greater emphasis was placed on integrative aspects of research by establishing Work Packages and by launching eight postdoctoral research projects. Four research areas formed the core of NCCR North-South activities during phase 2:

“Governance & Conflict” sought to understand the complex processes of governance that play a role in transforming situations of conflict into a basis for cooperation.

“Livelihoods & Globalization” focused on the changing economic, social and political structures that determine the livelihood options available to the poor.

“Health & Environmental Sanitation” aimed at finding ways to integrate effective health and sanitation strategies into participatory planning processes.

“Natural Resources in Sustainable Development” explored potentials for making good use of resources like water, soil and

biodiversity while maintaining standards for sustainable development.

Since 2001, NCCR North-South researchers have published 1669 papers, including 338 peer-reviewed scientific articles. Between 2001 and 2008, 152 doctoral theses and an equal number of master's dissertations were launched, of which over 90 PhD studies were completed.

Outlook Phase 3

Phase 3 of the NCCR North-South has been designed to last a full-fledged 4-year period ending in June 2013. During this phase the network of 9 research regions and 6 Swiss research institutions and their international networks will be consolidated and prepared for continuing activities beyond the lifetime of the program.

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Sanitation, Livelihoods and Environment

In Southeast Asia, our research focused on equity effective and environmentally sustainable sanitation, multi-level stakeholder processes for development interventions, and livelihood and environment in trans-contextual perspectives.

The Southeast Asia partnership region is one of the eight NCCR North-South JACS. The JACS SEA comprises Thailand, Lao PDR, Vietnam, the Yunnan Province in China, Cambodia and Myanmar (Figure 1).

Institutional setup

The regional coordination office of the NCCR North-South is situated at the Asian Institute of Technology (AIT) in Pathumthani, Thailand. Dr. Thammarat Koottatep has acted as regional coordinator of the program since 2001. The program is supported by a regional advisory board (RAB) with representatives from universities, government and international NGOs. The RAB is chaired by Prof. Chongrak Polprasert, Director of the Sirindhorn International Institute of Technology (SIIT), Thammasat University, Bangkok. The main Swiss and Asian partner institutions involved in the JACS SEA are listed on page 27.

JACS SEA focus in Phase 2

NCCR North-South research conducted in JACS SEA during phase 2 (2005-2009) focused on three main research themes.

Theme 1: Equity effective and environmentally sustainable sanitation for reducing disease burden (health risks)

Research related to theme 1 contributed to the development of an approach to assist scientists and planners in establishing and calibrating a reliable material flow model of an environmental sanitation system or a river basin despite limited data availability (pages 6, 7). Other methodological highlights related to theme 1 include the development and adaptation of a stakeholder analysis and expert interview methodology to assess the potential and limitations of introducing innovative urban environmental sanitation systems (page 12). Research on technical aspects of environmental sanitation resulted in the development of technologies for the decentralized treatment of wastewater and faecal sludge (pages 12, 13).



Photo 1: Rapid economic growth and urban development (e.g. Hanoi) intensifies pressure on natural resources and increases environmental pollution (Photo: A. Morel)

Research also focused on the development and validation of an integrated MFA-QMRA-EPI-SSA assessment framework for ESS (page 8). The framework (or components of it) has been applied in field studies in Vietnam (page 11) and Thailand (pages 9, 10, 14).

Theme 2: Multi-level stakeholder processes for development interventions and coping strategies

Research related to JACS theme 2 was dedicated to a cross-JACS comparative analysis of decision-making processes in sustainable urban planning projects in selected case studies in Buenos Aires, Havana and in Bangkok (page 15). Research also focused on the validation of the Household-Centred Environmental Sanitation Approach (HCES). For that purpose, a case study was conducted in Vientiane, Lao PDR (page 21). Within a transversal research project conducted in Lao PDR, the analysis of over 330 stakeholders and development interventions at multiple levels allowed the



Figure 1: NCCR North-South in Southeast Asia is implemented in the Greater Mekong Sub-region (GMS)

researchers to describe the governance landscape of poverty and environment across the country (page 16).

Theme 3: Livelihood and environment in trans-contextual perspectives

Research related to theme 3 was oriented to an integrative analysis of the poverty-environment nexus in Lao PDR, with the aim of detecting typical patterns of environmental degradation and related to welfare or poverty (and vice versa, page 17). The researchers were able to quantify shares of population living in different landscape mosaics and hence to make meaningful estimations about current land use. Main findings were published in two books intended to contribute to sustainable and equitable development in Lao PDR (page 18).

Research in the JACS SEA region resulted in more than 20 peer-reviewed publications, six books and many scientific reports and conference articles. A selection of the most relevant publications is presented on page 25. Since the beginning of the NCCR North-South in 2001, five PhD and more than 30 MSc theses were completed in JACS SEA. Seven PhD theses will soon be finalized (page 22).

Partnership Actions (PAMS)

NCCR North-South also enabled to implement six Partnership Actions (so-called PAMS) in Southeast Asia. PAMS projects are designed to address specific problems by applying research results to real situations. The PAMS projects implemented in SEA are presented on pages 19 to 21.

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Environmental Sanitation Planning: Putting the Households at the Center

A. Montangero¹, M. Schaffner², A. Morel¹, C. Lüthi¹,
R. Schertenleib¹, H. Nguyen-Viet³, N. Surinkul⁴, T. Koottatep⁴

Conventional approaches addressing the problems related to urban environmental sanitation and water pollution control have rarely been appropriate in the developing country context. New approaches should strive towards responding to the consumer demand and promoting user ownership of services while also protecting the environment.

From supply-driven to demand-responsive planning

The Household-Centered Environmental Sanitation Planning (HCES) approach was conceived by a Working Group of the WSSCC and developed by Eawag/Sandec. The HCES approach places the household at the core of the planning process and thus responds directly to user's needs and demands.



Photo 1: Community workshop in Vientiane, Lao PDR: assessing environmental sanitation services (step 3 of the HCES process). (Photo: A. Morel)

It is a multi-actor approach emphasizing the participation of all stakeholders in planning and implementing urban environmental sanitation services. It further targets resource conservation and reuse to reduce waste disposal. Preliminary guidelines were published in June 2005 targeting public

officials and decision-makers and sector specialists. These guidelines have been tested in several JACS of NCCR North-South. In Southeast Asia, the approach has been tested in Vientiane, Lao PDR (refer to page 21).

Closing the nutrient cycle

Various tools have been developed to support the implementation of this approach. One of these tools is the Material Flow Analysis (MFA). It can be applied to assess the current environmental sanitation system (ESS) and to simulate the impact of changes in the system on resource consumption and environmental pollution. It therefore supports the evaluation of potential future options developed in a multi-stakeholder process. It is particularly appropriate to identify systems that promote resource recovery, for example by reusing treated human waste in agriculture, and hence contribute to closing the nutrient cycle. The application of the MFA tool to the ESS of Hanoi, Vietnam, is presented on page 7.

A second tool - the Quantitative Microbial Risk Assessment (QMRA) - can be coupled to the MFA to assess ESS not only with regard to resource conservation and environmental protection but also to health risks. The QMRA tool was applied in different studies in Southeast Asia, partly combined with the MFA methodology. These studies are presented on pages 8 to 11.

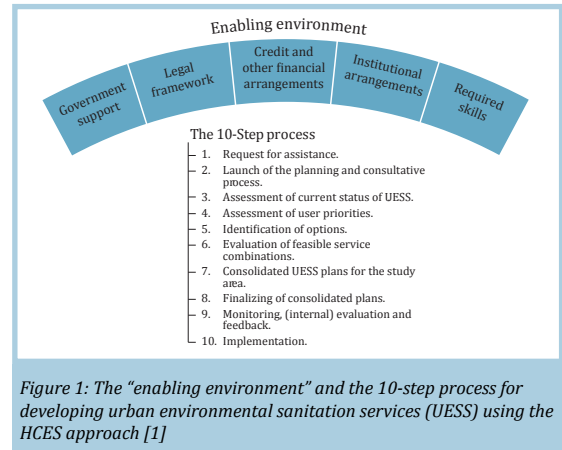


Figure 1: The "enabling environment" and the 10-step process for developing urban environmental sanitation services (UESS) using the HCES approach [1]

Scientific basis for informed choices

The HCES process ensures that the information obtained by applying tools such as MFA and QMRA regarding the current (and future) sanitation systems, is effectively communicated to the households and other stakeholders. This facilitates the joint development of potential options and supports informed decision-making.

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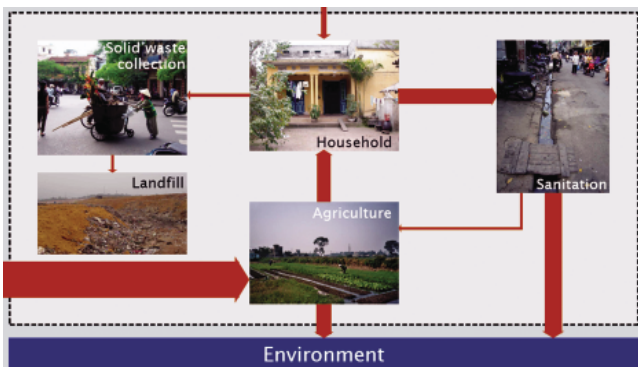


Figure 2: Main phosphorus flows in the environmental sanitation system of Hanoi province, Vietnam [2].

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Material Flow Analysis (MFA) for Environmental Sanitation Planning

Agnes Montangero¹, Le Ngoc Cau², Viet-Anh Nguyen³, Vu Dinh Tuan⁴, Pham Thuy Nga³

An approach was developed which assists planners in establishing and calibrating a reliable material flow model despite limited data availability. The model was tested and validated in Hanoi.

Most of the wastewater generated worldwide is discharged untreated into aquatic systems, thus leading to water pollution and loss of valuable nutrients. Production of artificial nitrogen fertilizer is energy-intensive and phosphate rocks have to be mined for the production of phosphorus fertilizers. To secure water and phosphorus reserves for future generations, new environmental sanitation concepts are required. Those should promote the saving and reuse of limited resources and preserve the environment.

