

Creation of New Waterfront Environment through a Drainage Improvement Project in Phnom Penh, Kingdom of Cambodia

Masakazu Maeda¹, Tsuyoshi Matsushita², Moeung Sophan³

1. Introduction

Phnom Penh, the capital of the Kingdom of Cambodia, is located at the west side of the confluence of Mekong River and Sap River. It is the political, economic and cultural center of the country, and its socioeconomic aspects are summarized in Table 1.1. All of the drainage facilities in Phnom Penh were not functioning well due to old age and poor maintenance after the 1970's. As a result, the city suffers from habitual inundation and poor environmental conditions caused by stagnant waste and storm water in lowland areas. These are serious constraints to the residents' living environment as well as social and economic development of the city.

Table 1.1 Socio-economic Aspects of the Municipality of Phnom Penh

Area	375 km ² (0.2% of the national land area)
GDP Total Per capita	13 billion US dollar (Approx. 30% of the national GDP) 1,000 US dollar
Economic Indices	Number of Shops in markets: 25,000 Number of Registered Commercial Bodies: 12,000
Population in Year 2003	1,011,264 (8% of the national population)
Population Density	2,697 persons/km ² Downtown area (four districts): 17,743 persons/km ² Suburban area (three districts): 1,471 persons/km ²
Gender Ratio	Male: 47%, Female: 53%
Growth Rate	3.9% per year
Number of Household	5.6 persons/household
Rate of Infant Mortality	Under 1 year old: 9.5%, Under 5 years old: 12.5%

Source: Department of Planning, Municipality of Phnom Penh, June 2004.

¹ MSc., P.E. jp, General Manager, Business Planning & Promotion Division, CTI Engineering International Co., Ltd.

² MSc., Civil Engineer, Disaster Management Division, CTI Engineering International Co., Ltd.

³ Deputy Manager, Department of Public Works and Transport, Municipality of Phnom Penh

In response to request of the Government of the Kingdom of Cambodia, the Government of Japan carried out “The Project for Flood Protection and Drainage Improvement in the Municipality of Phnom Penh” from 1998 to 2004 including formulation of a master plan, conducting a feasibility study and detailed design.

The Project covers improvement of the existing drainage channels and ring dike road, and construction of pumping station and sluiceways. After implementation of the Project, Phnom Penh is secured against the flooding of Mekong River system by the flood protection facilities, and inundation damage in the southwest part of the city caused by storm rainfall is remarkably reduced. More importantly, the Project creates a new waterfront environment for the surrounding residents. People living along the improved channels enjoy the greeny and heart-easing space in day and night and some of them begin small shops on the reclaimed land.

This paper presents how the Project was planned, what impacts the Project has brought the waterfront area.

2. Present Conditions of Flood Control and Drainage Improvement for the Municipality of Phnom Penh

Phnom Penh is naturally located in a flood prone area due to its topographical condition; there are many lowland areas, ponds and swamps in the city since it had been developed on an alluvial fan. During periods when river water level is low in a dry season, rainwater is drained out into the river by gravity flow. On the other hand, during periods when river water level is high, river water level rises up to almost the same level as the ground surface elevation. Drainage of rainwater by gravity flow becomes impossible in the latter period, so that compulsory drainage by pump is required. Although it is protected against flood of Mekong River system by outer ring dikes, drainage system and pumping stations are thus indispensable for mitigation of the inland flood.

Average annual rainfall in Phnom Penh for the last 5 years from 2001 to 2005 was around 1,400 millimeters (mm). Annual maximum rainfall and rainy days were recorded in 2001 with values of 1,604 mm and 154 days respectively. On a year-round basis, precipitation and rainy days from December to April are around

50 mm per month and 5 days per month respectively, while those from March to November are more than 100 mm per month and 10 days per month, respectively. In general, the monthly maximum of precipitation and rainy days is recorded in either September or October. Cause of inundation is mainly rainfall of tropical shower in these months. Inundation can be seen here and there by local rainfall in this rainy season (see photos below).



