2015 Hanoi Internship Report

July 13-15, 2015

SUSTEP Program

JDS Special Program

University of Tsukuba

(in collaboration with the Delft University of Technology and the Hanoi University of Natural Resources and Environment)

I. Outline

This field trip was designed to examine pressing environmental issues in Vietnam, especially as they pertain to water management, climate change, environmental policies, and environmental disaster/adaptation/mitigation. The activities during the trip were mainly divided into two components: (1) participation in the international collaborative workshop among the Hanoi University of Natural Resources and Environment (HUNRE), the Delft University of Technology (TUD, The Netherlands), and the University of Tsukuba; and (2) a field visit to the Day River area with experts and students from Delft and HUNRE. The former activity was to exchange research ideas among University of Tsukuba students, Dutch experts and Vietnamese participants for further discussion regarding how scientists may better deal with some of environmental problems that are discussed in the seminar. The latter activity aimed to identify pressing matters in the field and then examine how further research activities may help better mitigate or solve these matters. In short, what we expected to achieve through this trip was to develop three salient skills among participants: (1) identifying pressing problems from observation and listening, (2) placing the identified local environmental problems within a global context, and (3) formulating opinion about the possibility of solving the problems. The essays that are included in this final report demonstrate that the above objectives are broadly met.

The students' essays focused on three topics: (1) water pollution, (2) water treatment, and (3) waste management. Their discussions in the essays are largely based on their field observation, which was aided by excellent guide by young HUNRE students and staff. With Delft experts (Dr Martine Rutten and Dr Maurits Ertsen), some of our students also visited several local farmers (both adults and children) along the river and asked about their use of water as well as disposal practices. Some also keenly observed waste disposal conditions in rural areas. From a very limited time they had for interview and field observation in general, they collected a good amount of information and developed interesting insights for solutions. Their insights also reflect their backgrounds to some extent. These students are very much familiar with similar environmental conditions as they grew up in some developing countries. Some of them worked for their governments for several years and observed similar conditions in different parts of their countries. At the University of Tsukuba they also took courses about waste management and the water environment among many others that are related to environmental issues. This means that the combination of some course works and field exercises do help students to develop more in-depth academic insights in identifying problem areas and proposing some possible solutions.

This field trip was made possible by a number of people. Drs Maurits Ertsen and Marine Rutten of the Delft University of Technology were instrumental in arranging our workshop at HUNRE. Dr Pham Quy Nhan, Vice President of HUNRE, also spent the whole day with us in the workshop. He helped arrange his staff and students to help Tsukuba students for three days. Also, Ms Ngan Vu Thi Thuy, invaluable staff member of HUNRE's Department of Science, Technology, and International Cooperation, did much of preparatory arrangement for us. Without her help, this trip could not have materialized. Finally, I would like to acknowledge that this trip was partly funded by the JDS special program grant of the Japan Ministry of Foreign Affairs.

Kenichi Matsui,
SUSTEP Program chair
University of Tsukuba

II. Schedule

Date	Route	Places to Visit	Activities & Notes
7/13	Narita (10:00) to Hanoi (13:35) VN311	Cau Giay Hotel Hanoi city area	Take Narita Express Bus leaving Tsukuba at 5:50am. Meet at the bus terminal at 5:40am. Seat reservation is needed.
7/14	Hanoi	HUNRE Department of Science, Technology & International Cooperation 41 Phudien, Bac-Tuliem, Hanoi	See attached program for the workshop
7/15	Hanoi Day River	Day River area	Day River excursion
8/16		HUNRE	See attached program for the workshop
8/17	Hanoi (7:45) to Haneda (15:05)		Leave Cau Giay hotel at 5am.

III. Workshop Program

WORKSHOP PROGRAM ON
INTEGRATED MANAGEMENT OF WATER AND ENVIRONMENT
Hanoi, 14-16 July, 2015

1, Time: from 14 to 16 of July, 2015
2, Venue: Hanoi University of Natural Resources and Environment
41 Phudien road, North – TuLiem, Hanoi.
3, Participants: about 25-30 people
- Lecturers and students, HUNRE; WRU; HCMUNRE
- Lecturers and students, Tsukuba
- Lectuers from Tu-Delft

Time	Activities	Responsibility
July 14th 2015		
9.00 – 9.30	Welcome	HUNRE
9.30 – 11.30	Presentation from HUNRE: - Brief introduction of HUNRE - Overview of Day river area incl. Water resources and its situation/problems.	Prof. Nhan
	Lunch	HUNRE
13.00 – 14.45	Presentation from Tsukuba University: - Brief introduction of Tsukuba University - Wishes from this workshop and experiences to be share.	Prof. Matsui Kenichi

15.00 – 16.00	Presentation from Delft University: - Brief introduction of Delft University. - Experiences on Water sector from the research project in Viet Nam and other countries in ASEAN	Prof. Maurit
16.00 – 17.00	Discussion about excursion activities/group topics, etc Guidance for field trip on 15 of July, 2015	
	July 15th, 2015	
9.30 – 16.30	Day river excursion	Participants
	July 16th, 2015	
9.30 – 11.30	- Exercise on the field excursion	HUNRE, Tu-Delft, Tsukuba
	Lunch	
13.30 – 16.00	- Group discussion - Presentation of exercise on the field trip	Participants
16.00 – 16.30	Closing remark	
16.30 – 17 00	Opening discussion for future collaboration (Business working)	HUNRE, Tu-Delft, Tsukuba

Field Study on Current Domestic Polluting Activities of Water Bodies and Restoration

Renugapathy Kandiah

The international internship to Vietnam took place from 13 July to 17 July 2015 in Hanoi, and its suburban areas. There were 13 students from the SUSTEP program guided by Prof. Kenichi Matsui. The Hanoi University of Natural Resources and Environment (HUNRE), the Delft University of Technology, and the University of Tsukuba collaboratively organized the workshop and field trip.

The main purposes of this internship were to identify local environmental problems, place them within global context, and suggest solutions to the problems. These outstanding skills were expected to be developed through the seminar, field excursion to problem-focal areas and discussions. These activities are largely related to water management.

On the first day, 14 July 2015, the seminar was held at HUNRE. The academics introduced their academic curricula on environmental studies in their universities. The students from the University of Tsukuba presented specific water related experiences from their countries, and the discussion followed towards the feasible solutions. The students were divided into seven groups to analyze different topics in the field trip.

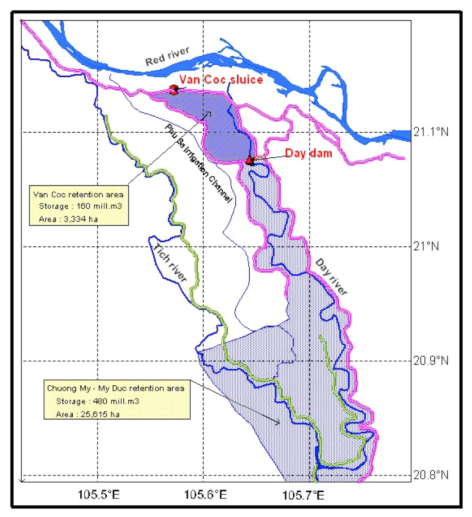
On the following day, the field excursion was made to observe local socio-economic issues. The field observation focused on the identification of environmental problems that are to be discussed further in class on the third day. The discussions that followed on the last day resulted into presentation by each group. Each group received comments from other students and academics. My group presented about the **'**Impacts of domestic pollution on water bodies.'

Introduction

The Hanoi is located in the Red River Basin. The annual rainfall of Hanoi is about 1,600mm and 85 percent of the rainfall occurs from May to October. The main water resources are groundwater and surface water.

The ground water is mainly used for domestic purposes. The extraction of groundwater began in 1909. The groundwater is mainly extracted by tube wells. Some studies suggested that the Holocene aquifer pollution in Hanoi was accelerated by the wastewater disposal of domestic and industrial activities without treatment. In addition, the Holocene aquifer is considerably contaminated with heavy metals like mercury and arsenic largely due to natural conditions.

The surface water sources are mainly from rivers and lakes. The Red River is originated in China. The Day and Lo rivers are connected with the Red River in Hanoi. Because Hanoi is located within the floodplain of the Red River, flood is likely to occur in most rainy seasons such as July and August in upstream region.