Material flow analysis

An MFA tool was developed for planning environmental sanitation options with limited data availability and data collection means (Figure 1). It allows for an assessment of the impact of different scenarios on water and nutrient consumption, nutrient discharge into the environment and nutrient recovery for food production. The main element of the tool is a stochastic model describing goods as well as nitrogen and phosphorus flows within a regional environmental sanitation and agricultural system. The tool integrates concepts for uncertainty analysis and plausibility assessment. It also suggests

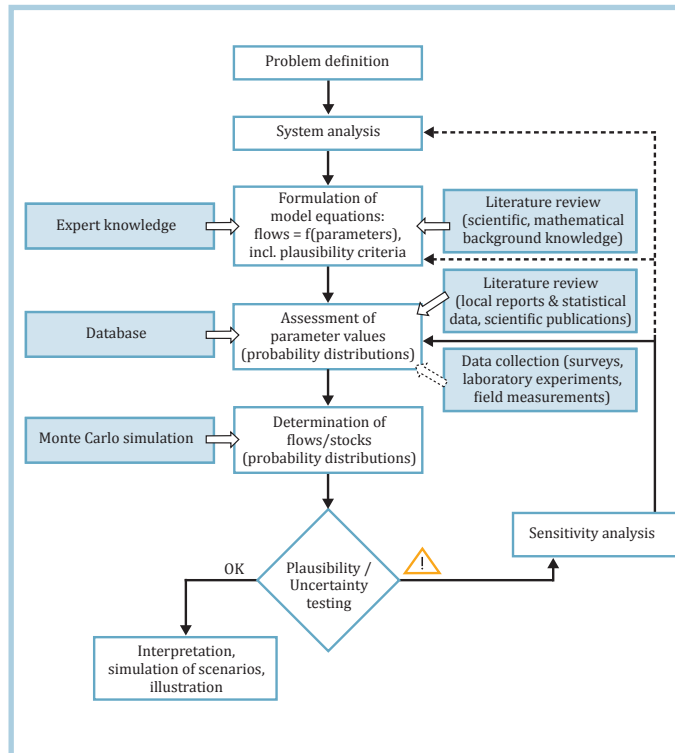


Figure 1: The MFA tool suggested by [3]. The tool also integrates in the MFA method concepts for uncertainty analysis and plausibility assessment.

methods to fill data gaps such as eliciting expert judgment [2].

A case study was conducted in Hanoi, Vietnam, to test the tool and calibrate the model. The model was applied to simulate the impact of different changes in Hanoi's environmental sanitation and agricultural system.

Urine diversion vs. septic tanks

Septic tanks are the most widespread onsite sanitation installations in Hanoi. However, unlike septic tanks, which are inefficient in retaining nutrients, urine diversion latrines immobilize most of the nutrients contained in human excreta. Replacing septic tanks by urine diversion latrines would result in a considerable nutrient load reduction into surface water and nutrient recovery increase for food production, thus reducing the need for artificial fertilizers. Moreover, both the agricultural nutrient demand and the amount

of nutrients in waste would be considerably reduced if livestock production were replaced by a higher production of fish, vegetables, beans, soybean, and nuts. Moreover, the percentage of nutrient recovery in Hanoi's peri-urban agriculture would further increase. This indicates that the type of sanitation option selected has a significant influence on nutrient cycles in a region, and that consideration of the peri-urban agricultural sub-system and reuse practices is also of key importance to improve nutrient management.

Plausibility and sensitivity

Plausibility assessment and careful characterization and analysis of uncertainty enabled the researchers to draw conclusions based on the model outcomes despite

significant uncertainties. The tool therefore proved to support the planning of environmental sanitation options that contribute to the minimization of resource consumption and environmental pollution despite limited data availability.

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Photo 1: Current environmental sanitation services in Hanoi contribute to environmental pollution (Photo: A. Morel)

Integrated Framework for Health and Environmental Sanitation Assessment

Hung Nguyen-Viet¹, Roland Schertenleib², Chris Zurbrügg², Jakob Zinsstag¹, Marcel Tanner¹

A framework was developed that combines health, environment and socio-economic assessments to reach a comprehensive understanding of the relationship between these components that would lead to more effective interventions.

Improving health systems, environmental sanitation and conserving natural resources for sustainable development form part of the UN's Millennium Development Goals. Eawag/Sandec and the Swiss Tropical Institute (STI) have developed a new conceptual framework to assess ways of improving health and the environment in an integrated manner. The framework uses an approach that combines the assessment of various factors such as health, ecological, social, economic, and cultural.

Conceptual framework

The framework starts with a rapid analysis of both the status of health and the physical, social, cultural, and economic environment (Figure 1). This provides a basis for understanding the key issues to improve health and environmental aspects in a given area. Three main components are subsequently assessed: health status, physical environment, as well as the socio-economic and cultural environment.

The analyses lead to an in-depth understanding of health, ecological and social risks while allowing critical control points (CCP) to be identified in relation to the following factors: epidemiological, ecological, socio-economic, and cultural. They complement the conventional CCP approach by including an actor perspective that considers vulnerability to risk and patterns of resilience. Interventions



Photo 1: Farmers working with excreta and wastewater in a field in Hanam (Photo: H. Nguyen-Viet).

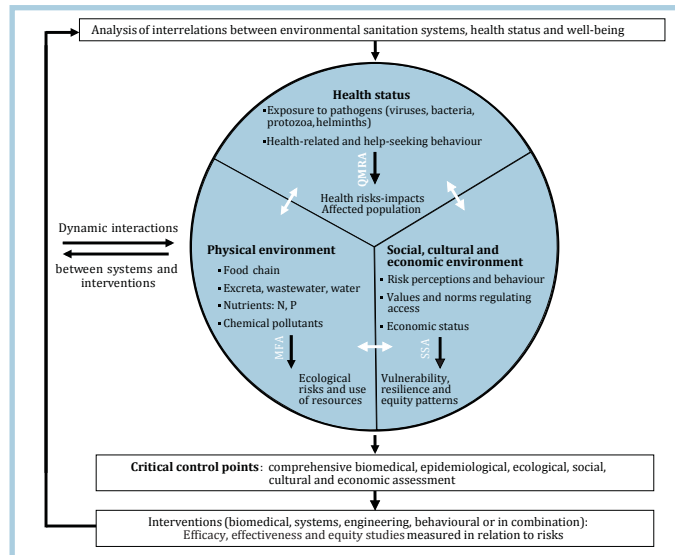


Figure 1: Conceptual framework for Health and Environmental Sanitation Planning. EPI: Epidemiology, QMRA: Quantitative Microbial Risk Assessment, MFA: Material Flow Analysis, SSA: Social Science Analysis [1].

derived from the comprehensive analysis consider biomedical, engineering and social science perspectives or a combination of both. The framework thus jointly addresses health and environmental sanitation improvements as well as the recovery and reuse of natural resources. The interventions are assessed with regards to reducing specific risk factors and vulnerability, thus enhancing health status and assuring equity [1].

Case studies in Vietnam

The framework is currently being tested in the peri-urban study site of Hanam – a Northern Province of Vietnam. Human excreta and wastewater reuse in agriculture and aquaculture has been identified as an issue of environmental sanitation and agriculture, health and well-being (Photo 1). The material flow analysis (MFA) method has been used to analyze environmental sanitation and agricultural systems with emphasis on nutrient flow of nitrogen (N) and phosphorus (P) [2]. According to preliminary results, on-site sanitation and crop production discharge the largest flows of N and P into water bodies through drainage systems. Remediation options are therefore expected to mitigate

environmental impacts, for instance, by turning waste into fertilizers. A set of epidemiological and quantitative microbial risk assessment (QMRA) studies has been carried out on the health effects of wastewater and excreta reuse [3]. A cross-sectional study on the prevalence of diarrhea, helminth and protozoan infections as a function of excreta and wastewater reuse has been conducted to identify exposure to wastewater and excreta responsible for these health outcomes (see page 11). In parallel, QMRA is used to determine diarrhea infection risks by wastewater and excreta reuse with a focus on protozoa and bacteria, and a follow-up, a one-year study was conducted on risk surveillance at different exposure points. A first survey on threat appraisal revealed that the population recognizes the threat emanating from the black color and bad smell of wastewater, the bad smell of excreta, inappropriate practices of excreta management and suspected diseases caused by contact with excreta or wastewater.

Other case studies are ongoing in other geographical sites. Wastewater health risk assessments were conducted in Pathumthani, Thailand and in Abidjan, Côte d'Ivoire (refer to articles on pages 9 and 10).

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Quantifying Diarrhea Infection Risks

Aleix Ferrer Duch¹, Hung Nguyen-Viet¹, Antoine Morel², Jakob Zinsstag¹

Quantitative microbial risk assessment (QMRA) was used to determine the risks of diarrhea infection caused by human interactions with untreated wastewater and contaminated surface water in a peri-urban area of Thailand.

This study assessed diarrhea infection risks by wastewater use in Klong Luang municipality in Thailand. Bangkok has 1165 man-made drainage and irrigation canals of 2280 km total length. Use of this water for agricultural and recreational purposes has a very long tradition in peri-urban areas such as Klong Luang; however, the suitability of such practices is increasingly questioned.



Photo 1: Wastewater sampling in the canal (Photo: Hung Nguyen-Viet)

As a result of rapid urbanization and industrialization, the quality of the canal water has deteriorated considerably over the last decade, mainly due to the discharge of untreated domestic and industrial wastewaters.

QMRA, Real-Time PCR

The *Quantitative Microbial Risk Assessment* (QMRA) method was used to determine the risks caused by human exposure to protozoa [2]. The QMRA methodology follows a four-step approach as described in Table 1.

Diarrhea infection caused by the two protozoa *Entamoeba histolytica* and *Giardia lamblia* has been identified as a relevant hazard in the study area (step 1). Dose-response models for the two protozoa were based on international literature (step 2). Population exposure to the hazards (step 3) was characterized and quantified by a household survey (i.e. frequency and intensity

of exposure, reuse practices, eating habits, personal hygiene, behaviors etc.). Wastewater samples were collected in sewers, wastewater treatment plants, canals, and irrigation water. Samples of vegetables traditionally eaten raw (i.e. morning glory (*Ipomoea aquatica*), Thai basil (*Ocimum basilicum*) and Tulsi (*Ocimum tenuiflorum*) were collected from agricultural fields. Protozoan concentrations at the most relevant exposure points in the environmental sanitation system were quantified using Real Time PCR (54 samples in total).

Integration of steps 1 to 3 enabled the researchers to characterize the risks of infection in the study area (step 4). The risk of diarrhea was calculated using estimated probability density functions, randomly sampled by Monte Carlo simulation. Finally, the quantified risks were converted into DALYs (disability adjusted lifeyears). DALYs represent the time lost through disability or death caused by a disease as compared to a life free of disability in the absence of the disease [2].

Morning glory, hand washing

The results obtained reveal high concentrations of *G. lamblia* and *E. histolytica* in canal water and on vegetables (morning glory, Thai basil and Tulsi). Highest infection risks (*G. lamblia* = 1.00 & *E. histolytica* = 0.48) and highest load of *G. lamblia* = 2,631 and *E. histolytica* = 37,431 cysts/100g⁻¹

on vegetables were caused by consumption of morning glory; a highly appreciated vegetable growing in the canal and partly eaten raw. Among the human behavior studied, current hand washing practices also resulted in high infection risks (*E. histolytica* = 5.2 E-2). Other exposure routes studied here, like fishing or collecting vegetable in the canal, resulted in comparatively low risks.

Calculated health risks and reported occurrence of diarrhea diseases in the project area were extrapolated to DALYs. According to this estimate, diarrhea infection caused a loss of almost 1.5 years of healthy life in Klong Luang municipality in 2005 (total population: 49,296).