At Charles de Gaulle Boulevard



Near the Central Market

Photo 2.1 Inundation Conditions of the City

3. The Project for Flood Protection and Drainage Improvement for the Municipality of Phnom Penh

3.1 Background of the Project

To solve the inundation problem, the Government of the Kingdom of Cambodia had conducted various studies for drainage improvement of the city through bilateral assistance from the City of Paris and through international assistance from the World Bank, the Asian Development Bank and other financial institutions. However, implementation of the project was less progressed since there had been no master plan for drainage improvement and flood control covering the whole area of the city.

The Government of the Kingdom of Cambodia had made a request for technical cooperation from the Government of Japan to formulate a master plan for the flood protection and urban drainage improvement in Phnom Penh and suburbs.

In response, the Government of Japan had dispatched a study team through the Japan International Cooperation Agency (hereinafter referred to as “JICA”) to formulate the master plan and to conduct a feasibility study on priority projects selected from the master plan. That study was conducted from March 1998 to August 1999. Based on these priority projects, “The Project for Flood Protection and Drainage Improvement in the Municipality of Phnom Penh” was carried out

under the Japan’s Grant Aid Scheme from year of 2001 to 2004.

3.2 Outline of the Project

The Project included reinforcement of ring dike road about 4.3 kilometers (km) in length, improvement of drainage channels with a total length of 4.5 km and construction of a new pumping station with a drainage capacity of 15 cubic meters per second focusing on improvement of southwest area of the city. Figure 3.1 shows 17.47 square kilometers (km²) of the project area and locations of these respective facilities.

3.3 Design Policy

(1) Planning Scale

The existing dike was planned to be reinforced to make it safe from the recorded highest water level of the Mekong River and Sap River, which corresponded to about 30-year probability of planning scale. On the other hand, the planning scale of

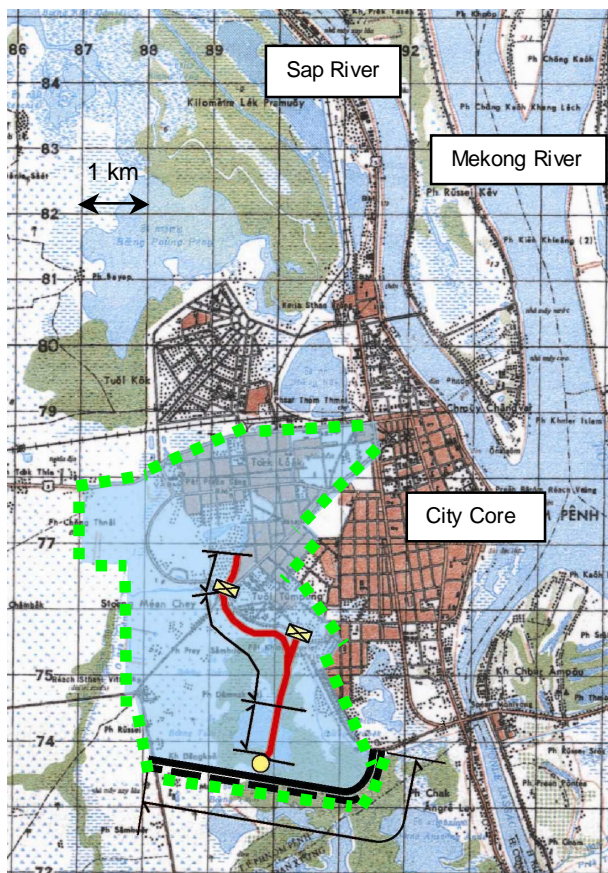


Figure 3.1 Project Area

- Legend:
- ■ ■ ■ ■ Boundary of Project Area
 - Drainage Channel
 - Ring Dike Road
 - ▭ Sluiceway
 - Pumping Station

drainage facilities was set as scale of 5-year probability to be able to drain the storm water in the objective watershed (Area: 17.47 km²) to outside of the ring dike within 24 hours.

