

Livelihood Challenges of the Communities in Catchments Area of and along the Hong Kae Semi-artificial Drainage Channel in Vientiane Capital, Lao PDR

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Abstract

Livelihood challenges of the communities in catchments area of and along the Hong Kae semi-artificial drainage channel in Vientiane Capital, Lao PDR.

Wastewater in Vientiane Capital has drained to Nong Chanh Marsh. There are two main semi-artificial channels, Hong Kae and Hong Xeng, functioned as gravitational drainage channels connected between wastewater storage of Nong Chanh Marsh and the ecological wastewater treatment system of That Louang Marsh, about over three Km length, before draining into Mekong River at the South of Vientiane Capital at Houy Mak Hio River Mouth. The study area is based water quality monitoring in the particular Hong Kae Channel, which is one of the large channels in Vientiane that stores wastewater from the communities in the urban area. There fore the objectives of the study are to: Monitor dynamic changes of water quality and their distinctions in different seasonal periods in one of the main drainage channels in Vientiane Capital, Hong Kae; and Assess major economic and social impacts to some communities residing around Hong Kae channel. Methodology of the study is part of the program on water quality monitoring and social economic impacts, for particular water quality monitoring and impact analysis on Hong Kae Channel, the study team, Field survey was conducted by preparing questionnaires and interviewing of representatives of 32 households, residing around Hong Kae area in 3 villages of Xaysetha District.

Based on household interview, 59.4% of interviewees used water from Hongkea for their agricultural and fishery activities, while 40.6 % was never. From all of these interviewees, 87.5% of them claimed that wastewater created physically and mentally disturbance for their daily lives. Within these, 93.8% claimed of bad odor, 56.3% of too much garbage, and 21.9% of less water. Most of interviewees reported that the serious wastewater disturbances started from 2000.

According to the study in three periods as a model, it was analyzed that water quality status in the Hong Kae Channel was terribly deteriorated, especially since 2002. This drove a number of possible impacts to the communities as well as living things and ecosystem in the catchment of and along the Hong Kae Channel. It is, therefore, recommended that relevant organizations should pay their stronger attention for wastewater management in the Hong Kae, as well as other channels in the Vientiane. These may include effective planning of wastewater and solid waste management; intensive water quality monitoring and information sharing; awareness campaigning on conservation of water resources, ecosystem and environment, basic hygiene and health care, and regular channel clean-up.

Keywords: Hongkea, Wastewater, Water quality, Monitor dynamic changes, Chemical and Physical Analysis, Social and Economic Impact Analysis

Introduction

Vientiane is the Capital City of the Lao PDR at where about over 6 hundred thousand inhabitants resided in its urban area. Wastewater in Vientiane Capital has drained to Nong Chanh Marsh. There are two main semi-artificial channels, Hong Kae and Hong Xeng, functioned as gravitational drainage channels connected between wastewater storage of Nong Chanh Marsh and the ecological wastewater treatment system of That Louang Marsh, about over three Km length, before draining into Mekong River at the South of Vientiane Capital at Houy Mak Hio River Mouth.

The study area is based water quality monitoring in the particular Hong Kae Channel, which is one of the large channels in Vientiane that stores wastewater from the communities, restaurants, markets, factories, hospitals in the urban area of Vientiane capital. The length of Hong Kae Channel form Nong Chanh to That Louang Marsh takes about 3,400 m. Before 2000, Hong Kae used to be irrigation channel supplied water from Mekong and Vientiane flood water to the Northeast part of Vientiane, where the agricultural areas existed. These agricultural areas have been narrowed due to the urbanization of Vientiane Capital. The system was modified as domestic wastewater and Vientiane flood water transport and treatment facilities. There fore the objectives of the study are to:

- Monitor dynamic changes of water quality and their distinctions in different seasonal periods in one of the main drainage channels in Vientiane Capital, Hong Kae; and
- Assess major economic and social impacts to some communities residing around Hong Kae channel.