Main observations

The methodology applied allows the researchers to identify the main transmission routes of protozoa-related diseases in an environmental sanitation system and to quantify the infection probability for main exposure scenarios. An improved understanding of the interrelation between hazard, exposure to hazard and resulting health risks enables the researchers to quantify the impact of potential interventions on public health and to assess their suitability in reaching (locally defined) acceptable risks. In the context of Klong Luang, we are convinced that awareness-raising among the population is the intervention with the highest potential in reducing health risks caused by direct or indirect exposure to untreated wastewater.

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| Steps | Description |
|------------------------|--|
| Hazard identification | Describe acute and chronic human health effects associated with any particular hazard. |
| Dose-response analysis | Characterise the relationship between various doses administered and incidence of the health effect. |
| Exposure assessment | Determine size and nature of the population exposed and route, amount and duration of exposure. |
| Risk characterisation | Integrate the information from the different identification steps to assess the magnitude of the public health problem, variability and uncertainty. |

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Fate of *E. coli* and *Salmonella* in Tropical Farmland and their Associated Health Risks

Narong Surinkul¹, Antoine Morel², Thammarat Koottatep¹

This study investigated the die-off rates of *E. coli* and *Salmonella* in water and soil, and determined the reduction rates of those pathogens on vegetables resulting from typical washing practices. Results revealed that exposure to sunlight and washing with tap water can significantly reduce the pathogen concentrations on lettuce.

The objective of this PhD research was to investigate the die-off of *E. coli* and *Salmonella* spp. in a vegetable farmland system. *E. coli* and *Salmonella* are widely detected on vegetables in Southeast Asia which are conventionally irrigated with contaminated surface water, wastewater or sludge.

Methodology

Batch tests of *E. coli* and *Salmonella* die-off rates in water and soil were conducted at the Environmental Engineering Management (EEM) Laboratory, Asian Institute of Technology (AIT), Thailand. Cultures of both indicators were added to samples of canal water (10 L) and soil (1 kg) from the vegetable farm. Temperature of the batch experiments was maintained at 10, 20, 30, 40 °C in a controlled incubator, and at solar intensity reduction of 0, 50, 70, 100 % at ambient temperature.

Plot tests of *E. coli* and *Salmonella* reduction rates on vegetable and washing process were studied in a lettuce producing farm in the peri-urban area of Bangkok. Indicator organisms were added to the irrigation water. Both the irrigation water and the water used to wash the lettuce were analyzed in terms of indicator organism concentrations. The temperature of ambient tests was between 26-33 °C with a maximal solar intensity of 650 cal cm⁻² d⁻¹ and 12-h of light time per day. Concentrations of *E. coli* and *Salmonella* were analyzed by the MPN technique in Standard Methods for water and wastewater examination, 9221F and 9260D.



Figure 1: Tropical vegetable farmland system in Thailand (N. Surinkul)

Results and Discussion

Die-off rates were calculated from the first-order equation (see Table 1) and temperature coefficients (θ) in equation $k_t = k_{20} (\theta)^{t-20}$ were 1.05 and 1.04 in water and soil, respectively.

In water, die-off rates of *E. coli* were higher than *Salmonella*. Die-off rates of *Salmonella* in soil were higher than *E. coli*. This is because soil contains enough nutrients to support the growth of *E. coli*. Die-off rates of both indicators increased with increasing solar radiation. Solar intensity had a great influence on die-off rates of the indicators which in water were adjusted with a factor of 1.0-1.5 for *E. coli* and 1.0-1.2 for *Salmonella*. Daily reduction of both indicators on the leaves of lettuce was 1-4 log and the washing process by tap water could reduce the concentrations by 1-3 log.

Conclusions

Obtained die-off rates of *E. coli* and *Salmonella* in water and soil, and reduction rates on vegetable leaves or during the washing process can be used to determine concentrations of both indicators

in typical farmland systems in Southeast Asia. These predicted concentrations can be used to determine pathogen flows in a system and ultimately help to quantify microbial health risks.

Current research focuses on the integration of the Pathogen Flow Analysis (PFA) concept into the QMRA methodology. The integrated methodology is a promising tool for health and environmental sanitation planning.

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Table 1: Die-off rates of *E. coli* and *Salmonella* in water and soil, and reduction rates on vegetable and washing

| | Die-off rates k_{20} d ⁻¹ (1-7 days) | Adj. factor of k_{20} due to solar intensity | Reduction rates |
|--------------------------|---|--|------------------------------------|
| <i>E. coli</i> | | | |
| water | 0.865 | 1.0-1.5 | 1-4 log d ⁻¹ 1-3 log |
| soil | 0.121 | 1.0 | |
| vegetable | | | |
| washing | | | |
| <i>Salmonella</i> | | | |
| water | 0.531 | 1.0-1.2 | 1-4 log d ⁻¹ 1-3 log |
| soil | 0.687 | 1.0 | |
| vegetable | | | |
| washing | | | |

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Transmission of Parasitic Infections by Wastewater and Excreta Re-use in Agriculture in Vietnam

Phuc Pham Duc^{1,2}, Hung Nguyen Viet¹, Jakob Zinsstag¹, Marcel Tanner¹, Phung Dac Cam², Peter Odermatt¹

An epidemiological study was conducted in Northern Vietnam to understand the transmission of helminth and protozoan infections. Results suggest that exposure to wastewater and excreta re-use in agriculture are the most important exposure variables for helminth infections.

Introduction

In Vietnam, the use of human excreta as fertilizer, and the use of wastewater for irrigation and aquaculture have a long tradition. While this practice has advantages in terms of environmental and economical impacts, they represent potential health risks if excreta and wastewater are not properly managed. The general goal of this project is to further understand the transmission dynamics of the parasitic infections related to the use of wastewater and excreta among groups at risk in Ha Nam province, North Vietnam.

Methodology

From June to October 2008 a first household survey was carried out in two communes Nhat Tan and Hoang Tay, Ha Nam province, situated ~60 km South Hanoi. In this area the sanitation facilities at household and community level are of low quality. The water from Nhue River is intensively used for irrigation although charged with untreated wastewaters from households, industries and hospitals from Hanoi.

A total 794 people from 215 households were enrolled. Information on demographical and socioeconomic status of the households and exposure to wastewater was assessed by questionnaire. Multiple stool samples were collected from all participants. Helminth and protozoan infections were diagnosed by standard laboratory techniques [1, 2].



Photo 1: Farmer collecting excreta from a household latrine before applying it as fertilizer in his fields in Nhat Tan (Photo: A. Morel)

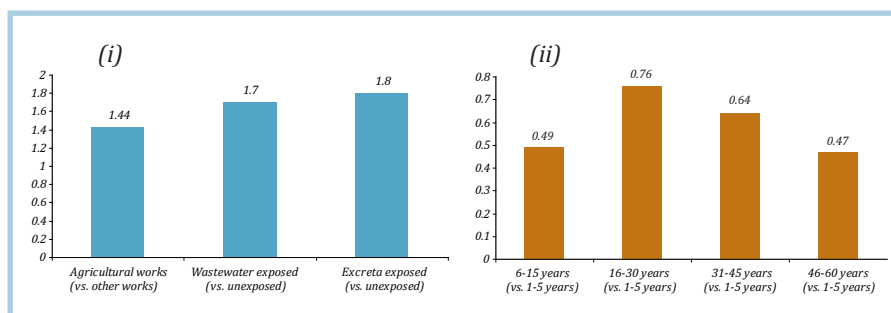


Figure 1: Odds ratios (OR) of risk factors for helminth infections in 215 households in Hanam: (i) OR of exposure to wastewater and excreta, and (ii) of different age groups vs. the 1-5 years group.

Main findings

The results showed that of the 215 study households, more than 80% had main incomes from the cultivation of rice, husbandry as well as fish breeding. Most households (94%) possess a latrine. About 56% of the households used human faeces and 48% animal manure to fertilize plants while most households (90%) used domestic wastewater and water from the Nhue River for agriculture fields and fishponds. Parasitological examination revealed that 376 people (47%) were infected with at least one of the three helminth species *Ascaris lumbricoide*, *Trichuris trichiura*, and hookworm; 146 (19%) had a *A. lumbricoide*, 298 (38%) a *T. trichiura*, and 21 (3%) a hookworm infection. Generally, the intensity of infection was low. Furthermore, *Entamoeba histolytica* (6%) and *Giardia lamblia* (2.4%) were diagnosed in considerable prevalence rates.

Analyses show that the use of human excreta was significantly associated with the risk of general helminth infection (OR 1.8; $P < 0.0001$, Figure 1) with a prevalence rate of 55% in the exposed group. In addition, there was a significant difference in helminth infections between people who were exposed to wastewater (54%) and those who were not (OR 1.7; $P = 0.001$). However, helminth infection rate did not differ with access to latrines. Agricultural and aquacultural activities were a strong risk factor for all helminth infections (OR 1.44; $P = 0.019$) with a prevalence of 51%. Women (51%) were more infected with

helminths than men (44%; $P = 0.02$). Children under five years of age had the lowest infection rates (38%) whereas the highest prevalence rates were found for age-groups of 31-45 years (52%) and 6-15 years (52%). Helminth infection was negatively associated with educational level (OR=0.44; $P = 0.001$) with a prevalence of 50% in people with lower educational level.

Discussion, conclusion

Our study, which was conducted in the rainy and wet season, confirms that exposure to human excreta and wastewater used in agriculture as fertilizer and irrigation water are important risk factors for parasitic infections. Currently research is focusing on helminth transmission during the dry season. This study is expected to indicate the impact of seasonal changes on helminths transmission. Future efforts we aim at deepen our understanding on the determinants of transmission of parasitic infections in these communities. This will hopefully enable to identify easily preventable and/or modifiable risk factors which – at a later stage – can be targeted for prevention efforts.

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Innovative Wastewater Treatment – from Laboratory research to Wide-scale Application

Antoine Morel¹, Yuttachai Sarathai², Viet-Anh Nguyen³, Thammarat Koottatep²

Low-cost wastewater treatment systems exist, but few systems are actually implemented in Southeast Asia. Which factors hinder a wide-scale application of such systems, and how can these barriers be overcome?

The objective of this research was to assess the suitability of two promising technologies for the decentralized treatment of domestic wastewater (Figure 1), and to identify the main barriers to their wider application in Southeast Asia. For that purpose, eight NCCR North-South related research projects conducted in SEA were reviewed.

Technical solutions to pollution control measures at the source

The anaerobic baffled reactor (ABR) and constructed wetlands (CW) are able to treat domestic wastewater to satisfactory levels at reasonable costs. Discharge standards of all Southeast Asian countries can be met. Treatment performance, costs, strengths and limitations of the two systems are summarized in Table 1.