(2) Social Considerations

To secure the Right-of-Way for the improvement of drainage channels and construction of a new pumping station, it is impossible to avoid house relocation. However, land acquisition and house relocation attendant on the Project implementation often cause social conflicts. The determination of alignment of drainage channels and layout of a new pumping station was therefore given particular attention to minimize the number of houses to be relocated.

(3) Environmental Considerations

Reclamation along the existing channel was made to build banks and then to stabilize the channel flow especially in the time of flooding. Simultaneously, this work creates new space along the channel with a maintenance road as illustrated in Figure 3.2.

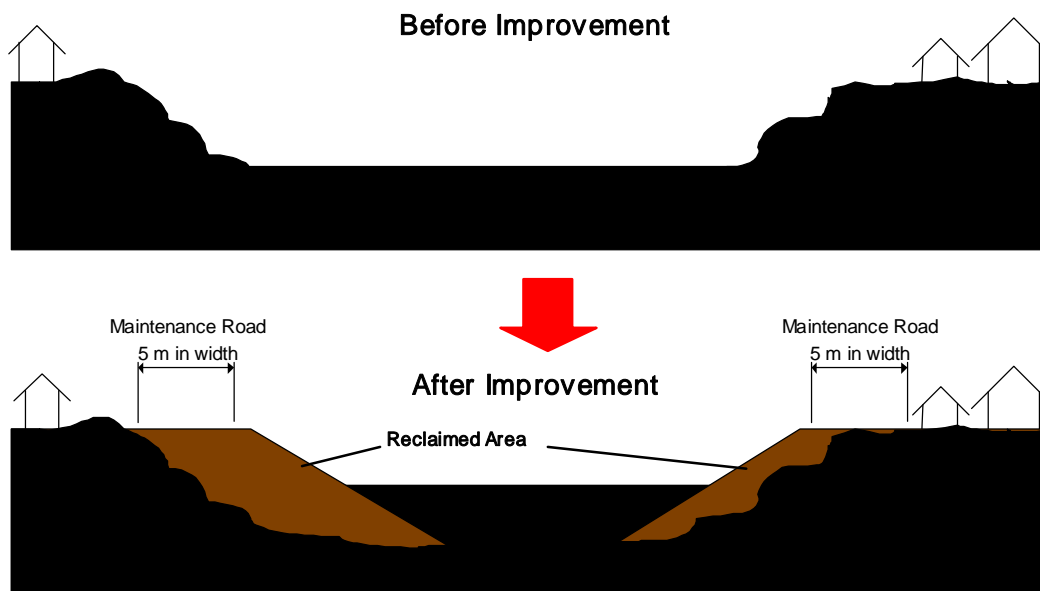


Figure 3.2 Cross Sectional View of Reclamation Work along the Channel

The reclamation work, however, needs a large amount of labor and cost because the project site is located on the soft ground comprising alluvial clay soil.

4. Effects of the Project

After implementation of the Project, whole of Phnom Penh is secured against the flooding of Mekong River system by the flood protection facilities, and inundation damage in the southwest part of the city caused by storm rainfall is remarkably reduced by the drainage facilities improved in the Project.

In addition, new space along the channel has resulted in not only ease of maintenance for the channel but also quality of life for the surrounding residents. Submerged area where people could not approach before changed into attractive places such as an open-air restaurant, a stall selling fruits, vegetables and daily goods, and a riverside promenade (see Photo 4.1).



A Open-air Restaurant



A Street Stall along the Channel

Photo 4.1 New Attractive Places along the Channel

Above all, the improved 4.5 km long channel had produced new waterfront environment both sides. The slope of bank is covered with sodding to protect from erosion and consequently its green color creates an easy and nature-friendly atmosphere (see Photos 4.2 to 4.5).