Methodology

- The study is part of the program on water quality monitoring and social-economic impacts, conducted by the Faculty of Environmental Science and Development, National University of Lao PDR, which had been taken place in that Louang Marsh and its draining channels during 2002 – 2008.
- For particular water quality monitoring and impact analysis on Hong Kae Channel, the study team, included my self Oulavanh Sinsamphanh and Ms. Souksamone Latsachanh, Bachelor Students of the Faculty of Environmental Science and Development, National University of Lao PDR, was formed, for this particular purpose.
- The study had been advised by Dr. Bounthan Bounvilay, Vice Director of Faculty of Environmental Science and Development, University of Lao PDR, and Mr. Panya Simounkhoun, Lecturer of the mentioned Faculty.
- Field survey was conducted by preparing questionnaires and interviewing of representatives of 32 households, in which 65.6% was female and 34.4% was male, residing around Hong Kae area in 3 villages: Sysangvone, Hong Kae and Phonthan of Xaysetha District.
- Secondary data were also collected from reviewing the Water Quality Monitoring Report in 2002 – 2003 of the Faculty of Science, Department of Chemistry, the National University of Laos and the Study Water Quality of That Louang Swamp Wetland by Integrated Physical-Chemical and Biological Factors, May 2004. Accordingly, the data was analyzed comparing the values of some key water quality indicators resulted in September and December 2002, and May 2003.
- Based on the results, conclusions and recommendation were conceptually prepared.

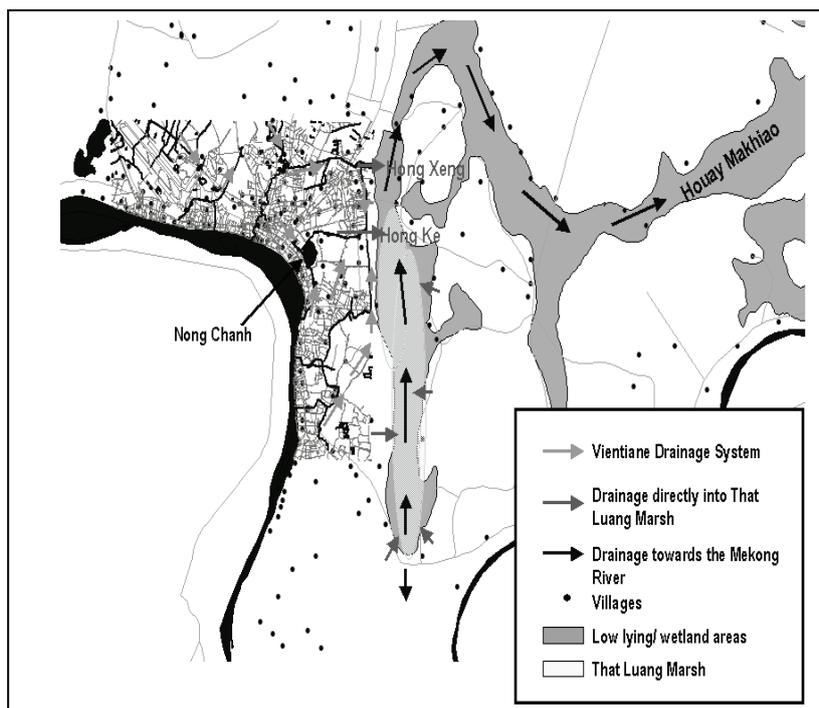


Figure 1. Map of Central Vientiane and That Louang Swamp and semi-artificial channels

Results and Discussion

Chemical and Physical Analysis

In 2000, the Science Technology and Environment Agency issued a Decision on Wastewater Management and Monitoring. The Decision set the classification of domestic effluent water quality standards and Ambient Water Quality Standard. The aim of the decision is to set the foundation for managing and monitoring of domestic wastewater and agricultural discharge water quality. Numbers of applied parameters and their set standards are shown in Table 1.