Photo 1: Constructed wetland system treating domestic wastewater of hotels and households on Phi Phi Island, Thailand. The park-like system is frequently visited, thus supporting the acknowledgement and dissemination of the technology. (Photo: T. Koottatep)

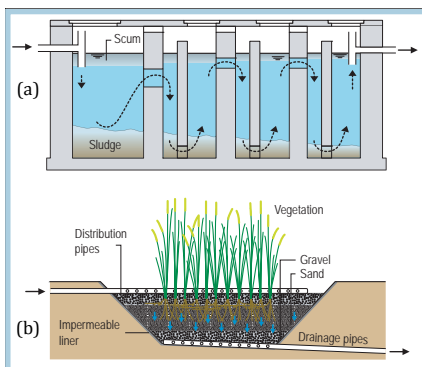


Figure 1: The wastewater treatment technologies investigated - (a) the anaerobic baffled reactor (ABR) and (b) the constructed wetland (CW)

What hinders wider application?

The basic reluctance of key stakeholders (government, engineers, community) to adopt innovative solutions to wastewater management is caused by a number of interrelated factors, including:

- Little legislative support for implementation of innovative solutions;
- Lack of knowledge on and trust in technical innovations;
- Lack of managerial capacity and availability of technical skills;
- Lack of success stories and guidance;
- Ineffective transfer of knowledge from research institutions to decision makers and practitioners.

From research to regional application

The main challenge is to increase trust and create demand for innovative wastewater management systems, and to build up the capacities to promote, disseminate, design, construct and operate these systems. A combination of different measures is required, including:

- Advocacy at the political level, awareness raising at the community level;
- Development of appropriate standards and guidelines;
- Demonstration projects to stimulate a wider interest and increase trust (e.g. Photo 1);
- Technical and managerial training of relevant stakeholders.

Table 1: Performance, cost, strengths and limitations of ABR and CW for wastewater treatment [1]

| | Anaerobic baffled reactor (ABR) | Constructed wetland (CW) |
|-------------|---|--|
| Efficiency | COD = 72–90%; SS = 78–94%; TP = 33%; TKN = 47% | COD = 80–90%; SS = 80–95%; TN = 40–60% |
| Costs | 35–70 USD per person | 60–120 USD per person |
| Strengths | High treatment efficiency (BOD, SS) High stability to organic and hydraulic shock loads High-level academic qualifications not required for operation and maintenance | High treatment efficiency (including nutrients, pathogens) Discharge standards can be met Pleasant landscaping possible High-level academic qualifications not required for operation and maintenance |
| Limitations | Limited nutrient and pathogen removal Effluent standards cannot be reached | High permanent space requirement Great care required during construction and acclimatization |

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Hydraulic Modeling of an Anaerobic Baffled Reactor (ABR)

Yuttachai Sarathai¹, Antoine Morel², Thamarat Koottatep¹

Residence time distribution (RTD) studies conducted in Thailand allowed the researchers to describe and model the hydraulic behavior of the anaerobic baffled reactor (ABR) treating domestic wastewater.

Residence time distribution (RTD) analyses (lithium chloride) were carried out in laboratory-scale ABRs, which were comprised of one sedimentation chamber and three up-flow chambers in series (Fig. 1). The RTD curves were established using steady flow and non-steady flow tracer theories as described by [1]. These curves were used to quantify dead space, mean hydraulic retention time, short circuit effects, and mixing patterns in the ABR operated at different peak flow factors (PFF 1–6), hydraulic retention times (HRT 24h, 36h, 48h) and influent COD concentrations (379, 911 and 1 500 mg/L. RTD was further used to test the suitability of two non-ideal flow models (tank-and-series, TIS, and dispersion plug flow, DPF) to characterize ABR's hydraulic behavior.

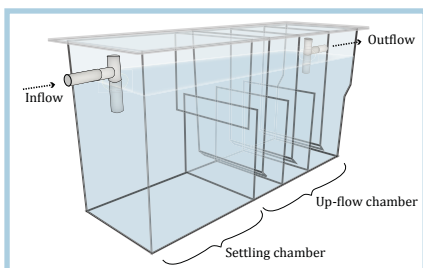


Figure 1: Schematic diagram of the ABR model used in the experiments [3]

Research findings

Dead space and short-circuits: RTD curves proved to be a good instrument to analyze the complex hydraulic patterns in ABR. The tracer response curves revealed rapid tracer breakthrough, indicative of prominent short circuit channels, and formation of circulation zones (dead zones), which could compromise the overall treatment efficiency of an ABR. The highest short-circuit effects were observed at low nominal HRT (24h and 36h), with increased short circuiting at increased peak flow factors. At a nominal HRT of 48h, peak flows had little impact on short circuits. Dead space in the reactor operated at peak flow factors 4 or lower was minimal (15% or lower) compared to alternative high-rate anaerobic treatment systems such as the anaerobic filter

(AF) and the upflow anaerobic sludge bed reactor (UASB) ranging from 50–75% and 15–45%, respectively [2]. No clear trend could be observed between dead space and nominal HRT or biomass concentration. A substantial increase in dead space (from 15% to 25%) was observed at low nominal HRT (24h and 36h), when peak flows increased from 4 to 6 [3]. Dead space is assumed to increase mainly in the up-flow chambers due to increased upflow velocities of the fluid.

Hydraulic modelling

Two non-ideal single parameter models (TIS and DPF) were applied to the experimental data.

DPF model: The dispersion calculated in the experiments (0.10–0.19), corresponds to a large dispersion in the reactor with flow patterns far from plug-flow, thus indicating that the ABR does not behave like an ideal plug-flow reactor. The DPF model also simulated higher grades of symmetry than the observed RTD curves, dissimilar to the longitudinal dispersion (mixing) occurring in the ABR.

TIS model: At steady flow and non-steady flow (PFF 2–4), ABR's hydraulic behavior can reasonably well be compared to a 4 tanks-in-series (TIS) model. N was calculated based (1) on the variance of the RTD curve and (2) on the peak of the RTD curve. N values calculated as a function of the variance of the RTD curve were too high ($N = 7–14$). The second method provided more accurate results, with N close to 4 (3.6). This number is equal to the number of compartments in the ABR, thus indicating that the ABR behaves like four continuously stirred tank reactors (CSTRs) operated in series.

Conclusions

Based on the RTD curves, it is possible to analyze the complex hydraulic patterns in an ABR. The method allows rapid identification and quantification of short-circuiting effects, dead space and hydraulic efficiency.

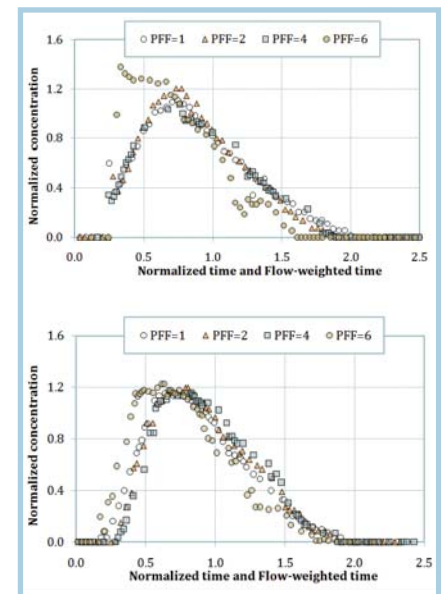


Figure 2: RTD curves of the ABR operated at different peak flow factors (PFF) and HRT (i: HRT = 24h; ii: HRT = 48h) [3]

The ABR is hydraulically very efficient at 24h–48h HRT and dead space below 15%. As high peak flow factors (PFF = 6) strongly affect hydraulic efficiency of the ABR at low nominal HRT (24h–36h), a nominal HRT of 48h is recommended. The TIS model with four tanks in series accurately reflects hydraulic behavior of an ABR with one sedimentation and three up-flow chambers operated at 24h, 36h and 48h HRT for steady flow and non-steady flow up to 4 peak flow factors.

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Understanding Environmental Governance in Water and Sanitation: a Case Study in Thailand

Soparth Pongquan¹, Boontawee Teamvan¹, Chris Zurbrugg²

Institutional factors are a key element in provision, upgrading and maintenance of sanitation infrastructure and services. This study analyzed the institutional challenges in ensuring good environmental sanitation governance in one municipality in Thailand.

The main objectives of the study were (i) to review environmental key policies, plans and legislations at national and local levels in Thailand; (ii) to examine existing governance structures; (iii) to understand the available means of execution/enforcement of laws, rules and regulations at different levels and forms of governance in water and sanitation; and (iv) to identify institutional challenges and prospects in ensuring good environmental governance and suggest recommendations for improvement.

The field study area was Klong Luang municipality in Pathumthani province. Total area is 42.93 km² with 12,139 households (42,889 inhabitants) in 11 villages with two types of local governments (municipality and sub-district or Tambon Administrative Organization (TAO)).

Methodology

The secondary data collected was comprised of a review of environmental policies, plans, legislations, rules and regulations at central, regional, provincial and local levels as well as related literature and case studies. Primary data collection included methods of semi-structured interviews with key government officers at various levels, other staff in local governments,

community leaders and local residents.

Environmental governance in Thailand

Environmental governance focusing of local involvement in national and local environmental acts and laws has been encouraged by the Thai government during the Ninth (2002-2006) and Tenth National Economic and Social Development Plans (2007-2011) by formulating the National Environmental Management Plan (2007-2011) [1]. To enhance decentralized local authorities (municipalities and TAOs) to be more involved in managing their own acts and laws, a three-year local development plan was formulated and managed by those local agencies under the framework of the National Decentralization Act 1994. This enhances the implementation of several governance issues including rules of law, participation, accountability and transparency, with regard to environmental issues both from national, regional, provincial and local levels.

Key findings, recommendations

Water sanitation governance has been well defined in environmental management plans at national, regional, provincial and local levels. Basically, decentralized local governments (i.e. municipalities and TAOs) assume the main responsibility in operation and management. Several laws regulate and stress the importance of domestic waste water management as key factors to enhance environmental health protection and water pollution control activities [2]. However, with the implementation and coordination of the environmental plans there has been some confusion among central and local levels, particularly on environmental tax policy which specifically concerns the collection of water quality fee which is still under debate and of political controversy.

Key environmental governance practices were applied in Thailand with public hearings (for national and regional projects), public participation (indirectly through local representatives or committee members or directly by citizens), transparency and

information dissemination. This applied for policies, plans and projects, and accountability of institutional mechanisms at various levels. The main challenges identified in this study were limited public participation and lack of access to information at local level [3]. Furthermore, decentralized local governments are capable of managing relatively small scale projects but have limited capacity and technical competencies to manage large-scale water and sanitation projects.



Photo 1: Klong Luang, Pathumthani Province, Thailand. (Photo: T. Boontawee)

The main recommendations of this research study are: (i) to strengthen institutional coordination in implementation of the environmental plans, particularly at local level, (ii) increase capacity of local governments in managing large-scale water and sanitation projects, (iii) decentralizing decision making to local governments on water governance policies, and (iv) enhancing transparency and participation in local planning, implementation and evaluation.