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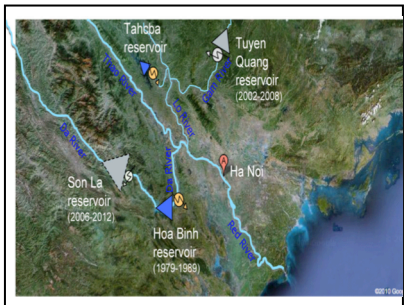
http://baobab.elet.polimi.it/iwrmwiki/IMRR:WP3.3thestakeholders/en#citeref-fig:day_ret_area_59-0



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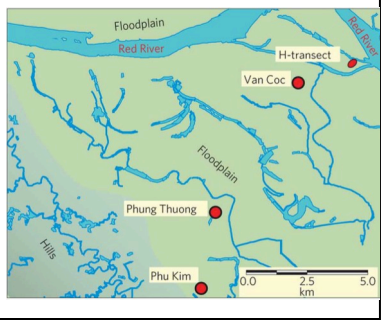

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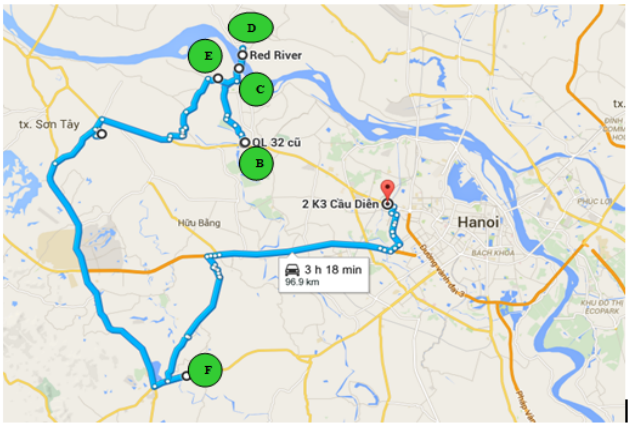
http://www.nature.com/ngeo/journal/v5/n9/fig_tab/ngeo1540_f1.html

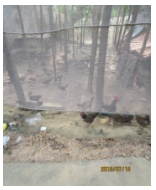
To mitigate damage from the flood in Hanoi during the rainy season, Day Dam was built in 1937 across the Day River. This meant to prevent the flooding from running into the Day River. This Van Coc Reservoir was designed to store the flood water.

Observations

During our field excursion to sites B, C, D and F as indicated in the map below, our group made the following observations. These field observations shown in the table directed us to make the interpretations to predict the feasible solutions on the theme of my group -'Impacts of domestic pollution on water bodies'.



Source:
https://www.google.co.jp/maps/place/Hanoi

No	Place	Observations	Photos	Interpretation
01	B	Waste and wastewater were found in the reservoir. There is no flow in the water and its surface was covered with water hyacinth (*Eichhornia crassipes*).	 	The pollutants are accumulated by leachate from solid waste dumping and emission of waste water from surrounding area.
02	C	The domestic or industrial cleaning activity also occurred in riverside. From the right bank of the Red River, the technical measurement of river velocity was conducted. At that time, sand transportation by ships (approximately 30 load/hr) was also observed long the river.	 	The cleaning activity increases the pollutants into riverwater. The sand transportation by fuel engines have the possiblity for oil pollution and continuous sand mining also affect the river's environment
03	D	On the left bank we observed eroded conditions. Duck rearing was observed in the riverside.		This kind of activities increases the organic pollutants.
04	F	-The bank of the Tich Giang river was used to raise cow, poultry. No prevention activities against discharging poultry wastes into river were observed. Local people have about 200 birds in their poultry farm. They use chicken faecal waste as fertilizer. -The leachate from farms runs into ponds inside their premises and to the river. -During the interview with people, the following facts were obtained: they use groundwater. -Due to the polluted condition, they are not keen to use river water for domestic needs. They identify contamination of their groundwater on colour change. -One elder also told that the water level in the river is not enough. Local people are not aware of water pollutants or their origins.	   	-The runoffs in rainny days washout the organic matters from this riveside farms, and leachate directly into river and increases the BOD (Biological Oxygen Demand). Increasing BOD effect the water polltion. -The people could able to predict the polluted status from the physical characters. -There was no aware on chemical or / and scientific relation between the emision of pollutants and ground water pollution.

05		My insight and observation The organic matter in the river was likely accelerating by domestic activities like faecal wastes, which highly contain nitrogen.		Water pollution in the field survey river area may be increasing BOD by organic matter runoff.

Discussion

The farmers who live along rivers economically depend on livestock rearing like poultry and cattle. Some farmers use faecal wastes from their farms as fertilizer. Some have ponds on their premises to store water for raising poultry and fish. The groundwater is used for domestic purposes and river water is only used for agriculture and domestic or industrial cleaning.

Although local people are aware of the polluted status of the river, they are not aware of the root causes, parts of which are related to their activities. To reduce pollution in the river, the following policy options can be considered:

1. The scientific findings are explained in simplest way to reach the public so that local farmers can imagine the future situation of water pollution. This work can be enhanced through rural people's local networks. From catering businesses to handicraft making activities, women we met at riversides were good at networking. Therefore, this networking ability can be used for environmental education.
2. After establishing the local awareness, the attempts to create a policy should be undertaken
3. The policy making process normally carries out from top-level to root level due to the convenience to implementation. But, this kind of environmental related policy making should be carried out by incorporating with relevant stakeholders especially key persons from the people.
4. The different levels of openness, approaches, and tools like explaining sustainable benefits of the policy should be transparently transformed to public and then, the public compliance should be obtained before implementation.
5. To be successful policy making, the policy should be weaved based on the scientific, feasible and social aspects. If the policy will be made as above method, it will be easily understood by root level and followed.

Therefore, the initiative for policy making to solve this environmental issue should be made parallel to the awareness through populist ways to public in order to change their attitude.

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4. http://www.nature.com/ngeo/journal/v5/n9/fig_tab/ngeo1540_f1.html
5. https://www.google.co.jp/maps/place/Hanoi

Improving water quality in Day River, VIETNAN

SEVERE Yves Edouard

From 13 to 17 January 2015, students of the University of Tsukuba took part in a Seminar and field trip in Hanoi, Vietnam. This trip is part of its SUSTEP program activities. This field trip was designed to examine/analyze pressing environmental issues in Vietnam. This activity was divided into two parts:

1. - A workshop with the Hanoi University of Natural Resources and Environment (HUNRE), The Delft University of Technology (TUD, The Netherlands), and the University of Tsukuba. The main purpose was to exchange research ideas between students from the University of Tsukuba, Dutch experts and Vietnamese participants (students and researchers) regarding how scientist may better deal with water problems.

2. - A field visit to the Day River watershed.

Each student was assign to:
a. - Identify a pressing problem from observation and listening
b. - Identify a local environmental problem within a global context
c. - Propose a sustainable solution or strategy a better to achieve its goal.

Several groups were organized with several topics including the causes of pollution of the Day River, the bad exploitation of underground water through wells, the causes of the reduction of water flow in the river, and pollution of the Day River by households and industries. We visited several locations along the Day River, and it was also an opportunity for Vietnamese students (HUNRE, WRU and HCMURE) to proceed with the practical exercises of water quality control (e.g., arsenic, iron). Reports from these groups focused on four aspects: 1.- problems, 2.- causes, 3.- effects, 4.- solutions.

Among the topics that were discussed in the workshop, I would like to highlight some aspects of household and industrial water pollution with some pragmatic solutions in mind.

Background:
Vietnam has relatively abundant water resources with a dense river network consisting of 2,372 rivers, including 13 large river basins. The total annual river flow volume is approximately 847 billion m3 (MONRE, 2006a). In addition groundwater resources were relatively abundant with an estimated (volume of 48 m3 / year (ADB, 2007, 2008a, 2008b).
These water resources have been playing very important roles in the development of the country. Thus, water resources have long been recognized as a key resource for the socio-economic development of the country, managing this vital resource becomes a critical task to ensure the nation's well being and sustainability.

Causes
Day River, like most rivers in Vietnam are polluted due to a large amount of household and industrial wastes according to the Institute of Natural Resources and Environment. In addition Wastewater from hospitals and breeding sector have been daily flowing into the rivers.

Effects
Day River is now too polluted to be used, this has negative impacts on domestic water supplies, agricultural production and aquatic life.

Biological pollutants
The Day River is important source of irrigation water in agriculture. Crops that are irrigated with river water include rice, beans, corn leafy vegetables and fruits are exposure to biological pollutants.
Appropriate preparation of food crops prior to consumption can eliminate the exposure pathways of biological pollutant (Vuong et al. in prep b). In Day River young children and adolescents mainly conduct recreational activities including swimming and fishing. These recreational activities can increase the likelihood of exposure to pollutants through skin contact with water and sediment

Chemical pollutants
The general population may be exposed to lead in ambient air, foods, drinking water, soil, and dust. Segments of the general population at highest risk of health effects from lead exposure are preschool-age children and pregnant women and their fetuses. Lead exposure may also cause anemia. At high levels of exposure, lead can severely damage the brain and kidneys in adults or children and ultimately cause death. In pregnant women, high levels of exposure to lead may cause miscarriage. High-level exposure in men can damage the organs responsible for sperm production (ATSDR, 2005).