Table 1. Determination of standard for waste water treatment from public areas to the environment

No	Unit (mg/l)	Standard
1	pH-value	6 – 9.5
2	BOD: the amount of oxygen required by polluted water to clean up by means of bacteria flora by using oxygen dissolved in the water.	No more than 30
3	Suspended solids	No more than 30
4	Settleable solids	0.5
5	Total dissolved solids	1,500
6	Chemical oxygen demand (COD): the amount of oxygen required by polluted water to clean up by means of chemical reactions	No more than 120
7	Sulfide	1
8	Total Kjeldahl Nitrogen (TKN)	No more than 100
9	Fat oil and grease	No more than 5
10	Temperature [°C]	No more than 40

Due to the study was to integrate physical-chemical and biological Factors for the more comprehensive results as it would suitably be used for reflecting impacts from water quality to the surrounding community. Therefore, some of the parameters applied for the study are not included in the issued standard, eg. EC, DO, nutrients values of $\text{NH}_3\text{-N}$, $\text{NO}_3\text{-N}$, $\text{NO}_2\text{-N}$, $\text{PO}_4\text{-P}$, Total-N, and Total-P. On the other hand, some parameters applied in the standards are not part of

study parameters, eg Suspended Solids, Total Dissolved Solids, COD, Sulfide, TKN, and Fat oil and grease.

There were 11 chemical and physical water quality parameters applied for the analysis, while some of them were not set in the Ambient Water Quality Standard, issued by the Science Technology and Environment Agency in 2000 (Table 2). However, these can sufficiently be matched to the social and economic analysis.

Table 2. Values of water quality monitoring at Hong Kae during September and December 2002, and May 2003, comparing to ambient water quality standard.

Parameters	Unit	September 2002	December 2002	May 2003	Standard (STEA, 2000)
pH	(mg/l)	7.8	7.9	8.8	6 – 9.5
Temperature	°C	28	24.1	32.6	*
Electrical Conductivity (EC)	(micro/cm)	266	279	438	*
Dissolve Oxygen (DO)	mg/l	2.8	1.4	1.1	>2
Biological Oxygen Demand (BOD)	mg/l	39	64.6	78.3	4
Ammonia nitrogen (NH ₃ -N)	mg/l	0.294	0.461	0.389	0.2
Nitrate-Nitrogen (NO ₃ -N)	mg/l	3.064	2.824	3.991	0.8
Nitrite-Nitrogen(NO ₂ -N)	(mg/l)	0.605	0.455	0.831	5
PO ₄ -P	(mg/l)	5.4	5.95	6.45	30
Total-N	(mg/l)	5.6	*	3.19	*
Total-P	(mg/l)	*	*	5.951	*

Source: Study water quality of Thatloang Swamp wetland by integrated physical-chemical and biological factors, by faculty of science.

Based on seasonally periodical monitoring and analysis found that:

- Rages of temperature were between 24.1°C and 32.6°C, in which the minimum temperature was in December and the maximum is in May of the study periods. Trends of water temperatures in the Hong Kae Channel were consistent to the seasonal air temperatures, which was observably considered as normal condition;
- pH values were ranged between 7.73 and 8.75, which were considered as minor changes and still within the limitation ranges of issued standard;
- Electrical Conductivity was ranged between 266 and 438 micro/cm. It was analyzed that within the physical factors, distinctions of EC values were caused by the increasing of dissolved solid ion in the channel wastewater in each season. This reflected the increasing pollution in the channel and diluted by flow volume in different seasons.
- Dissolved Oxygen in September 2002 (Rainy Season) had the highest value of 2.8 mg/L and dropped to the lowest in May 2003 of 1.1 mg/L. It was observed that in general the average DO value in the three observed periods was lower than the standard ranges (>2 mg/L). This was caused by high concentration of pollutant during the low flow and high temperature period, which was consistent to the Oxygen demand by bacteria for solving the increasing organic matters in the opposite direction of DO;
- Bio Oxygen Demand values were changed based on seasonal measures. The BOD value was at minimum level of 39 mg/L in September 2002 and maximum level of 78.3 mg/L in May 2003;

- According to the analysis of DO and BOD values, which were considered as important factors for water quality monitoring in theological context, we can observe that trends of these two parameters will change in opposite direction. In each measure, BOD was increased while DO was decreased. It was found that BOD values extracted from each monitoring period were over the domestic wastewater discharge standard, issued by STEA in 2000 (4 mg/L).
- The results of monitoring of Ammonia Nitrogen in the three study periods had shown that: in September 2002, the Ammonia Nitrogen values in September and December 2002 and May 2003 were 0.249 mg/L, 0.461 mg/L and 0.389 mg/L, respectively. In comparing the three values, it was analyzed that the Ammonia substance caused a considerable impact to aquatic ecosystem during and at the end of rainy season, while high pH value in dry season caused relatively high Ammonia value and exceeded the standard (Std = 0.4; pH > 7.5), which drove dangerous to aquatic reproduction process in the Hong Kae Channel.
- The results of monitoring of Nitrate Nitrogen in the three study periods had shown that: the concentration of Nitrate in rainy season reached the highest value of 0.831 mg/L and lowest value in dry season of 0.455 mg/L.
- The results of monitoring of Phosphate concentration in the three study period had shown that: Phosphate values during rainy and the end of rainy seasons of 2002 and dry season of 2003 were 5.4 mg/L, 5.9 mg/L and 6.4 mg/L, respectively.