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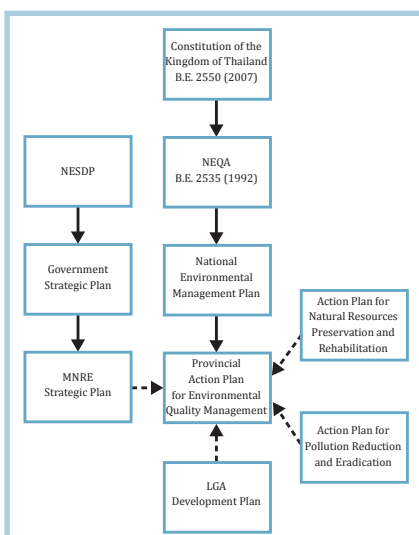


Figure 1: Institutional Linkages of Environmental Plans in Thailand [3]

Innovations in Decision-making Processes in Sustainable Urban Projects

Adriana Rabinovich¹, Yongtanit Pimonsathean², Andrea Catenazzi³

The widening of decision-making processes to different actors is seen as an innovation in urban planning. Research evidence shows that institutional arrangements which allow contradictory interests to be negotiated are fundamental to sustainable rehabilitation projects.

Since the 1980s, the promotion of heritage values has gradually become a relevant issue for urban planning. For more than 20 years, there has been a steady increase in the number of projects to rehabilitate historic centers in various cities across the world, within the framework of a debate on heritage that has evolved from building preservation to a wider approach encompassing socio-cultural values, strongly influenced by the impact of specific rehabilitation policies at the international level^(a).

Rehabilitation projects in Buenos Aires, Havana and Bangkok

The ongoing research project is based on the comparative analysis of concrete interventions for the rehabilitation of inner-areas with heritage value in Buenos Aires, Argentina, La Havana, Cuba and Bangkok, Thailand. The studied projects aimed to combine the preservation of heritage values, the opportunities for the economic development of the area, while guaranteeing access to the habitat of the lower-income population. Indeed, the three operations deal with structural tensions as permanence vs. relocalization of inhabitants, the market profit logic vs. the one of the heritage preservation as well as the tension between having a city for its inhabitants or a scenery for tourists.

The Tha Tian Community

In Bangkok, research focused on the Revitalization of the Tha Tian Historic Community, an urban intervention based on a bottom-up approach developed against the implementation of the Conservation Master Plan for Bangkok (CMPB). According to the CMPB, a top-down master plan drawn up by the national conservation Committee "Rattanakosin", the Tha Tian community was to be demolished and replaced by open spaces and greenery. Nearly 2000 inhabitants were threatened with eviction.

In 1998, in the midst of tension between the residents and the conservation committee, an alternative plan was proposed at local level.

Communication among stakeholders was facilitated by professionals of the local planning schools^(b) and the decision on alternative plan was agreed by the concerned groups. It was established that the relocation was not needed, that valued buildings were to be restored and public pedestrian ways should be improved.

allocated to organize conferences and training programs for community representatives and the case is often raised among the development organizations like the BMA, the National Housing Authority and the Crown Property Bureau.

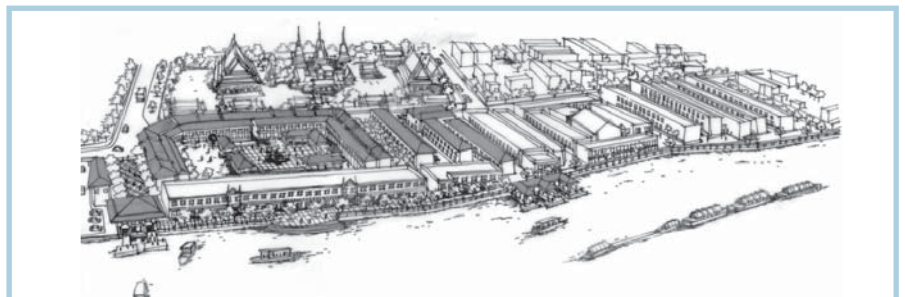


Figure 1: The alternative development plan for the Tha Tian Community, developed in a multi-stakeholder participation process. (Y. Pimonsathean)

Decision-making processes

The research project conducted in the framework of NCCR North-South focused on the analysis of the decision-making processes, seen as an arena in which different values and logics have to coexist. The methodological approach allowed the researchers to identify those specific institutional arrangements at different levels that as modes of governance in each context evolved during the concrete interventions. In Bangkok, research showed that the institutional arrangements introduced at the local level for the rehabilitation of the Tha Tian community required the establishment of trust in alternative mechanisms of decision-making, widening it to new actors such as the local government, the landlords and property owners, the community and the university, which acts both as advocate and facilitator in the process.

Although multi-stakeholder participation in urban projects is quite new to Thailand, research results have been very beneficial to the on-going projects regarding historic city centre rehabilitation, and to strengthening the role of the university. The participatory experience is now being applied to other urban community development projects, annual budgets are

At the international level, the comparative research, through north-south and south-south cooperation, contributes to an international debate of the planning approaches in different countries, with consideration of the socio-political factors, in relation to decentralization and governance, which could be a path to analyze decision-making processes and the role of multiple actors in promoting the development of sustainable cities.

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^(a) E.g. the 1972 UNESCO Convention, the 1977 Charter of Machu Picchu, the 1983 Declaration of Mexico City, the Washington Charter, and the UNESCO World Heritage Centre Policies.

^(b) The King Mongkut's Institute of Technology Ladkrabang and Thammasat University.

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Decision-making on Human-environment Systems: A Meso-level Analysis of Governance Landscapes

Peter Messerli¹

The management of land systems in rural areas of Lao PDR is increasingly determined by decisions made beyond the local level. In order to better understand poverty-environment interactions, this research project analyzes configurations of multi-level decision-making in a spatially explicit manner. The resulting governance landscapes represent an important differentiation of the Lao development context.

Globalization of decision-making in the Lao PDR

Rural areas of the Lao PDR are currently undergoing rapid transformations. A key characteristic of this process is that decisions on land management are not restricted to local actors anymore but are increasingly embedded in a multi-level setting, where regional, national and even global stakeholders are more and more important. Correspondingly, land systems and more specifically human-environmental interactions cannot be adequately understood without knowing their linkages to decisions and structures made elsewhere. Research is needed to analyze the configuration of such multi-level decision-making, how its spatial variation forms so-called governance landscapes, and how these landscapes relate to concrete development outcomes in terms of poverty and environment.

A new approach to analyze governance landscapes

This research initiative systematically analyses development interventions by public sector actors such as governmental agencies, multi- and bi-lateral development partners, and NGOs. The analytical categories of actors and development interventions are first studied in terms of their interactions paying special attention to a spatially explicit analysis using Geographic Information Systems (GIS). Second, in-depth analysis is carried out to better understand the types of activities carried out and the financial means allocated. Also, actors' values and strategies are studied, as well as the role of knowledge in decision-making.

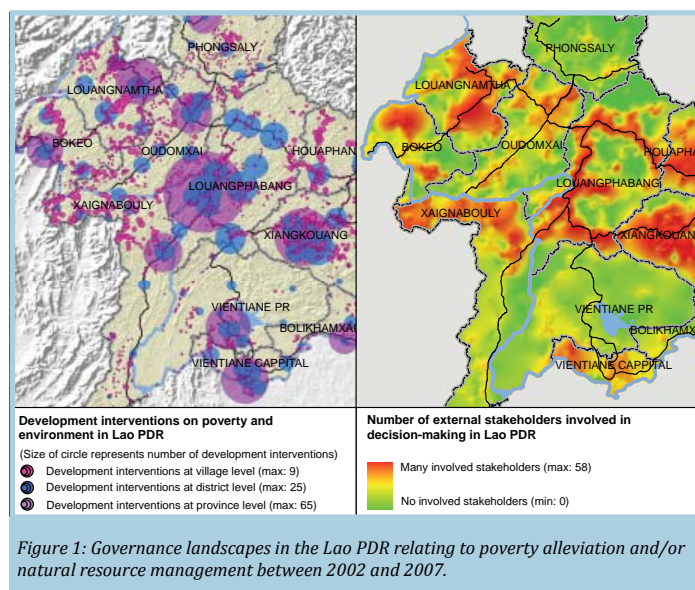


Figure 1: Governance landscapes in the Lao PDR relating to poverty alleviation and/or natural resource management between 2002 and 2007.

Spatial patterns of public development interventions

An analysis of 327 development interventions targeting poverty and/or natural resource management between 2002 and 2007 shows that approximately 45% of all Lao villages and 60% of the population have seen at least one external development intervention (Figure 1, left). Moreover, the highest number of projects did not target the village level itself but rather decision-makers at district, province and national levels. Distinctive spatial patterns can be observed, with interventions clustering along the road network, province and district capitals, or where different strategic interests manifest spatial overlays. For example in northwest Lao PDR, the new economic corridor of the Asian Development Bank (ADB) crosses the Nam Ha National Protected Area (NPAs) and leads to a very high density of different development interventions.

Each development intervention involves multiple stakeholders with different roles. By relating these stakeholders to the geographical position of development interventions, we are able to show the spatial distribution of

stakeholders involved in decision-making across the country (Figure 1, right). Whereas some regions remain quite autonomous vis-à-vis public sector stakeholders, other regions are confronted with a high number of actors and hence their regulatory power.

These distinct governance landscapes represent an important differentiation of the Lao development context. They must not only be taken into account when trying to understand linkages between poverty and the environment, but also when exploring options and constraints for future development in different regions of Lao PDR. Furthermore,

we also observe how globalisation creates new spaces, where former peripheral localities may become central and globalized places.

In-depth research on multi-level decision-making

Current research is focusing on a more in-depth analysis of multi-level decision-making by further analyzing development activities and related actors. This will improve the understanding on how concrete realities of development contexts are taken into account by decision-makers, and conversely, if designed strategies and interventions respond to real problems and opportunities.

Finally, research will undertake to link the analysis of governance landscapes to key sustainability indicators. This shall allow to identify promising and diverse pathways leading to equitable trade-offs and sustainable management of human-environment systems.

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Accessibility, Environmental Dynamics and Socioeconomic Disparities

Michael Epprecht¹, Andreas Heinimann¹, Peter Messerli¹, Dietrich Schmidt-Vogt², Urs Wiesmann¹

Poverty and environmental degradation are often thought to be causally connected. While access to natural resources is a determining factor for environmental dynamics and human well-being, social distances are a determining factor for whether accessibility leads to actual access, thereby impacting individual well-being and environmental dynamics.

Access and accessibility are important determinants of people's ability to utilize natural resources, and have a strong impact on household welfare. Two NCCR North-South case studies, deliver basic information of the impact of access to services, and access to natural resources, on household poverty and on the environment"

Most poor live in the lowlands

Small area estimated poverty statistics for Vietnam reveal clear spatial patterns in human well-being, with a strong upland - lowland disparity. Although uplands are the poorest areas of the country, most poor live in the better-off and well accessible lowlands. These spatial patterns have socio-demographic underpinnings that are relevant to pro-poor policy-making.