Solutions:
To reduce the pollution of the Day River, it is highly recommended that:

-The Vietnamese government promotes awareness of water pollution among local communities.
- The government should target the most heavily polluting industry sectors. Each of the top polluting industry sectors should be required to prepare environmental management plans with take a product life cycle and integrated pollution management approach.
-The government encourages companies/factories/hospitals to build new sewage system
-The Vietnamese government provides waste management technology to the people living along the river including the collection of solid waste and the selection of additional landfill sites.
- The government encourages farmers to practice manure management system. High manure application rates can improve soil fertility and soil physical properties.
-Local authorities must ensure that all wastewater from companies and hospitals have to be treated before being discharged into rivers.
- The government has to install clean water supply system in all stations along the Day River.
- The government authorities make constant monitoring to assess water quality.
- The government has to setup an area-based model, which can more readily handle seasonal variation and economic growth for projecting future pollution pressures.
- In long-term, integrate the information from the Day River experience and widen the scope to inform policy at a national scale of implementation.

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About arsenic contamination of groundwater in Vietnam

ZHAO ZIWEN

1. Background

1.1 Arsenic

Arsenic, as a non-metallic element, is often concentrated in groundwater. Arsenic has both natural and anthropogenic origins. From natural origins, arsenic is associated with sulphurous minerals of sulphur, iron and various other metals. Arsenic is also generated by human activities through, for example, precious metals mining, pharmaceutical manufacturing, wood processing, glassmaking, electronics manufacturing, and chemical production. [1]

1.2 Effects on human health

Arsenic is classified as a human carcinogen and known as the "King of Poisons" because of its high mutagenic, carcinogenic, and teratogenic characteristics[2]. According to some references, 99% of human exposure to arsenic is through ingestion: 70% is from food and 29% is from water[3, 4]. Once ingested, arsenic continues to bio-accumulate in the body[4]. Remarkable percentages (10–20%) of people examined in Bihar (India) and Bangladesh were identified to have skin lesions and cancers bound with arsenic exposure. Other types of cancers such as liver, lung, and bladder were also observed among the people who had high arsenic exposure.[5]

As for the reason of causing disease, arsenic inhibits more than 200 enzymes in human cells and affects proteins function in various mechanisms of the body [6]. Because arsenic in groundwater is the main source of human exposure, this report will focus on arsenic contamination of groundwater in Vietnam.

2. Arsenic contamination in Vietnam

2.1 Current Situation

Vietnam, located in Southeast Asia, is an agricultural country with a population of 88 million. The residents are concentrated mainly in the Red River Delta in the North and in the Mekong River Delta in the South [5]. In the Hanoi region, groundwater that is pumped by household tube wells is commonly used as drinking water, bathing and washing without high quality treatment. This was confirmed in our investigation at one villager's house in Para-urban Hanoi.

Around the Red River Delta in Vietnam, Berget and others [7] found elevated varied levels of As concentrations (up to 3050 mg/L) in groundwater, which are above the WHO (World Health Organization) drinking water guideline (10 mg/L). These levels are comparable to those in Bangladesh and West Bengal, India. Berget et al. also found that approximately 11 million people depend on groundwater from the delta areas as their main water source.

Around the Mekong River Delta, more than 40% of tube wells contained greater than 100 μg/L of arsenic, with a range up to 1610 μg/L[4]. This level of concentration is almost three times higher than the safe determined by the WHO.

The extensive use of groundwater for crops and drinking water is a huge issue because these two river systems have extremely high arsenic concentration. Although there is a base of natural arsenic contamination in groundwater due to natural geochemical sources, the primary source of the contamination problem for Vietnam is anthropogenic. This spike of arsenic in groundwater must be quickly reduced; especially it has a serious impact on human living and environmental sustainability.

2.2 Reasons for arsenic contamination

Firstly, the soil layers in Vietnam, like most of South-East Asia, derive its sediments from the Himalayas that were washed down to the Mekong and Red River deltas by rainfall. While, these arsenic rich sediments are absorbed into neo-formed iron oxides.[8] Secondly, since the late 1900's, Vietnamese farmers have used arsenicals such as monosodium methane arsenate, disodium methane arsenate as pest control for crops in rural areas. These chemicals also account for a large part of arsenic sources. Thirdly, due to poor wastewater and waste management, plenty of greywater and refuse flows into the river and are deposited in the alluvial deltas, creating an organic reducing condition that promotes the release of arsenicals from soil layer to groundwater[9].

3. Solutions for arsenic contamination

In order to solve arsenic contamination, it is important to conduct more research and measure arsenic concentration in groundwater in all cities. These concentrations of arsenic, matched up with the average income of the surrounding population, must be taken into account in building drinking water treatment system and a relatively lower standard groundwater system for crop production.

Then, constructing and completing sewage system is an effective and ultimate means to control water environment pollution in urban area, especially trace metal. Besides, more appropriate and modern technologies need to be introduced or developed on mitigating arsenic contamination, like sand filtration systems with co-precipitation which are considered as one of the most effective treatment systems, or Integrated Agriculture-Aquaculture system.

Next, instead of the high toxicity of conventional pesticides in agriculture, control pesticide environmental pollution. Simultaneously, research and develop new agrochemicals. As the local government, subsidies and corresponding improving affordability are their obligations and responsibilities.

Finally, the government needs to place emphasis on educating the population of the dangers of arsenic in groundwater near their homes, in their drinking water. And improve consciousness of protecting the water environment and their physical health.

4. Conclusions

In regard to arsenic contamination, it is far from enough to introduce or develop some kinds of modern technologies or improve some specific aspects. Instead, the cooperation and consociation of individuals, family, enterprise and government is the key to the problem, even most of environmental issues. Increase of personal income and national economy; improvement of personal qualifications and corporate social responsibility; certainly, the formulation of government policies is indispensable.

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Possibility to reduce an intensive groundwater pumping and illegal wastewater discharge in Vietnam

Enkhbold Bayarmaa

Vietnam is one of the countries with serious water pollution problems (Anwarul et al, 2009). For example, arsenic contamination is becoming wider in both surface and groundwater. About seven million inhabitants use groundwater that is contaminated with arsenic and other pollutants in Vietnam (Winkel et al, 2011). According to Suwal, almost 80% of total diseases are caused by polluted water (Suwal, 2015). Although the Vietnamese government has taken measures to provide safe water from pollution in the past few decades, there has not been significant improvement partly because of a shortage of appropriate policy and management. The country is also short of physical infrastructure and financial capacity (Suwal, 2015). The main cause of water pollution is related to intensive groundwater pumping and illegal direct discharge from households and industries into natural drainage (Van Dan, 2002). Additionally, Vietnam is a flood prone country, and when it happens, contaminated water spread throughout the affected area that poses inhabitants' health risks (Suwal, 2015).

In my observation of field trip in the Day River valley in Hanoi, Vietnam, I came up with the following ideas as part of the solutions to water pollution. These can be taken at four levels – grassroot, institutional, governmental and international.

Grassroot level: I think that one of the most important steps for water management is to change public awareness and their relationship to nature. In order to reach this goal, the public participation in any pro-environmental activity is very important. Also, regular training should be conducted by scientist in a way that captures interests among the wider public with different interests. For example, scientific organizations may conduct field trips to communities in the watershed like the Day River valley, check water pollution levels together with local participants and show them the result of analysis. Then communities may be aware of high level of river pollution and its potential negative results that could impact the environment and human health. Therefore, the local participants and researchers discuss about solution and propose to work together with the government. For example, during the field trip in the Day River valley, I identified that the local people illegally discharge wastewater to the river directly because they prefer using groundwater only. Thus, communities should demand the government to financially support the construction of the pipeline system and water treatment facility. Also, local people can create ditches for discharging wastewater with the other inhabitants by forming an environment community. I hope this approach could be effective.

Institutional level: Scientists and researchers should always be supported from the government to conduct survey and provide updated data. I believe that successful and sustainable policies are based on solid scientific data. Therefore, the government should ensure research institutions to participate in the implementation of every environmental conservation activity. Moreover, scientists should educate governmental officials and young generations to raise their awareness of nature protection.

Governmental level: The Vietnamese government should strengthen the policy and monitoring system against illegal wastewater discharge and intensive groundwater pumping. State and local level governments should also ensure that inhabitants comply with the laws and regulations. Moreover, endeavouring cooperation with international donor organizations to implement promising projects and

programs that address water quality improvement is very important. For example, NGOs and aid organizations can help construct new water purification and wastewater treatment plants with the pipelines for water delivery and wastewater discharge. Also, learning from the best experiences of other developed countries significantly benefits Vietnamese water management. Moreover, there should be encouragement and discouragement systems. As for encouragement, if someone initiates a significant pollution mitigation practice, he or she will receive benefits from the government. As for discouragement, if someone illegally discharges pollutants, he or she should be punished strictly.