Generally, it was observed that trends of water quality in the Hong Kae Channel from previous up to date has been gradually deteriorated and drove more seriously impact to inner and surrounding environments, especially in the dry seasons when low flow and high pollutant concentration were occurred. It was analyzed that major influences to the water quality in the Hong Kae Channel were the causes of

- The increasing number of population in nearby and within catchment area of the channel as of urbanization and immigration. The building structures and domestic sanitary and drainage systems in Vientiane including the study area were already poor coupling with low environmental awareness of dense residential dwellers and newly household community-scale businesses and industrial processing activities created in the area who directly and indirectly disposed and discharged to the channel system;
- More intensive agriculture practices in outer skirt of the urban area of Vientiane center. Even though the agriculture land had gradually diverted to urbanity, however agriculture waste was still one of the major sources of pollution in the whole drainage system, including Hong Kae Channel. In order to improve the productivity, more intensive agriculture was practiced which consumed more fertilizers and pesticides were applied which drove more concentration of chemicals and fertilities in the drainage system; and
- The channel improvement project conducted by the Vientiane Urban Development and Administration Authority. The project consolidated the channel from earth to concrete structure which considerably reduced bioactivities and natural treatment in the channel;

Social and Economic Impact Analysis

Based on household interview, 59.4% of interviewees used water from Hongkea for their agricultural and fishery activities, while 40.6 % was never. From all of these interviewees,

87.5% of them claimed that wastewater created physically and mentally disturbance for their daily lives. Within these, 93.8% claimed of bad odor, 56.3% of too much garbage, and 21.9% of less water. Most of interviewees reported that the serious wastewater disturbances started from 2000.

Interviewee's opinions regarding existing wastewater that 65.6% claimed relevant organizations ignored sufficient wastewater management, 12.5% claimed industrial factories discharged their used water without prior sufficient treatment, 65.6% claimed the wastewater source from domestic discharges, 68.8% claimed the lack of environmental awareness village communities due to the lack of awareness program at village and community levels, 12.5% claimed some villagers / farmers applied chemicals for their agricultural practices, and 9.4% claimed the use of pesticides.

Regarding time dimension of wastewater evolution based on the interviewee individual observation, 78.1% reported water in Hong Kae Channel was in fresh condition before 2002 and only 9.4% reported water in the channel was remain fresh after 2002. Before 2002, only 34.4% reported their observation of dense domestic solid wastes in the channel, which increased to 81.2% after 2002.

Another observation was that water weeds were rapidly spread throughout the channel, while aquatic lives, e.g: natural fish, were reduced. Further more, there were common responses on the impacts that some water-borne diseases occasionally spread in the communities, such as diarrhea and cholera etc. 68.8% of interviewees believed that pollution in channel water impacted their health through consuming vegetables from their gardens where they used channel water for irrigation, however actual residues has not been detected; 56.3% observed that soil fertility was degraded; and 40.4% reported their gardening products were increased, while 31.1% reportedly reduced.

Conclusion and recommendations

According to the study in three periods as a model, it was analyzed that water quality status in the Hong Kae Channel was terribly deteriorated, especially since 2002. This drove a number of possible impacts to the communities as well as living things and ecosystem in the catchment of and along the Hong Kae Channel. It is, therefore, recommended that relevant organizations should pay their stronger attention for wastewater management in the Hong Kae, as well as other channels in the Vientiane. These may include effective planning of wastewater and solid waste management; intensive water quality monitoring and information sharing; awareness campaigning on conservation of water resources, ecosystem and environment, basic hygiene and health care, and regular channel clean-up.

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