Sociocultural vs. physical distances

While accessibility to local services is a determining factor for poverty incidence in Vietnam, actual access is only partly determined by physical distances, but more so by socio-cultural distances. Social distances therefore largely determine actual access.

Physical accessibility to forests on the other hand proved to be a strong determinant of

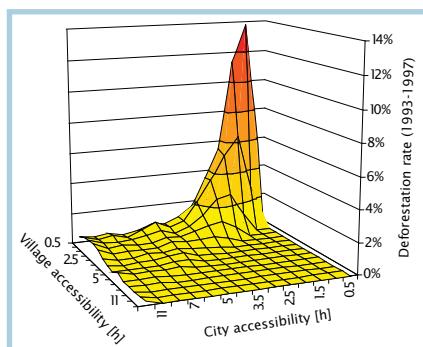


Figure 2: Deforestation in the Lower Mekong Basin in relation to village and city accessibility [2]

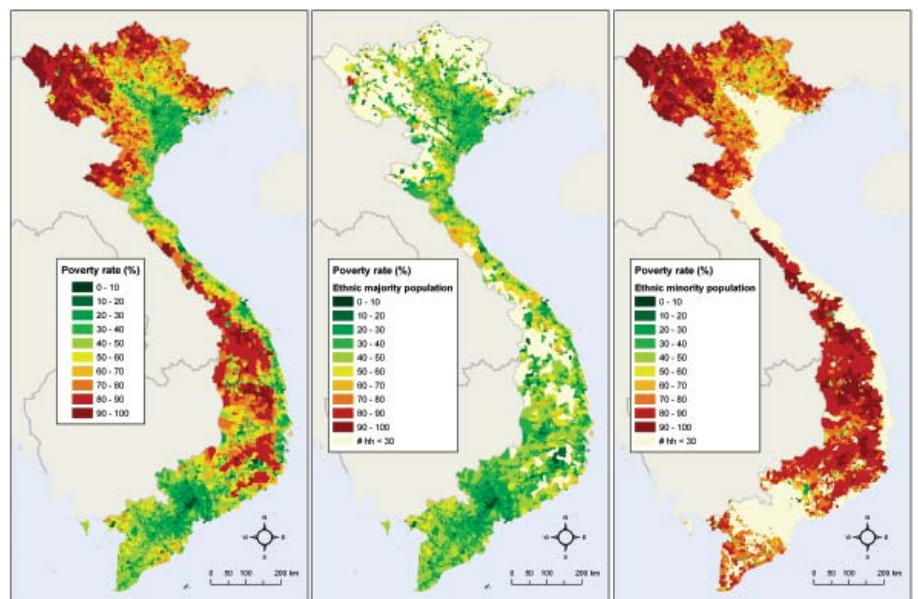


Figure 1: Determinants of poverty in Vietnam [1]

forest cover changes. While local accessibility is a key prerequisite for deforestation in the Lower Mekong Basin, the deforestation capacity of cities is considerable. Being within reach of provincial, national, or even international actors has a strong influence on deforestation through the enhanced commercialization of agricultural and forestry outputs.

Poverty and environmental degradation

Even if closely correlated by location, patterns of poverty and environmental degradation cannot necessarily be brought into direct causal relation. Rather, underlying drivers can be found in actual access of actors to markets, services and natural resources.

Although physically closer to natural resources and typically more directly dependent on them, the local poor often do not have the necessary access and rights to benefit from natural resources or protect them against frequent overexploitation by external actors.

Creating infrastructure often benefits external and better-off actors as they are able to quickly transform accessibility into access to services and resources. Poor actors will need time to adapt and may in the meantime be deprived from their environmental subsistence base.

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Socio-Economic Atlas and Poverty Maps for the Lao PDR

Peter Messerli¹, Andreas Heinemann¹, Michael Epprecht¹

Two new publications of the NCCR North-South program offer detailed perspectives on the socio-economic reality of the Lao PDR.

The NCCR North-South and its Lao and international partners have published two new books intended to contribute to sustainable and equitable development in Lao PDR (Figure 1). The two books are products of a fruitful collaboration among various institutions. Supported by the Swiss Agency for Development and Cooperation (SDC), four institutions shared data, knowledge and experience in a joint project entitled “Socio-Economic Atlas and Poverty Maps for the Lao PDR”: the Department of Statistics (DOS) of the Ministry of Planning and Investment (MPI), the Lao National Mekong Committee Secretariat (LNMCS), NCCR North-South, and the International Food Policy Research Institute (IFPRI).

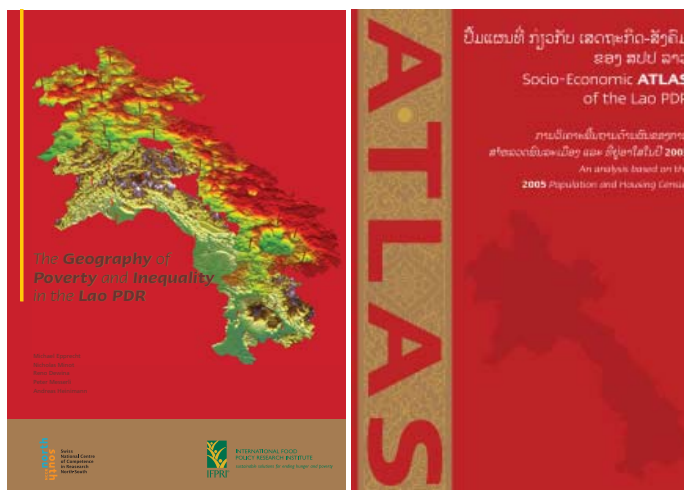


Figure 1: *Geography of Poverty and Inequality in the Lao PDR* [1], and *Socio-Economic Atlas of the Lao PDR* [2].

Socio-Economic Atlas of the Lao PDR

The project emerged from the recognition that the existing valuable information on the socio-economic situation of the Lao PDR remains insufficiently used, particularly due to the difficulty to access and analyze it. The Socio-Economic Atlas constitutes an innovative tool to bring reliable and comprehensive information on the socio-economic status to the broad public in a user-friendly and open manner.

The Atlas presents seventy indicators of the human condition of the people of the Lao PDR based for the most part on data collected in the National Population and Housing Census of 2005. It contains a comprehensive set of maps showing a wide range of socio-economic aspects of the Lao population at the village level, accompanied by thematic analysis. For the first time, census data have been mapped with such a high degree of spatial disaggregation.

Understanding patterns such as the incidence and density of poverty can help define policy making. It can serve as a basis for stimulating discussions on the current socio-economic characteristics of the country and on any future

developments. In this way, the Atlas is expected to contribute to linking knowledge and decision-making hence making development in the Lao PDR more sustainable and equitable.

Geography of Poverty and Inequality in the Lao PDR

The commitment to poverty reduction plays a central role in the Lao PDR's development strategies, and many international organizations are supporting these efforts. Knowledge about poverty is of the utmost importance for informed decision-making and for evidence-based formulation of policies. Not only should the current status of poverty in the country be understood, but also how it is defined and perceived by the peoples concerned, and how it changes over time. With rapid national and regional economic growth, there are concerns about the inclusiveness of current policies in terms of people and places.

All aspects of poverty have a geographical dimension, and information on the geographic distribution of poverty is becoming increasingly recognized as essential for poverty analysis and pro-poor policy-making. Combining information from the 2003 Lao Expenditure and Consumption Survey (LECS III) and the 2005 National Population and Housing Census, this book presents for the first time, estimates of different poverty and welfare measures at

a spatially highly disaggregated level. This allows not only an understanding of the detailed spatial patterns of poverty and inequality within the Lao PDR but also allows an analysis of its relation to many geographic features. The results from this study can serve as an important source of information to improve the targeting of poverty alleviation programs in Lao PDR.

The books can be downloaded from the NCCR North-South website, or from www.laoatlas.net.

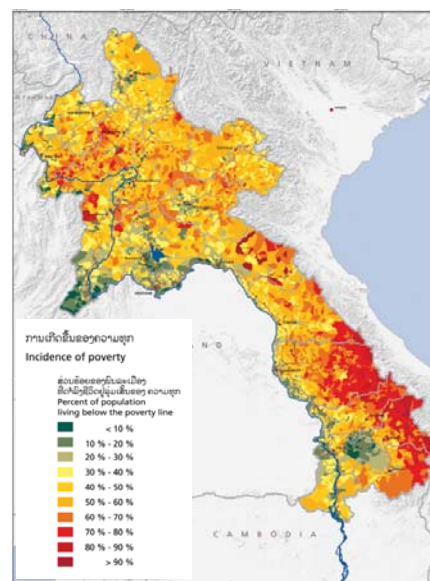


Figure 2: Example of thematic maps published in [2] - poverty rates in Lao PDR

Contact: peter.messerli@cde.unibe.ch

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Bridging the Gap between Research and Practice

Partnership Actions for Mitigating Syndromes (PAMS) are projects of limited financial scope and duration, implemented by local actors in partnership with scientific and non-scientific stakeholders. Six PAMS projects were implemented in Southeast Asia.

Partnership Actions implement and test approaches, methods and tools developed in research, in order to identify promising strategies and potentials for sustainable development. The projects can cover a variety of activities such as training courses, policy dialogue, cultural programs, or small-scale improvements in infrastructure and technology. Each Partnership Action project is carefully planned to enable and promote mutual learning between the research community and society.

Partnership Actions or, for short, PAMS, are a vehicle for testing the applicability of development research results. Each PAMS project is designed to implement strategies developed jointly by researchers and local stakeholders. Based on a transdisciplinary approach to development research, Partnership Actions are meant to promote mutual learning and knowledge-sharing between academic and non-academic partners in sustainable development.

Over the last eight years, 62 PAMS projects were implemented in the framework of the NCCR North-South program. Six of these PAMS projects were implemented in Southeast Asia. The following table provides an overview of the PAMS projects implemented during phase 1 of the NCCR North-South program. The two PAMS implemented in phase 2 are presented on pages 20 and 21.

The NCCR North-South website provides detailed information on the completed and ongoing Partnership Actions.

The interested reader may also contact the Regional Coordination Office in Bangkok, or the PAMS coordination office at the NCCR North-South Management Centre in Switzerland (refer to page 27).

Contact

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PAMS Project in Cambodia & Thailand

Women negotiating the borders: Marketing route and cross-border trade of inland fish between Thailand and Cambodia

By means of informal interviews, in-depth case studies, life histories, and a joint workshop, this study examined the marketing route of cross-border inland fish trade between Cambodia and Thailand, the actors involved and the power relations between them, especially women/men and buyers/sellers.