International level: Dr. Pham Quy Nhan of the Hanoi University of Natural Resources and Environment (HUNRE) said in his presentation on July 13 that "Sixty percent of river flows from outside of Vietnam". Therefore, integrated water management should take into account international contexts. The countries that use international rivers should formulate and implement a long-term joint program for water conservation. For example, they may conduct a regular joint monitoring and assessment about water quality and its safety. Also, they may organize a regular international conference to exchange information about their best practices that are beneficial for further sustainable cooperation on water management.

In conclusion, water pollution we observed during our Vietnam internship is one of the very serious environmental problems in developing countries. It could cause terrible consequences to human heath in Vietnam in the future. Even though the government has been taking some measures against water pollution, there has not been significant improvement. However, those four steps are mentioned above in separate, they should be connected and implemented together in order to receive successful achievements. I believe my four recommendations may provide some answer to these problems.

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Wastewater treatment problem and solution of Hanoi

Hoang Phan Bich Ngoc

With a growing number of inhabitants together with rapid urban sprawl, Hanoi has to deal with the increasing amount of wastes. However, the process of wastewater treatment, which is one of the most urgent tasks in environmental protection, is still undervalued. This report will review some general information about the source of wastewater, the disposal network, waste treatment policy in Hanoi. I also suggest my own ideas for solution on these problems.

1. Source of wastewater in Hanoi

The main sources of wastewater in Hanoi are domestic wastewater, hospital wastewater and industrial wastewater (Nguyen, 2013). The main source of BOD founded in natural water bodies is derived from domestic wastewater with 161.22 tons/days, following by industrial wastewater with 60.782 tons/day (Table 1).

Table 1: Estimated total pollution load of wastewater source in Hanoi.

	BOD (Tons/day)
Domestic wastewater	161.22
Hospital wastewater	0.912
Industrial wastewater	60.782

Source: Duong, 2013

2. Wastewater disposal system in Hanoi

Hanoi's sewerage and drainage systems constructed from 1905 to 1945. These old systems cover an area of 1,000 ha. in the central part of the old city, meaning only 35-40% the Hanoi citizen benefit from these systems (Ngo, 2009).

In general, there are three ways to treat the wastewater in Hanoi: through septic tanks, water borne sewers and on-site systems (Figure 1). The Hanoi Sewerage and Drainage Company (SADCO) manage wastewater treatment. Septic tanks are used to treat household wastewater before going to the drainage system. Industries and other communal houses have their own wastewater treatment facility before disposing wastewater to the public system. The water collected from this system or storm water can be used to clean streets. However, as only 40% of the Hanoi population benefit from the city sewerage system, the other 60% of citizens simply dispose their waste water directly to rivers and the ponds (Ngo, 2009).

In addition, City's sewerage channels are inappropriately designed. The low-slope channels accumulate a large amount of sludge and sediment in the systems. In areas such as Ba Dinh and Hoan Kiem, the sewerage system has not been upgraded since the first half of the twentieth century, and the carrying capacity cannot meet the increasing demand, due to the recent rapid growth of the population (Ngo, 2009).

Furthermore, since the storm water also flows into these old channels, there is a typical seasonal flood in Hanoi during the rainy season, resulting in environmental pollution, traffic accidents and other social problems.

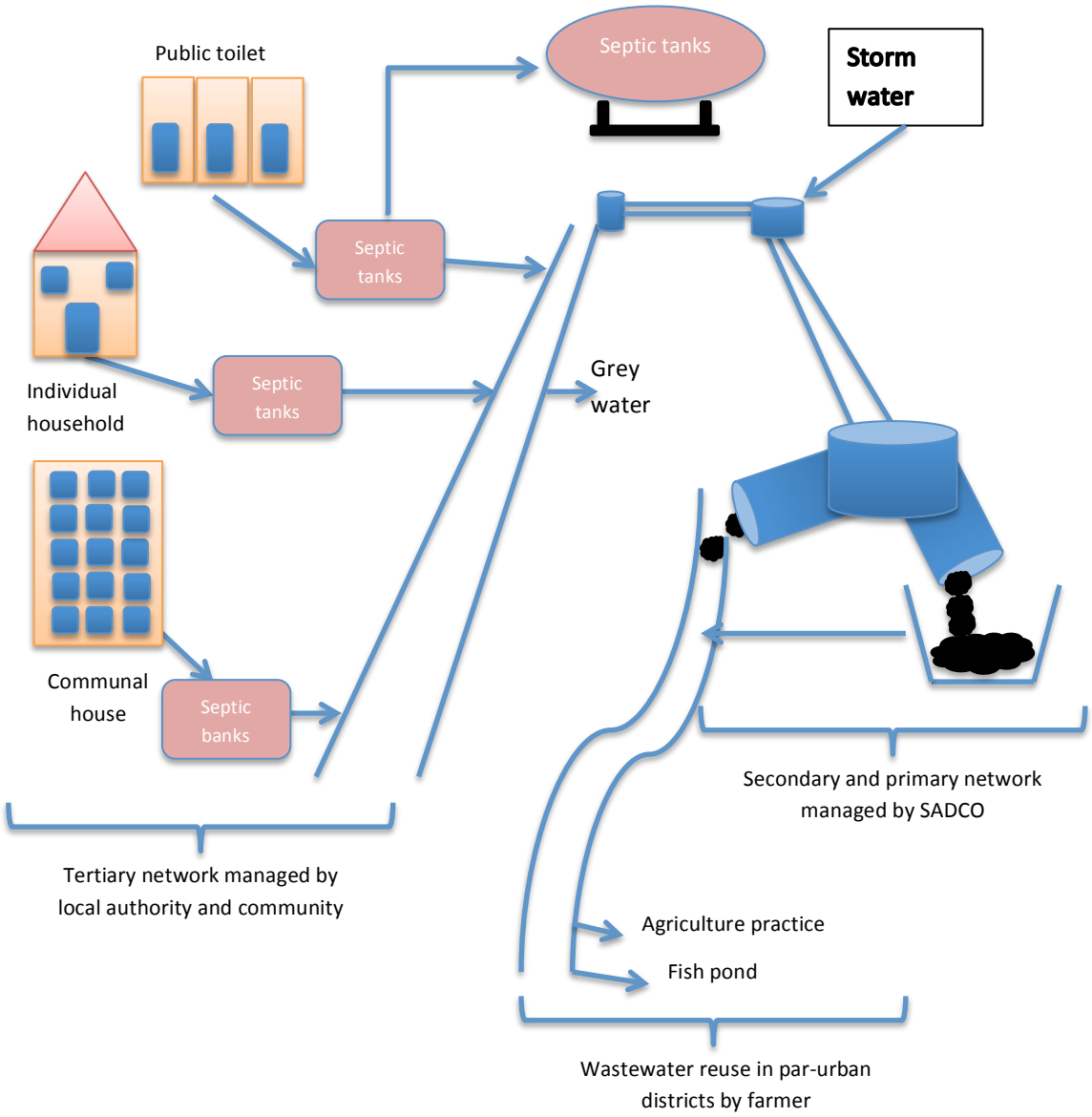

Figure 1: Sewerage and drainage system in Hanoi. Source: Ngo, 2009

The wastewater is often reused for agriculture in para-urban. With nutrient content, this water may be suitable for agriculture irrigation and plant growing. However, the municipal wastewater also carries inorganic substances, toxic elements (1.09 - 2.14 µg Cd L-1, 0.16 - 0.33 mg Cu L-1, 2.75 - 4.02 µg Pb L-1, 0.20 - 0.34 mg Zn L-1 and 0.22 - 0.44 mg Mn L-1) and heavy metal (Chu et al, 2010). This will affect the soil quality and increase health risk to consumers.

3. The wastewater treatment in Hanoi

My group could not find the specific data about treatment facility in communal houses (industrial and hospital), but we found the result of an inspection of industrial zones. This information reveals the status of the industrial treatment in Vietnam (Figure 2).