Theme I: Sustainable Development including Urban Disaster Management



Before Improvement



After Improvement

Photo 4.2 Comparison with Before and After the Channel Improvement (1)



Before Improvement



After Improvement

Photo 4.3 Comparison with Before and After the Channel Improvement (2)



Before
Improvement



After
Improvement

Photo 4.4 Comparison with Before and After the Channel Improvement (3)



Before Improvement



After Improvement

Photo 4.5 Comparison with Before and After the Channel Improvement (4)

5. Operation and Management, and Sustainability of the Project

Operation and maintenance (O&M) of the Project has been undertaken by the Department of Public Works and Transport (DPWT) of the Municipality. The Drainage and Sewerage Division is responsible for the O&M of the drainage channel as well as the other drainage pumping stations in the city. As of the beginning of year 2006, the number of personnel belonging to this Division is 60 accounting for about 16% of the total of DPWT. Although the number of O&M staff seemed to be enough, periodical inspection was not a routine task for the Division at the time of completion.

In order to secure sustainability of the Project, the consultant prepared a maintenance manual for the Drainage and Sewerage Division. The manual

stipulates how often a monitoring and maintenance work is conducted, what kind of objects and items the staff should be monitored and maintained. These rules are enforced appropriately and continuous maintenance work has been carried out based on a list of checkpoints in the manual.

Another important issue regarding the project sustainability is cleaning of the channel. Regular sweeping along the channel is necessary for maintaining proper flow capacity of the channel since garbage collection cannot catch up with discharge of waste. If once a pile of garbage inside the channel or on the slope of the channel can be seen, people will never have scruples about throwing garbage into the channel. Therefore, the Municipality has disbursed the budget for local communities to make a regular cleaning since the Project was completed. The condition of the channel thus currently keeps clean except the water quality.

6. Challenges for the Future

Wastewater together with storm water collected by the sewer and drainage system is finally pumped out of the city area to ponds and swamps in the south and north of the city core. There is no treatment system although the ponds and swamps are functioning as natural oxidation ponds. Due to rapid urbanization, these ponds and swamps are invaded by houses, factories and other activities and decreasing the capacity, and cannot demonstrate the natural purification any longer.

Table 6.1 gives surface areas of ponds and swamps in the northeast area of Phnom Penh, in 2003 and 2005, for example, estimated by image analysis of satellite photographs as shown in Figure 6.1. Future area is estimated based on land use plan in 2020 of Bureau of Urban Affairs of the Municipality.

Table 6.1 Surface Area of Ponds and Swamps in Northeast Area of Phnom Penh

Ponds/Swamps	2003 (Photo taken in Jan. 2003)	2005 (Present) (Photo taken in Nov. 2004)	2020 (Future)
Northeast	13.3 sq.km (100%)	6.5 sq.km (49%)	3.8 sq.km (29%)

Much land development and reclamation have taken place in this area, and surface area of ponds and swamps has been decreasing as well. It is estimated that

surface area of ponds and swamps in the northeast area has decreased almost in half during past two years only. Moreover, surface area of ponds and swamps in 2020 is half of present area.