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PAMS Project in Vietnam

Developing a Socio-Economic Atlas of Vietnam

The goal of the project was to enable staff of the General Statistical Office and of the Information Centre for Agriculture and Rural Development of the Ministry of Agriculture and Rural Development of Vietnam to make tabular statistical data available in an appropriate format to key policy makers, as well as to a wider public. This was to be achieved through training in the visualization of selected socioeconomic indicators in a spatially explicit way in the form of a socioeconomic Atlas.

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PAMS Project in Thailand

Development of technical guidelines on constructed wetlands for septage treatment and management

This PAMS project evaluated the long-term performance of constructed wetlands treating faecal sludge, which were jointly developed and implemented by the Asian Institute of Technology (AIT) and the Pollution Control Department (PCD) of Thailand. The PAMS resulted in the development of technical guidelines for septage treatment and management. These guidelines are currently used by local municipalities in Thailand.

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PAMS Project in Yunnan Province, China

Implementation, monitoring and promotion of urine-separating dry toilets in a village in China

The aim of this PAMS project was to implement urine separating dry toilets in Zhonghe Village, a village near the Dianchi Lake (south of Kunming, capital city of the Yunnan Province, P.R. China). The sanitation system with urine diversion dehydrates the faeces and allows the safe reuse of human excreta as fertilizer in agriculture. The PAMS allowed the implementation of more than 100 urine diversion latrines in a rural to peri-urban setting, thus (i) diminishing the health risks caused by inadequate sanitation, (ii) helping to close the nutrients cycles on a local level thereby avoiding their uncontrolled discharge into the environment, and (iii) promoting this practice for further dissemination on a larger scale.

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Development of a Strategy to Improve Faecal Sludge Management in Thailand

Supattra Jiawkok¹, Thammarat Koottatep¹, Antoine Morel²

Thai authorities, academia, the private sector and citizens have contributed to the development of a national strategy to improve faecal sludge management (FSM) in Thailand.

The pollution control authorities in Thailand have, until recently, used a technical approach to solve the problems of faecal sludge management. The capacities and perceptions of local authorities, service providers and households were ignored. As a result, the strategies applied were not adapted to the local context and thus failed. The Thai Department of Health (under the Ministry of Public Health) and the Asian Institute of Technology (AIT) recognized the problem and launched a project to identify the main limitations to more sustainable FSM in Thailand and to develop a strategy to overcome these limitations



Photo 1 (top): The national FSM strategy was discussed and endorsed at a national seminar organized in Bangkok on 15-16 May 2008 (Photo: S. Jiawkok).

Photo 2 (bottom): Constructed wetlands for FS treatment in Baan Klang municipality were rehabilitated in the framework of the PAMS project. (Photo: S. Jiawkok).

A case study was conducted in the Baan Klang municipality, Lamphoon Province in Thailand. Current FSM practices were determined based on a household survey, focus group discussions and stakeholder dialog. The performance of FS treatment plants (constructed wetlands) was assessed on the basis of conventional performance indicators. A SWOT analysis was conducted in multi-stakeholder consultation workshops. The outcomes of this analysis were discussed in a national workshop to define an action plan to improve FSM in Baan Klang, and used as a basis to develop a national FSM improvement strategy (Photo 1).

Barriers to sustainable FSM

A review of the current management practices in Baan Klang revealed that 97% of the FS is currently discharged untreated onto agricultural land, into aquaculture ponds or surface water and only 3% of the FS is treated. The following causes for ineffective management of FS were identified by the focus groups:

- FS treatment capacities are not sufficient;
- Treatment plant operators are not well trained;
- FS emptying services perform poorly, illicit sludge dumping remains unpunished;
- Current legislation is not enforced;
- Management capacities at the municipal level are insufficient.

The lack of strategies, activity plans or funds to improve FSM are attributed to the fact that FSM is low on the priority list of municipalities. There is a general lack of public awareness on the importance of FSM.

National FSM strategy

The multi-stakeholder dialogue resulted in the definition of a FSM improvement strategy comprising four main components:

(i) Building FSM capacity at the local authority level, including implementation of an administration system, increasing human resources, allocating a budget for FSM,

implementing a customer service system.

(ii) Promoting the dissemination of state-of-the-art FS collection and treatment technologies (e.g. improved sludge emptying trucks, vertical flow constructed wetlands for FS treatment).

(iii) Raising awareness on the need to improve FSM by disseminating local and national information.

(iv) Creating a national monitoring and evaluation system of municipal FSM performance (i.e. FS emptying, treatment and reuse), which could be evaluated based on municipal Key Performance Indicators (KPIs) of FSM.

Next steps

The strategy, developed within the framework of the PAMS project, was endorsed by local, regional and national authorities under the Ministry of Public Health (MoPH). Though a clear concept on the implementation strategy is still missing, some components are currently being put into practice. AIT is, for example, currently supporting the MoPH in revising national regulations on FSM (including emptying, transport, treatment, and disposal), where the outcome of PAMS is introduced. The MoPH has also invited NCCR researchers to conduct training courses on improved FSM and sustainable sanitation for local authorities in Southern, North-eastern and Central Thailand.

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Objectives and activities

The main objectives of this PAMS project were to (i) review current faecal sludge management practices, (ii) identify the main stakeholders affecting or affected by FSM, (iii) determine the factors affecting faecal sludge management, and (iv) define a strategy to improve FSM in Thailand.

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²Swiss Federal Institute of Aquatic Science and Technology (Eawag), Switzerland

Participatory Planning of Environmental Sanitation in Vientiane, Lao PDR

Antoine Morel¹, Saykham Thammanosouth², Thongdom Chanthala²

This PAMS project helped to improve the environmental sanitation services (ESS) in a low-income neighborhood of Vientiane. At the same time, it helped to field test and validate the Household-Centered Environmental Sanitation (HCES) approach co-developed by NCCR North-South researchers.

The PAMS project adopted a demand-driven and participatory planning approach (HCES approach) to improve environmental sanitation services (ESS) in Hatsady Tai, a low-income village (Ban) in Vientiane.

The three main project components included: (i) community-level capacity building and awareness raising in environmental management, (ii) participatory planning of ESS and (iii) implementation of the developed ESS plans with private sector involvement.

The planning process

The planning process followed the 10 Steps of the HCES approach [1]. The local community was involved from the very early stages of the project through participation in: (i) assessing the current ESS and hygiene practices; (ii) establishing their needs and priorities; (iii) developing a sound concept for improved ESS, including technical and managerial components (institutional setup, financial management, O&M); (iv) physical implementation of the interventions; and (v) management (O&M, financial management) of the improved ESS.

Main project outputs

Some 110 residents in the centre of the Ban benefitted from the project, whose main outputs comprised:

(i) Improved ESS infrastructure, consisting of a wastewater collection and treatment system servicing 50 households, a storm water drainage, and an improved solid waste collection system;

(ii) Environmental management regulations and procedures, which define organizational structures and responsibilities, financing principles and mechanisms, and reporting procedures.

(iii) Adapted institutional organization: A Village Environmental Unit (VEU), composed of representatives from the community and the

local authorities was created and played a key role in the planning process.

(iv) Increased capacities and awareness through training courses and awareness raising activities (such as participatory assessment of ESS and problem identification, village cleaning campaigns) and involvement in construction activities.

More guidance required

The HCES planning guideline [1] provided a useful theoretical framework with clear working principles easily understood by all parties involved. Additional training manuals and user guides, such as the Compendium of Sanitation Systems and Technologies [2], are necessary to facilitate application of the HCES framework.

Top-down or bottom-up

Transition from a top-down to a demand-responsive, bottom-up approach is not trivial. The decision-making power of district authorities in Lao PDR was clearly underestimated. This was felt before implementation of the developed plans, when decisions taken by the district (i.e. defining minimal road widths) significantly influenced the plans previously approved within the framework of a participatory and consultative process. The importance of a sound and comprehensive stakeholder analysis during the launching phase is thus reemphasized here.

Participatory processes take time

The HCES planning process was perceived as (too) long by the community. This strained situation disappeared with the ground-breaking ceremony. It is thus crucial that all involved stakeholders, especially the community, understand the rationale of such participatory processes to avoid frustrations and consultation marathons.



Photos 1–3: Different project phases, from top to bottom: Poor sanitation services were a priority issue for the community; Village Environmental Unit defining management regulations; construction of the stormwater drainage network. (Photos: A. Morel)

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² Public Works and Transport Institute (PTI), Lao PDR

Education and Training in JACS SEA

The training program for master students, PhD candidates and post-doctoral researchers includes basic theoretical and methodological training as well as regionally adapted courses. The NCCR North-South program has produced five PhD and more than 30 Master theses so far in Southeast Asia.

Education and Training (E&T) is an important component of the NCCR North-South program. It supports E&T by providing PhD fellowships, by supporting MSc field work and on-the-job training for all staff members of the program.

In addition to the individualized training, the NCCR North-South conducts thematic and methodological training courses, in order to help further interdisciplinary communication and cooperation between researchers. These courses are either regional or integrated: the regional courses group those people working in

the same geographic region, while the integrated courses involve participants from different parts of the world.

Since the beginning of the NCCR North-South in 2001, five PhD and more than 30 MSc theses were conducted in JACS SEA. Seven PhD theses will soon be finalized. The table below lists all PhD and the most recent MSc thesis conducted in JACS SEA.

E&T is also promoted through the organization of short-term training courses for authorities, academia and practitioners.

In phase 3 (2009-2013), E&T will be continued at different levels, mainly through the involvement of MSc students in the Research Projects (RPs), the participation at Integrated Training and Capitalizing on Experience Courses (ITCs) and the organization of one Regional Training Course (RTC) in the JACS region.

More information on the E&T component can be found on the internal NCCR North-South website:

www.nccr-north-south.unibe.ch/education.asp

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Consolidation of Research Partnership Networks

Phase 3 of the NCCR North–South has been designed to last 4–years, during which time the Swiss and international network of development–oriented research partnerships will be consolidated and prepared for continuing activities beyond the lifetime of the program.

Thematic Nodes (TN), Research Projects (RP)

In phase 3, particular emphasis will be placed on knowledge exchange with stakeholders from development cooperation and decision- and policy-makers in the North and the South. Phase 3 is characterized by 15 major research projects (RP), led by post-doctoral research teams from the North and the South. These research projects are grouped in 3 thematic nodes: *TN1* “livelihoods, institutions, conflicts”, *TN2* “health, services, planning”, and *TN3* “natural resources, economy, governance”. A fourth, Integrative Node (*IN*) includes various synthesis projects and activities, as well as the integrative efforts and other activities at the JACS level. The proposed approach shall build on existing strengths, while focusing on a limited number of themes, achieving greater integration and dissemination, accomplishing more capacity development and institution building in the South, and investing in developing outputs for policy and practice.

NCCR North–South in JACS SEA

The long-term vision for NCCR North–South activities in SEA in phase 3 and beyond is to sustain and concretize the program’s contributions to the region as well as to firmly institutionalize the RCO as a regional research node of the ASEAN’s Regional Center of Excellence on MDGs at the Asian Institute of Technology.