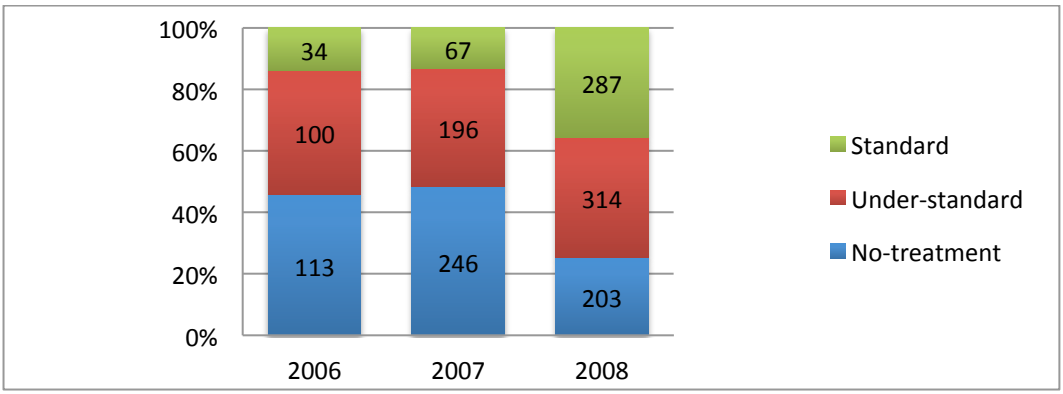

Figure 2: Inspection results of industrial zones in Vietnam. Source: Nguyen, 2010

According to the inspection, more industrial zone are equipped with treatment systems meeting the environmental standard. The number of zones without treatment dropped. However, the number of 'under standard' zones still remain to be the majority (approximately 37%). This limited progress largely owes to low-investment, installing and maintaining treatment facilities. In addition, it owes to a lack of professional staff and low awareness of industrial owners and operators about the important of waste management. The situation is similar at hospitals. According to Nguyen's study in 2010, less than 50% of hospitals had established wastewater facilities. Even with wastewater treatment facilities, their capacity is low and normally does the environmental standard.

4. Policy in wastewater treatment

Currently, there are many regulations on wastewater management such as the Law on Environmental Protection (revised) (2005), Government Decree No. 67/2003, Decree No. 04/2007: Environmental fee for industrial wastewater; Government Decree Nos. 59, 88, 115/2007 and Prime Minister's Decision Nos 1929 & 1930, Orientation for Urban and Industrial Water Supply and Wastewater Development (Technical Regulation-2009). There are overlaps and gaps in these regulations, especially concerning management responsibilities among different ministries and agencies. Thus, a new plan, 'The unified sanitation sector strategy and action plan' (U3SAP), was initiated in 2005 and proposes to the government in 2007. The objective was to remove the overlaps and inconsistencies in legislation, to establish an effective coordination in environmental activities, to improve sanitation of both rural and urban areas and to achieve the targets of existing strategies (e.g. National rural clean water supply and sanitation strategy) (Nguyen, 2011).

In my opinion, the sewerage should be included in this plan. The network of pipes and drains should be upgraded and modified in order to satisfy the demand of the increasing population. Furthermore, with the upgrading of drainage system, the treatment plant could operate better with their designed capacity.

In conclusion, the domestic water systems in Vietnam is very complicated and required great effort to cope with the growing population, rapid urbanization and the low level of public awareness. The legislation relating to water should be consistent and clear, giving the local and central authorities the power to enforce and control flood, pollution and drinking water. Furthermore, I believe that the central authority should improve the sewerage and drainable systems wastewater facilities in order to the flooding in the raining seasons.

4. Main findings during the intership

The target of our intership in Viet Nam is finding an environmental problem and then bring out some solutions for this problem. After two working days, my group focuses on the water usage of Thuy Xuan Tien commune, Chuong My district.

During one day of observation and interviewing with local people, my group found that:

4.1 Problem of water usage

There is not the tap water system and sewerage in this village. All of the households in this village use the ground water by digging the well. Each well costs from 4 to 5 million VND (200-250 $)

and it will be used for 7-10 years. Although, the water here is polluted by daily activities and contaminated by Fe from nearby industry factory, the water is not treated or simply treated before using. Moreover, this village is located near the cancer- village where has more than 70% of residents get cancer due to the water pollution.

Picture 1: A household's well

Picture 2: Treatment of drinking water by household

4.2 Policy suggestion

My group has two parts for the solution to improve the quality of water for local people. They are technical and policy suggestions. In this report, I will mention about some policy suggestion.

- It is necessary to have a local well management committee. This committee will have a clear understanding of local situation, since then, they can bring out appropriate solutions to ensure the quality of water as well as the effect in using well.
- The water filter system in each well must be installed in order to reduce the contamination. The local committee can help the household in installing and instruction in using this.
- There must have the regulation in the minimum depth limit level to make a well, depending the ground and the regulation in quality inspection.

Thanks to my fieldtrip in Viet Nam, I also to have a chance to work and talk with many guests and professors from many places in both technical and policy aspects.

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Increasing the Citizens' Awareness and Avoiding from Illegal Dumping of Wastes

Enkhbat Oyuntselmeg

In Vietnam, illegal dumping is one of the environmental priority issues that need to be regulated. According to the USEPA, an illegal dumping is defined as the disposal of solid and liquid wastes in an unpermitted area. Generally wastes are illegally dumped to avoid paying disposal fees required for appropriate disposal (Region 5, 1998). Illegal dumping or so-called "open dumping" also mostly occurs due to a lack of appropriate policy and inadequate local control and monitoring in Vietnam. So far as it depends on people's lack of awareness on environmental protection, river water quality especially is affected by open dumping from industries and householders.

During the fieldtrip in the river areas of Hanoi city, we observed that human activities have seriously polluted surface water. For instance, water in the Day, Red, Tich rivers we visited, is locally polluted by solid wastes and untreated waste water. Solid and liquid wastes are directly discharged into the rivers. According to Thi Van Le Khoa (2015), waste water from craft villages is discharged into the rivers and it comprises 4% of total waste water of the whole river basin. And the solid waste is disposed in an indiscriminate manner to river or lake banks. The domestic waste comprises 80% of the total amount of solid waste. As for the domestic waste water, Hanoi and Ha Tay contributes 71% of total amount. However, there are many other factors that affect river water quality. In this report, I will examine illegal household dumping in the rivershed. I will also consider possible ways to improve citizens' awareness on water and environmental conservation.

In the group discussion of the July workshop in Vietnam, our group discussed about why illegal dumping occurs, and what roles stakeholders play in this problem. We identified a few root causes. First, communities we visited in the watersheds of the Red, Day, and Tich rivers, there are no appropriate places to collect wastes. The piled solid wastes were observed along the rivershed. We also learned that there is a lack of water treatment facilities. The waste water from industries was being directly discharged into the Tick River. Although the Vietnamese government has promulgated law and regulations, their implementation mechanism is yet very inadequate. For example, there is no control and punishment for those waste disposal sites. Moreover, citizens do not seem to be well-informed about water and environmental conservation. So there is a need for an integrated approach among scientists, central government, local government, and local communities to educate local residents about the importance of water conservation and proper waste disposal.

In case of stakeholders' cooperation for water conservation, the role of residents' perception and attitude is significant. Here researchers can help update monitoring data about water quality in those rivers and report the results to the government authority. Local governments can also monitor water quality by following monitoring standards that are established under central government regulations. They should apply an appropriate waste management mechanism with proper waste collection method. Also the local government should motivate local people's participation in waste management and pay more attention to increasing the public awareness.

The question as to why citizens are not well-informed about water conservation so poor is also important to be considered. The reasons could be explained as people do not understand well about what environmental conservation is, what the benefits are of protecting nature and, what negative impacts will happen in the future after dumping wastes into rivers. In my opinion, improving citizens' understanding is the most significant priority work to be done in order to decrease water pollution and preserve nature.

Considering this situation, I developed the following recommendations for a local government to enhance citizens' knowledge and awareness:

- To educate people on environmental conservation by providing training programs to young children. Of course, adults need to be involved in the training program, but it is important to make children acquire perceptions and habitats at an early human development stage.
- To make convincing advertisement against illegal dumping. In order to convince people, the local government could do different kinds of advertisement such as making signs, documentary videos, brochures, and using television.
- To organize the public outreach program. For example, the Vietnamese government can designate one certain day of each month as a national cleanup day. And if the local government could organize some other activities it will help to increase the citizens' participation.
- To implement a rewarding system. For example, Dallas County in the U.S. has offered a 24-hour hotline (1-888-335-DUMP) for citizens to report illegal dumping. Citizens are asked to inform about violators and places where illegal dumping occurred. As a motivation to report illegal dumping, the county government offered a $50 reward to the informant whose information led to an arrest (the EPA Web, 2014). I think this is a good example to encourage citizens' participation.
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In conclusion, citizens' awareness and participations are important steps in fighting against illegal dumping, and sustaining and protecting the environment. So the local government's program against illegal dumping should begin by changing citizens' lifestyle tendency.