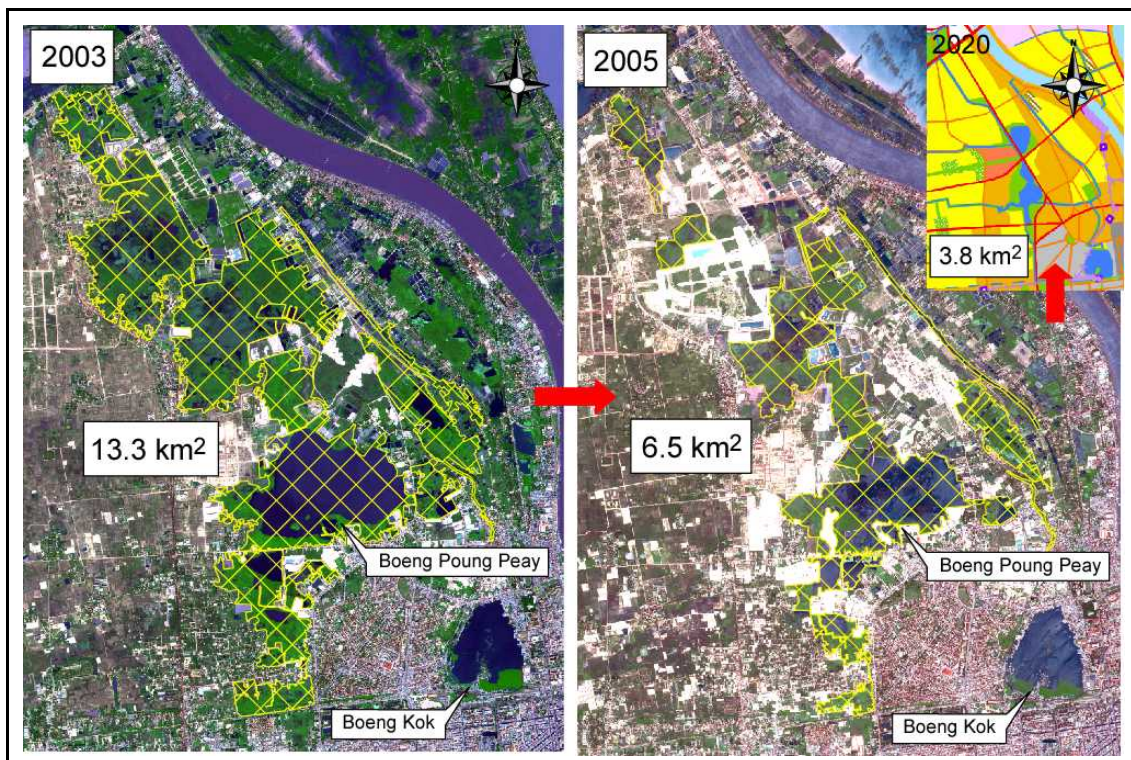


Figure 6.1 Surface area of Ponds and Swamps in Northeast Area

As a result, the water-environment in the city will be affected and deteriorated seriously, and the water quality of Mekong River that is the final disposal of wastewater from the city will be also polluted in the near future. Additionally, these ponds and swamps are functioning as retention ponds when it rains. It is clear that land development and reclamation will seriously affect to not only deterioration of water environment but also flood control function of ponds and swamps.

Authorized city development plan shall be therefore established, and all land developments shall be controlled and observed based on this plan by the Municipality of Phnom Penh with the cooperation of national level. The

uncontrolled land development must be banned urgently and punished by legislative measures. Also, construction of treatment plant shall be considered by using an economically and technically feasible way of treatment.

7. Conclusion

Drainage improvement in Phnom Penh impacted directly on residents' quality of life; that is, the Project not only improved sanitary condition and household economy but also provided tranquil waterfront space for the residents along the channel. Even though the reclamation work under the soft ground condition requires relatively much labor and cost, some sort of additional presence of social and environmental enhancement will be expected and of great importance. The Project shows one of successful examples obviously displaying this presence in a typical drainage improvement project in developing countries.

References

- Japan International Cooperation Agency (JICA), CTI Engineering International Co., Ltd. and Nippon Koei Co., Ltd., Basic Design Report on the Flood Protection and Drainage Improvement in the Municipality of Phnom Penh in the Kingdom of Cambodia, November 2001.
- CTI Engineering International Co., Ltd., Explanation Note about Northeast Area of Phnom Penh City, February 2006.
- NJS Consultants Co., Ltd. and CTI Engineering International Co., Ltd., Final Report on the Study on the Master Plan of Greater Phnom Penh Water Supply (Phase 2) in the Kingdom of Cambodia, February 2006.
- Japan International Cooperation Agency (JICA), CTI Engineering International Co., Ltd. in association with Nippon Koei Co., Ltd., Basic Design Report on the Project for Flood Protection and Drainage Improvement in the Municipality of Phnom Penh (Phase II) in the Kingdom of Cambodia, October 2006.