The research themes of JACS SEA for phase 3 include: (i) Multi-level stakeholder processes for development; (ii) Sustainable sanitation and health interventions; and (iii) Livelihood and environment in transcontextual perspectives. These themes are coherent with the five planned RPs under *TN2* and *TN3* to be actively undertaken in the region. These RPs are presented on the right side of this page.

Dr. Thammarat Koottatep of the Asian Institute of Technology in Bangkok remains Regional Coordinator (RC) of the NCCR North–South program in JACS SEA.

User driven sanitation – gender and the challenge for sanitation demand



The goal of this RP is to identify the factors which influence choice and demand for sanitation and to assess the specific design features and technologies that should be considered when planning gender-specific sanitation facilities. Field research in [Lao PDR](#), [Thailand](#), [Uganda](#), [Costa Rica](#). Contact: Christoph Luethi (christoph.luethi@eawag.ch), Dr. Thammarat Koottatep (thamarat@ait.ac.th)

Productive sanitation: balancing between health risk, livelihood opportunities and environmental impacts



This RP will develop a health and environmental risk-based assessment approach coupled with technical, economic and social assessment which fosters identification and application of sustainable sanitation options. The project will look at environmental and health risks and livelihood opportunity aspects of sanitation. Field research [Vietnam](#), [Thailand](#), [Cameroon](#), [Senegal](#). Contact: Dr. Hung Nguyen-Viet (hung.nguyen@unibas.ch)

Welfare impacts of accesses to services and natural resources at meso-scale



This RP will contribute to the understanding of the potential impacts of rural people’s limited access to services, including markets, information, healthcare and education, and to natural resources, on household welfare. The project is expected to make important contributions to the development of improved poverty alleviation efforts and natural resource management. Field research in [Lao PDR](#), [Vietnam](#), [Tanzania](#), [Kenya](#), [Mauritania](#). Contact: Dr. Michael Epprecht (michael.epprecht@cde.unibe.ch)

Landscape transformation and impacts on environmental services in relations to markets and accessibility



This RP aims at contributing to the understanding of the linkage between different levels of market accessibility transformations of the land use/land cover system and potential impacts, and tradeoffs of selected environmental services, or functions of the land. Methodological advances can be expected in relation to linking land cover data with land use information and spatially explicitly quantifying selected environmental service at landscape scale in space as well as time. Field research: [Lao PDR](#), [Ethiopia](#), [Kenya](#). Contact: Dr. Andreas Heinemann (andreas.heinemann@cde.unibe.ch)

Social services and control of infectious diseases in mobile populations of Africa and Asia



To improve social service provision, notably health and education, in mobile communities within countries and sub-regions, this RP sets up interdisciplinary teams to assess barriers to and needs in services, spatio-temporal disease transmission patterns and develops tools for identification of under-serving and enhancing effectiveness of intervention programs. Field research: [Mauritania](#), [Côte d’Ivoire](#), [Ethiopia](#), [Vietnam](#). Contact: Dr. Esther Schelling (esther.schelling@unibas.ch); Prof. Bassirou Bonfoh (bassirou.bonfoh@csrs.ci)

Latest News and Announcements



Vietnamese Medal of Merit for NCCR North-South researchers

Four Swiss researchers have been awarded prestigious medals by the Vietnamese government.

The medals were awarded by the Vietnamese Ministry of Education and Training (MOET) to the four Eawag scientists Roland Schertenleib, Antoine Morel, Michael Berg, and Walter Giger for their "great contributions and immense achievements for the education and training career in Vietnam." The Eawag scientists, two of whom also work with the NCCR North-South, were granted the honour for research done within higher education institutions in Vietnam. The medal is only rarely awarded to non-Vietnamese nationals. The official medal award ceremony took place at the Embassy of Vietnam in Bern on 10 March, 2009



Prof. Chongrak Polprasert appointed Director of SIIT, Thailand

Following 32 years of academic achievements at AIT, Prof. Chongrak Polprasert took his early retirement in June 2009 and was appointed Director and Professor of the Sirdindhorn International Institute of Technology (SIIT) at Thammasat University, Rangsit Campus, Thailand. The institute, having been graciously named by His Majesty King Bhumibol Adulyadej of Thailand in 1996, offers Bachelor, Master and Doctoral degrees in the fields of Engineering and Technology (www.siit.tu.ac.th). Prof. Chongrak kindly accepted to continue his Chairmanship of the Regional Advisory Board of JACS SEA in Phase 3 of the NCCR North-South program, during which time a research partnership with SIIT will be explored.

New PAMS project launched in Vietnam

A new PAMS project entitled "Development of a training module on health risk assessment related to water and sanitation, and food in Vietnam" will be implemented from October 2009 to September 2010, coordinated by the Hanoi School of Public Health (HSPH) and the National Institute of Health and Epidemiology (NIHE). The PAMS aims at developing a training module on health risk assessment related to water supply, sanitation and food safety in the context of Southeast Asia focusing on Vietnam. The PAMS is expected to be a starting point for building up a larger training program and a

network on health risk assessment in Vietnam and expanding afterwards to SEA with financial support from other funding agencies. Contact: Nguyen Thuy Quynh (Deputy Head, Dept. of Occupational Health, HSPH), Email: ntq@hsph.edu.vn



John Kalbermatten, "Low-cost sanitation champion", 1931-2009

Low-cost sanitation has lost its greatest Champion: John Kalbermatten died on Thursday, 26 February 2009 in Bethlehem, Pennsylvania. In the 1970s and early 80s John was the Senior Water & Wastes Advisor at the World Bank. He realized that the Bank's investments in sewerage were not reaching the poor and he persuaded the Bank to fund the 1976-78 low-cost sanitation research project. John then obtained funds from UNDP in 1978 for project GLO/78/006 for the Technology Advisory Group (TAG), which he established, to start putting the lessons of the research project into practice. TAG's successor today is the Water and Sanitation Program (WSP). John also played a key role in the development of the Household-Centered Environmental Sanitation (HCES) approach, which is currently tested and further developed by Eawag/Sandec in the framework of the NCCR North-South. John was a true visionary. (adapted from <http://duncanmarasanitation.blogspot.com>)



Dr. Schmidt-Vogt appointed senior expert at the Kunming Institute of Botany (KIB), China

Dr. Dietrich Schmidt-Vogt has been Associate Professor for Natural Resources Management (NRM) at the School of Environment, Resources and Development of AIT since June 2002. He coordinated the NCCR North-South research on NRM in JACS SEA in Phase 2. In September 2009 he will take up an assignment as CIM-senior expert at the Kunming Institute of Botany (KIB) of the Academia Sinica at Kunming, China. CIM (Centre for International Migration and Development) is the human resources placement organization for the German Development Cooperation and is supported by the Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ). The main tasks of Dietrich Schmidt-Vogt in Kunming will be to develop research capacities at KIB and to support its networking with academic institutions in the Greater Mekong Subregion.



RCO core staff

The JACS SEA Regional Coordination Office (RCO) is based at the Asian Institute of Technology (AIT) in Bangkok, Thailand. The RCO represents the NCCR North-South in Southeast Asia. It assures the coordination of all research activities in the region, and links with national, regional and international actors active or interested in the region.

The NCCR North-South team at AIT, (from left to right): Dr. Thammarat Koottatep, Antoine Morel, Yuttachai Sarathai, Attitaya Panuvatvanich, Narong Surinkul, Suchitra Piempinsest, Mingkhuan Wanichov, Chanya Leenasan, Sukon Hadsoi, Suppatra Jiawkok, Siriluk Saengpeng. Missing: Dr. Dietrich Schmidt-Vogt, Dr. Soparth Pongquan

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All publications are available on www.north-south.unibe.ch

The Asian Institute of Technology (AIT) – Host of the Regional Coordination Office



Situated just north of metropolitan Bangkok, Thailand, the Asian Institute of Technology (AIT) is a leading international postgraduate institution of technology, development and management. It promotes technological change and sustainable development in the Asia and Pacific region through higher education, research, outreach and capacity development. AIT is an independent and autonomous institute with international status that partners with public and private sector partners throughout the region and with some of the top universities and international organizations in the world. In addition to its main campus in Bangkok, Thailand, AIT has established centers in Vietnam and Indonesia.

AIT schools

The Institute is comprised of the School of Engineering and Technology, the School of Environment, Resources and Development, the School of Management, more than 30 established postgraduate programs, several outreach centers, and a continuing professional development center called the AIT Extension. All academic programs at AIT are taught in English.

AIT enjoys an international reputation based on the proven value of its work and its dedication to applying academic knowledge and skills to address the emergent challenges of the region. It exists to elevate our partners' understanding of global changes and their impact in Asia, and to influence and enable sustainable development for the better. AIT's vision is to be Asia's knowledge center and thought leader in technological innovation for sustainable development to foster a vibrant, prosperous Asia that joins the world in innovative responses to two of the greatest

challenges of the 21st century: global climate change and poverty.

Hub for global network of development partners

The Institute is currently home to approximately 2300 students from more than 40 countries, some 150 academics from 30 countries, 100 research staff, 500 support staff, centers in Vietnam and Indonesia, and about 250 research and outreach projects. As a multicultural and multinational educational hub for a global network of development partners, AIT is dedicated to the generation and transfer of knowledge, and the strengthening of capacity across borders. The AIT community extends far beyond its campus, including an extensive network of partners, alumni and former faculty and staff working in a wide range of sectors within the region and around the world.

Happy birthday!

In 2009, as AIT celebrates its 50th year of responding to Asia's needs, a newly published AIT alumni tracer study reports that 70 percent of AIT graduates have been contributing at very high and high levels in natural resource management, followed by 66 percent in environmental fields, 64 percent in gender awareness and in application and agriculture development, 55 percent in poverty alleviation, 37 percent in renewable and sustainable energy sectors, 30 percent in human rights and peace building and also by 26 percent found contributing in the health sector mainly for HIV/AIDS.

Center of Excellence on MDGs

Today, AIT houses such regional institutions as the United Nations Environment Program

(UNEP) and Telecoms sans Frontières, which are actively working on various development issues of Asian countries. AIT is an affiliated institute of the United Nations University (UNU), and is the regional knowledge hub on reduce, reuse and recycle (3Rs). The Institute was also recently designated by the United Nations as the site of the world's first Regional Center of Excellence on the Millennium Development Goals (MDGs) in partnership with UNITAR, UNDESA, UNDP, and UN-ECOSOC. This center aims to develop pedagogical modules, educational materials and tools for training of trainers for governments, educational institutions, civil society, NGOs, and the private sector.

Yunus Center

In late 2009, AIT will open the Yunus Center, named after Prof. Dr. Muhammad Yunus, co-winner of the 2006 Nobel Peace Prize. The Center will provide an independent and open platform for addressing issues in food security in a way that has a direct impact on poor people's lives. It will act as an incubator for new social business plans that challenge conventional academic wisdom; it will facilitate generation of community-based knowledge; and it will promote opportunities for both women and men.

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