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Maintaining Water Sustainability through the Proper Waste Management System in Hanoi, Vietnam

Moreen Bimali Weerasuriya

Hanoi city has encountered many problems related to water pollution and mismanagement. To name some, these problems include a lack of safe drinking water, eutrophication, ground water contamination and salt intrusion. This report will briefly discuss some aspects of these water pollution problems that are closely related to improper or illegal waste discharge. I will also make recommendations for improvements.

Some studies have shown that inadequate facilities along with a lack of proper waste collection mechanism have led to illegal/in proper waste disposal by local people to the rivershed environment. Dumping sides and waste water discharging points I observed during Vietnam internship in July 2015 had bad odor and, water stagnation that might led to mosquito breeding (figure 1). According to the presentation by the Hanoi University of Natural Resources and Environment (HUNRE) on July 14th, about 56% of the total waste discharge per waste volume in the Day River watershed is from domestic activities. According to Huong *et al*. (2011), about 92.2% of waste generated from a person is not recycled. This means that the introduction of the proper waste collection mechanism is an urgent requirement. The HUNRE experts further mentioned that everyday waste is collected in residential areas and street sides, but our study group did not observe any collection point along the river. Instead, free dumping appeared prominent practice. So I argue that the main reason for these problems owes to improper waste collection mechanism.

In order to prevent pollution, the continuous monitoring system of waste disposal is essential. From, the legal side an administrative authority for waste management can vigorously pursue legal actions against illegal dumping. The establishment of solid waste collection bins at domestic level will have people become involved in the waste management network. Also, kitchen waste can be recycled through composts. Municipal governments or other bodies that are in charge of collecting solid waste can distribute a waste collection calendar for residents.

Another approach to regulate water pollution is by sectors. In the agriculture sector, animal husbandry, which is one of the main livelihood activities, causes water pollution because livestock wastes are not collected but left within river system (figure 2). The high nitrogen content of animal manure may cause water eutrophication. Government support for Intensive rearing of the poultry and goose, and biogas incinerating or fertilizer production from collected manure, or introducing of small-scale treatment plants to manage nitrogen concentration is essential.

Since the Vietnamese economy is largely based on crop farming, changing the agricultural water consumption pattern will be difficult within a short time. However reducing the discharge of nutrient and chemical rich water to streams can be prevented. For example, in Shanghai, China some farms plant aquatic plants along irrigation ditches, which have the high potential to absorb chemical and nutrient.
In the industrial sector, the rapid industrialization has dramatically increased the amounts of toxic materials in water bodies. The industrial pollution is mainly because of a lack of concern and, financial capacity among industries to adopt treatment facilities. According to the estimate by the Ministry of Foreign Affairs of Denmark, Vietnamese industries produce an average 13, 100 tons of wastes every day, of which 20% is considered to be hazardous (2012). It is indeed important to require each company to introduce a proper industrial waste treatment mechanism and safeguard water and the environment in general. To promote this action, the Vietnamese government may introduce subsidies or loan schemes for industry owners to establish treatment plants.

Also the government may promote further coordination among sectors and stakeholders to promote water management in Vietnam. A proper coordination between stakeholders in making an achievable strategic plan requires the scientific studies about the amount and causes of waste generated, water quality parameters and remedial measures. Financial assistance to both local and state management is required in initial stages.

Cooperation from the village level administration can be achieved through various encouragement policies. For example, a rewarding system for effective waste managers will strengthen the implementation of this coordination effort. Promotion programmes can be used to increase the awareness of the general public about restoring water bodies so that, more local residents become ready to cooperate. Mobilizing village leaders to identify local needs and necessary actions originate will clarify priority areas for local environmental protection. Group discussions conducted during the internship with local people reveal that their negative perception toward the river pollution and the indeed requirement toward rebuilding the river system. This could be used as the turning point of implementing waste management mechanism.

Restoring of water system will help to re-cultivate the fields near dead river, increase the eco system balance and reduce water eutrophication. As a conclusion I like to recommend that there is an indeed requirement to rebuild the water system in Hanoi immediately to maintain the environment sustainable. According to my understanding during the internship, the central government should build a proper coordination among all stakeholder parties along with an achievable strategic plan is the most important element and, from the local level well organized waste collection mechanism and community based activities to clean the river systems are the main activities could be practiced to safeguard the river system from illegal waste dumping in Hanoi.

Figure 1: Waste Discharging Points

Figure 2: Animal Rearing Places

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Integrated Management of Water and the Environment

Ailyn Rojas

Introduction

From July 14th to 16th we, students from the Master's Program in Environmental Sciences and the Doctoral Program in Sustainable Environmental Studies of the University of Tsukuba, attended an international collaborative workshop with participants from the Hanoi University of Natural Resources and Environmental and the Delft University of Technology. The main topic was related to integrated water management in the Red and Day river watersheds.

The educational goals of the workshop were to have participants identify a specific problem, collect information about it through a field trip and examine and propose an integral solution, which might consider not only environmental aspects but also social and economic ones.

During the field trip we got a better understanding on the problems of water management in the Hanoi area. But because the approach of this workshop was about proposing an integrated solution we needed much more information than what we could collect by just observing and measuring data in the river. Therefore, at the last observation point of our field trip we discussed the possibility of talking with the locals about the river usage and their respective sources, waste water and solid wastes. This short conversation resulted in many interesting ideas that might help not only to increase the quality on the Tich and/or Day river but also to increase people's awareness and connection to them in a sense that will make people living near these rivers feel responsible and considerate to their quality and conditions.

Group Discussion Topic

During the field trip we discovered that some local people used ponds to store rain water for irrigation purposes. The problem we found on this point is that these peoples discharge their waste water into the ponds. Also, rain carries all the artificial fertilizers from the ground to the pond. After discovering this our group decided to discuss the possibilities of reducing the amount of pollutants that go to the pond. This means to examine a more local approach, which we hoped could help improve river quality and local' peoples environmental awareness.

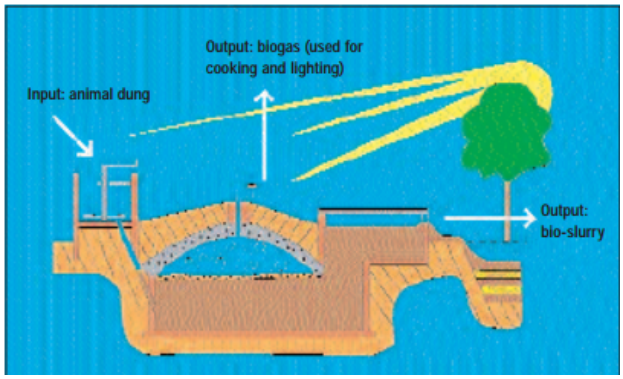
The problem source we focused on were:

1.- Chemical fertilizers.

We intended to replace chemical fertilizers with organic ones that can be produced by farmers. For that we came up two options between which people will be able to choose.

A) Composting: The idea is to utilize animals' manures, crops lefts overs and kitchen wastes as sources for compost. This option is low cost, and permits farmers to save money because they no longer need to purchase chemical fertilizers although it requires time and space for its implementation.

B) Biogasification: This option also utilize animals' manures, crops lefts overs, kitchen wastes and others as the sources of biogas. Smalls scale biogasification plants have already been successfully implemented in Vietnam each with a cost of approximately 100 USD, which is less costly than biogasification plants in other countries, where only big scale plants have been undertaken. If this small scale biogasification plant option is possible in other parts of Vietnam, local people can obtain gas allowing to save money.



Picture 1: Building a biogas digester in Vietnam Picture 2: Diagram of biogas plant.
Source: Journal in Renewable Energy World, "Asia Hits the Gas".

The secondary effect of these solutions is that they prevent animal manure from going into the river after rain or floods. This will reduce the amount of BOD in river and pond.

2.- Waste water discharge.

During the field trip we observed two type of household's water discharges. One type of household discharges wastewater to the ponds on their premises and the other to the river.

A) Discharge to ponds: In this case the solution we wanted to implement require two types of aquatic plants. One is water lily dwarf, which is already used in Vietnam. This plant is known to reduce toxins in water and it can be used to feed ducks. Another plant is acorus calamus, which helps supply oxygen.
B) Discharge to river: The solution, in this case, must come from the government. We propose that houses get separated by groups according to location and point of wastewater discharge. Each group, instead of discharging directly to the river will discharge their wastewater to a tank that contain the same plants as in option 1. After the water runs through this plants it will be discharge to the river.

The table below shows how stakeholders implement and take responsibilities for the options mentioned above:

Stakeholder	Biodigestion	Compost	Pond/Tanks
Government	Present cost and benefits of bio gasification plant. Set bioplant safety standards and do a final inspection for using the plant.	Present cost and benefits of compost. Provide training for composting process.	Buy and distribute the plants to locals. Determine location of tanks inside the communities. Construct pipes and tanks.
Researcher	No responsibility but there is an opportunity to find biomass research topics and investigation subjects.	Determine the nutrients in composts produced by locals and help them determine the correct ratio between organics and chemical fertilizers if necessary.	Determinate effectiveness of selected plants and propose improvements if necessary.
	Research opportunities.		

	Have to always present their results to the communities.
Communities Leader	Link the government and researches with locals. In charge of communicating research results and government planning, policies or norms to locals. In charge of communicating locals feedback to researches and government
Local People	Doing. Inform of problems to researches. Work together giving information to the researches or government for improvement.

Policies and Guidelines

To have stakeholders implement and take on the responsibilities mentioned above is that the following policies and guidelines must be implemented:

- **Related to implementation of solutions proposed on this program:** It is recommended that the government first implement composting, biogasification and/or wastewater treatment within active communities. In this type of communities the communication between locals and their community's leaders is strong, therefore starting with these groups will guarantee to receive feedback from locals through their community's leaders to improve their solution implementation programs before they continue in other less active communities. Finally they should include locals that are not grouped to complete the area or city targeted.
- **Related to information given by the government to Communities.** At the start of a solution implementation project, locals must be informed of the cost and benefits of the treatments mentioned above. This will increase people's awareness and participation.
- **Related to standards and work with researches:** Government must set biogasification/Compost facility and operation standards and have to provide training to locals for correct treatment operation. They should also receive feedback from researches to improve the effectiveness of the solutions applied.
- **About the flow of information:** Government must inform researches and community leaders about their role in the information flow and give specific about the what type of information is necessary to transmit according to the treatment being implemented. It will help create a team work between researches and locals and also increase the connection between locals and the environment.
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Conclusion and Comments

During the workshop group discussion and finally presentation of exercise on the field trip, different integrated water management proposal for improving the water quality in one of the three rivers, Red, Day and Tich were presented and discussed.

Our group water management proposal integrates solid waste and wastewater management with the intention of, not only improving river water quality, but also providing locals with economical advantages through utilizing their waste as a resource.

In Vietnam, agriculture is one of the two main economic sector and livestock industry is under a developing strategy to increase their production. This two economic sector provides with a stable biomass source that can benefit the population of Vietnam if treated.

As proposed in this report, the mentioned biomass can be treated with composting or biogasification process. The product after treatment: compost, energy and bio-slurry provide farmers with organic fertilizer and gas for cooking or lighting. This two types of treatment prevent animal manure from going into the river after rain or floods, therefore reducing the amount of BOD in river and pond. Both option are low cost and can be implemented in farms.

Considering the wastewater discharge to ponds or directly to the river observed during the field trip, we proposed utilizing two plants: water lily dwarf and acorus calamus, which helps absorbing toxins and supply oxygen. This pretreatment will help improve the quality of the waste water that will finally be discharge to the river.

We consider this solutions to be economically affordable by locals, and with high prospect of feasibility for their implementation by the government if all the proposal policies and guidelines are considered.

About the workshop, it helped us remember solving but wasn't much source of new inputs about water management. Although it was a good opportunity for experience integrated approach for solutions, which help our students to be more upstanding professionals.

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Report of International Field Appraisal in Hanoi Vietnam about the Water Usage Problem and Solution of the Thuy Xuan Tien Commune Chuong My District

HE HONGYU

1. Background of study site

Our target was the village in the watershed of the Day River, and the Day River is a distributary of the Red River. Our participation purpose was to find out the environmental problems of this village and focus on one topic to give some solutions. Our group focused on water usage problems.

2. Problem of water usage

All households we observed used groundwater by digging wells. These people do not have access to the tap water system and sewerage system. As their water is not treated, they cannot be sure if water is safe. Without the sewerage system, domestic waste water will be discharged into the river directly. The village we visited did not have public toilet. The river is also contaminated by ferrum from industries.

3.Solutions

3.1 Technical suggestions

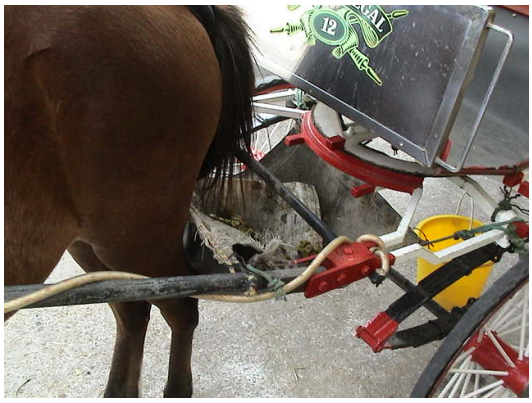
3.1.1 Treatment of drinking water

Picture 1 (One well costs 4-5million VND (200-250$),and the service life is 5-10 years)

Picture 2 (Purifier Water Cup, for about 1,800 yen (314 thousand VND))

The best solution to these problems is to establish the centralized water supply systems, including both the tap water system and sewerage systems with government support. In case water treatment capacity in Vietnam does not meet the demand, local people in remote areas may install a water purifier in every household. Without financial support from the government, villagers need to pay by themselves; there are also some inexpensive methods to precipitate well water. Picture 1 shows turbid well water. The villagers can mix 50g alumen with 1 ton of water, or they can use acticarbon in the turbid water tank. After precipitation through these methods, local people can use some purifier water cups to filtrate the water; then they will get safe drinking water.

3.1.2 Treatment of manure


Picture 3 (Manure Bag, it does not need much money)

Villagers will benefit by building private toilets with biogas tanks or establishing public toilets with biogas tanks. This is the best way to treat manure for this village we visited. If each household establishes biogas tanks, they can also get extra energy, and the contaminant in the river will also be reduced. Cattle with manure bags should work well in this village, and the collected manure can be recycled in biogas tanks. Then the sense of pleasure and comfort will be increased in the village. In many countries, horses are required to wear manure bags on city roads. If villagers can get support from government will be better, especially for the biogas tanks. I think the manure bag is cheap for villagers.

3.2 Policy suggestions

I think that the villagers will benefit from establishing a local well management committee to achieve unified water quality management by making an administrative standard. They may also get well

construction permits from local authorities or local committee. To reduce heavy metal contamination, the well management committee can establish a minimum depth limit level to make a well, depending the ground. Villagers may also want to install a water filtering system in each well. It is important to maintain a certain distance between the well and the septic tank so that well water will not be polluted by the septic tank. The quality of well water must be inspected once a month.

4. Conclusion

Environmental protection is closely related to technology, economy and education. Technology, economy and education are also interconnected. Technology helps the country to prevent and treat pollution and, in turn, solve environmental problems. It requires money normally, so the country's economy determines whether or not the country can afford necessary environmental protection actions. Education empowers the citizen with environmental awareness. It drives people to ask their government to pay attention to environmental protection. It also helps them cooperate with environmental protection policy. Education nourishes the creation of technology, and technology becomes a source of money. Technology, economy and education altogether reflect the development state of a country.

During our participation in Vietnam Internship, the professor from the Delft University of Technology said that we should consider Vietnamese villagers do not have much money, and they may have hard time to get support from their local government. If so it is really challenging for us to think about solutions. The professor also said that our suggestions sounded impracticable because most of our suggestions focused on the need for government support. But we did give some suggestions that do not require much money that emphasized promotion for awareness and motivation.

Water pollution on the ponds and rivers that are used for Irrigation in the Tri Thuy area

Yuan Tian

Introduction

Environmental pollution has become a serious problem in Vietnam due to the increase of factories, the improvement of living standards by rapid development and the poor environmental awareness of citizens. Water, as the source of living, is widely used for human living activities. Besides for drinking, water is used for doing laundry, cooking, irrigating, and so on. If water resources were severely polluted, it would have a serious impact on human living and environmental sustainability.

Unfortunately, in most parts of Vietnam, industrial and domestic wastewater is discharged into rivers and ponds directly because of a lack of wastewater management facilities that meet rapid industrialization and urbanization. In the rural area, wastewater from houses and farms strongly impact the water quality of ponds and rivers.

As water problems are common issues in most developing countries, it will take a long time to perfect environmental policy, coordinate between government and stakeholders, and enhance the monitoring technology for water quality. Meanwhile, water pollution in rural areas can be relatively easier to be solved comparing with that of urban areas.

How we find the problem

During our one-day excursion to the Day River valley, we found that farmers in the Tich River watershed almost do not use river water for irrigation even the croplands are close to the river because the water quality has rapidly deteriorated. Most of them have pond near their houses for rainwater collection and cropland irrigation. However, the ponds are also polluted mainly by organics from household and agricultural activities. Wastewater and solid wastes (manure and kitchen residues, etc.) that are produced by these activities directly affect the water quality of the ponds. During the rainy season, chemical fertilizers, which contain plenty of nitrogen, phosphorus and potassium, also would flow into the ponds with rain, resulting in the excessive growth of algae. These pollutants would generate bad smell from the ponds and visually unacceptable colors. When the polluted water is applied for irrigation, the crop productivities would be negatively affected and soil quality also would become lower. In addition, the solid wastes discharged into ponds would turn into sediment on the bottom of ponds, which is possible to affect the pond depth after several years.

Technological Approach

To improve water quality in household ponds and nearby rivers, an integrated system for solid waste and wastewater disposal should be taken into consideration. For treating solid wastes from agriculture and household activities, such as crop residue, manure and kitchen residue, two alternative options are available. One is composting. Household composts decompose organics to inorganics, which, in turn, can be used as natural organic fertilizers for cropland. The other option is anaerobic digestion that produces biogas for cooking. This technology has already been applied in some rural farms of Vietnam.

For cleaning pond, my study group in this internship considered the possibility of establishing a small-scale ecosystem pond. This pond can not only provide a beautiful and odorless scenery but also reduce the organics from households by having ecosystem functions that recycle organic wastes. This technology generally consists of three trophic levels. The first level has producers such as aquatic plants and autotrophs. They can utilize solar energy to produce nutrients for themselves and provide food for second level's organisms. For example, water lily (*Nymphaeaceae*) can degrade organics, remove heavy

metals in ponds and provide food for ducks. Sweet flag (*Acorus Calamus),* an oxygen-supplier plant, can increase dissolved oxygen for living organisms in ponds. Its roots can be used as medicine. In the second level there are consumers, such as insects, fishes and ducks that consume plants and tiny organisms for living. The third level has decomposers such as, microbes that decompose dead organic matters to carbon dioxide and nutrients that feed producers. Consequently, sediment in the ponds, normally consisted of organics, can be reduced by microbes To maximize benefits from this system, fruit trees, which can use the nutrients in soil of pond side, also can be planted around the ponds. Thus, farmers can get benefits from fruits, ducks, and plant root for medicine.

From above approach, the benefits of this system could be summarized as followings:

1. As solid wastes(crop residue, manure and kitchen residue) can be composted or digested, they will not dispose to ponds directly. The organic pollutants in ponds and sediment that may generated by solid wastes can be reduced.
2. The extra organics can be consumed by aquatic plants and microorganisms living in ponds. In turn, the generated nutrients(N, P, etc.) and carbon dioxide can be used for living of aquatic plants and fruit trees. Thus, the eutrophication and redundant organics that can generate odor and unacceptable colors will not happen.
3. As that mentioned before, root of sweet flag also can be used as medicine. Thus, farmers can get plenty of benefits not only from ducks and fruits produced from this system, but also from the aquatic plants.

In another word, our idea of ecosystem pond is a win-win strategy for farmers and the environment.

Monitoring Approach

In order to put this ecosystem pond into practice, coordination and cooperation among government, local communities, scientists and local people are needed.

Firstly, government should establish standards of detailed parameters(COD, BOD_5, dissolved oxygen, etc.) for well operation of this system. Secondly, the most important and also the hardest part, communities need to visit farmers to persuade them investing for this system. Considering poor conditions in rural areas, government can establish a micro-credit system, in which government agents lend money to farmers to establish this pond with low interests. Thirdly, it also necessary to get assistance from scientists. Since the components of manure, kitchen waste and agriculture residue change with different seasons, scientists can teach farmers how to monitor the elements in composted/digested solid wastes and their usefulness as fertilizer. It could be better if local government and community can cooperate with research institutions to establish a system on the basis of local conditions for maximizing the benefits from this system and teach farmers how to operate.

The monitoring can be done once in six months or one year to make sure that the recycled materials are suitable for plant growth. Actually, some on-farm research about this system has already been done before. Dang K. Nhan(2007) did many detailed research works on the role of fishpond in integrated agriculture-aquaculture (IAA) systems in Vietnam, which can be used as a reference.

Conclusion

Our idea of technological solution is similar to the IAA system that already has met the test of history in the highly populated regions of Asia. It has helped farmers to utilize as much household/agricultural wastes as possible. It also has benefited farmers and the environment by using the power of nature. Although the government may be willing to implement this kind of environmentally friendly project, we also should be mindful about local people's standpoint. During the process of practicing public consultation, the government also has the opportunity to raise awareness among local people about protecting the environment.

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Water Usage in Thuy Xuan Tien Commune, Chuong My District

Wu Yi

From what we interviewed with local people in Thuy Xuan Tien commune, we found that there are a lot of ground water problems. Our group focused on water usage in this district, especially the water quality of the well and the treatment of livestock wastes. Firstly, we observed the following conditions about this district.

- All households use groundwater by digging well instead of using water from river directly.
- The river water nearby is polluted by daily activities. It is also contaminated with iron (Fe) from factories.
- The underground water is not treated before using by local people.
- No public toilets exist in the neighborhood.,
- Livestock graze nearby river and discharge wastes directly into river and soil directly.

So, our group provided some technical suggestions and policy suggestions.

Technical suggestions [MONRE and Ministry of Planning and Investment work together to made plans and Ministry of Construction put into practice. Meanwhile, Local media assist to attract attention.]

Treatment of drinking water

- 1.MONRE and Ministry of Planning and Investment establish centralized water supply system (with government support)
- 2.Local media encourage people to set Family water purifier (without government support)
- 3.Local people buy purifier water cups
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- *Treatment of manure*
- 1.Local authorities establish some public toilets with public methane tank
- 2.Each household should have a methane tank
- 3.Farmers should use livestock waste collection bags.

Policy suggestions [MONRE and Ministry of Planning and Investment establish committee and water usage standards for local people.]

-MONRE establish a new completed local well management committee
-Ministry of Construction get well construction permit from local authorities
-MONRE and Ministry of Planning and Investment establish a minimum depth limit level to dig a well, which depends on the ground
-Ministry of Construction install water filter system in each well
-Local inspectors make sure the safe distance between the well and the methane tank
-Each well must be inspected once a month by local inspectors

In my opinion, what we should concentrate on is to apply some eco-technology and cheap suggestions. Among the ideas we discussed, I suggest that the government (MONRE) establish a methane tank for each household and encourage local people to make livestock manure collection bags.

After conducting the on-the-spot investigation among local villagers, I realized that the urgent matter for ground water pollution governance is not so much about requiring the government to formulate

rules and regulations or provide funds to upgrade sewage treatment system. The realistic condition is that the government does not have enough money and will to solve water pollution problem in the Chuong My district. Therefore, my concern is how to minimize pollution with the cheapest way under these circumstances.

The vast rural poor areas in China also have similar problems, and we can draw lessons from Chinese experience. Firstly, in my knowledge, it will take about 3.5 million VND to create a methane tank for each household, which is about the same cost of digging a well in the local area. Besides, the methane tank can solve the problem of manure. It prevents manure from infiltrating into soil or river directly. It also functions as toilet. The methane which was produced can be recycled as fertilizer and the source of energy. Thus, in the long run, a methane tank will bring much higher yield than digging a well. In addition, this technology has been well-established in China. Local people do not need to know much about how the technology works but just buy the complete set of tank equipment. It is very simple to use this technology from China because Vietnam borders China. Thereby, I argue that this option has high feasibility.

Secondly, one of the most important prevention methods local people need to fight against river water pollution in this district is to prevent livestock waste from directly entering into rivers. In my observation, grazing animals in this area directly excrete wastes on the ground, without any processing facility. The miscibility of manure is very strong, which can cause the loss of soil productivity. In fact, rural areas in China also has a lot of grazing livestock. The most original and the cheapest method is to give animals waste collection bags and then pour the collected feces into public methane tanks every day. These relatively simple waste processing methods are highly maneuverable and low cost with high potential economic benefits (recyclable fertilizer) to users; so I think this second option is also highly feasible.

Vietnam and China are both developing countries, and the state of water pollution in countryside in Vietnam and south of China is similar. So I think that two countries could work together for mutual interest. Meanwhile, in China, local governments have established funding platforms, which could attract local funds to be used for upgrading local sewage treatment systems. The Chinese government especially promotes the adoption of the PPP (Public-Private-Partnership) model in water management. As far as I know there are a lot of foreign-capital enterprises in Vietnam; the Vietnamese government could connect them with local authorities in charge of sewage treatment to develop some feasible items. It is a style like double play: funds from foreign-capital enterprises and promotion of water quality.

After all, it is necessary to strengthen global-regional cooperation/exchange, in search for common environment improvement.