# KHLONG: BANGKOK CANALS REVITALIZATION

By

Miss Dolruthai Jiarakul

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree

Doctor of Philosophy Program in Architectural Heritage Management and Tourism

International Program

Graduate School, Silpakorn University

Academic Year 2015

# KHLONG: BANGKOK CANALS REVITALIZATION

By

Miss Dolruthai Jiarakul

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree

Doctor of Philosophy Program in Architectural Heritage Management and Tourism

International Program

Graduate School, Silpakorn University

Academic Year 2015

The Graduate School, Silpakorn University has approved and accredited the Thesis title of “Khlong: Bangkok Canals Revitalization” submitted by Ms.Dolruthai Jiarakul as a partial fulfillment of the requirements for the degree of Doctor of Philosophy in Architectural Heritage Management and Tourism (International Program)

.....

(Associate Professor Panjai Tantatsanawong, Ph.D.)

Dean of Graduate School

...../...../.....

The Thesis Advisor

Professor William Chapman, Ph.D.

The Thesis Examaination Committee

..... Chairman

(Kreangkrai Kirdsiri, Ph.D.)

...../...../.....

..... Member

(Professor Emeritus Ornsiri Panin)

...../...../.....

..... Member

(Professor William Chapman, Ph.D.)

...../...../.....

53056952 : MAJOR : ARCHITECTURAL HERITAGE MANAGEMENT AND TOURISM
KEY WORD : KHLONG / CANALS / WATERWAYS / RESTORATION / DEVELOPMENT
DOLRUTHAI JIARAKUL: KHLONG: BANGKOK CANALS REVITALIZATION. THESIS ADVISOR : PROFESSOR WILLIAM CHAPMAN, Ph.D. 190 pp.

The study is aimed to argue that *khlong* in Bangkok that lie across the city is still a valuable asset. It can be brought back to life.

Bangkok is similar to many cities around the world that is water bourn. Canals are called *khlong* in Thai even though the definition is slightly different. *Khlong* is very valuable to Bangkok as it is the origin of Bangkok. Without Khlong Lat Bangkok excavation during the time of Ayutthaya, Bangkok would not have been Bangkok today. But the development of Bangkok has shifted from water to land. *Khlong* was then been neglected, encroached, and left in bad conditions. Water in *khlong* is polluted. And *khlong* does not connect to the people as like before.

Problems related to *khlong* are increasing and awakening problem is the flood in 2011. The flood make the people look back to *khlong* and seek for revitalization.

*Khlong* revitalizations projects are initiated in many *khlong* and many directions. Some are successful some are not. The researcher has concluded that *khlong* can still be reviving in a sustainable development direction toward water-based city that suit the geological attribute of Bangkok.

Program of Architectural Heritage Management and Tourism Graduate School, Silpakorn University
Student's signature ..... Academic Year 2015
Thesis Advisor's signature .....

**Acknowledgments**

I would like to express my gratitute to communities and staff that I have visited, learnt from, and experienced thoughout the research.

I would like to show my appreciation and thanks to my advisor, Professor Dr. William Chapman for his patience, encouragement, inspiration, and advice for me to complete this research and writting. I also thanks to Professor Emeritus Trungjai Buranasomphob, the founder of this program. And also, I thank Professor Sunon Palakavong Na Ayuddhaya, the director of this program for his contribution to the program. I thank my examination committee including Dr. Kreangkrai Kirdsiri and Professor Emeritus Ornsiri Panin who sacrificed valuable time for this thesis defense. I thank Dr. Tiamsoon Sirisrisak for his advice and support on this research. I thank Dr. Polladech Theerapappisit for his advice and motivation. I thank all professors from various universities who have donated themselves to enhance my knowledge and growth. I thank Ms. Thienrat Sakasuoarerk, Aj Supot, Khun Chai, Jeab, and other university staffs who have facilitated me throughout the program.

I thank my friend Dr. Mubarak Al Najem in supporting and encouraging me on completing this program. I thank all my friends who have supported me during this research. I acknowledge kind help from my friend Kanittha Suksong in arranging me interviews and Chatvadee Chaiaroondeekul in assisting me as I corrected my writings. I also acknowledge wonderful help from colleagues throughout the program particularly Rathirat Kheawmesuan, Jaroonsak Jurudhiranart, Dr. Pichet Teeranuson, Dr. Rungsima Kullapat, and Em Ungjitpisal at the final stage of my writing and accompany me on several research field trips.

Mostly, I would like to thank my family: Daoroong Jiarakul, Prasiddhi Jiarakul, Akom Boonsaeng, Wasin Boonsaeng, Kanokeluck Pissathanporn, Pakpoom Jiarakul, Nathinee Jiarakul, and Chompoonuj Jiarakul for their tremendous love, encouragement and understanding they have for me throughout my life, without them I would not have finished this dissertation.

## Table of Contents

## List of Tables

## List of Figures

Figures Page

Figures Page

Figures Page

Figures Page

Figures Page

# Chapter 1
# Introduction

## 1. Statement of Significance

*Khlong* have changed many times throughout the history of Bangkok. As the focus of the city changed, roles and values of *khlong* may change too. *Khlong* are part of the origin of Bangkok and they have witnessed and took part in many of the city's events as well as the ways of life of the people. They relate deeply to the community and to the city form and functions. The connection of *khlong* and the city has shown in many literatures, stories, arts, etc. They are also witnessed by the eyes of Bangkok's visitors and have been recognized through the appellation "Venice of the East," just like its ancestor, Ayutthaya. Many travel books and tourism websites include a *khlong* visit as a part of Bangkok attraction list. But the current condition of *khlong* presents a different picture. Many *khlong* have been neglected and are in bad condition. The role of *khlong* is not obviously demonstrated clearly. Problems and issues such as floods, pollution, and encroachment, arise more and more. **If *khlong* are really an important asset of the city, they should serve the city better. And in return *khlong* should be treated differently, why aren't they?**

The word *khlong* was found in Mon word commonly meaning waterways (The Royal Institute of Thailand, 1962), often translated into English as canals. *Khlong* were vital for Thai community. People called Bangkok "The Venice of the East" because of its *khlong*. And if Chao Phraya River is the artery of Thailand and Bangkok is the heart, khlong is the ventrical.

*Khlong* were strongly related to the settlement of Rattanakosin replicates predecessor, Ayutthaya. In 1767, after the fall of Ayutthaya, King Taksin moved the capital down south along the Chao Phraya River. He named the capital Thonburi. Thonburi is a capital with river runs through the middle. During those time waterways were important. *Khlong* served for defense, governance communication, transportation, trading, drainage, and in many other aspects.

In Rattanakosin, the capital shifted to the east side of Chao Phraya River. The city still remained on both sides of the River but expanded more to the east. Moats, which also served as *khlong*, were excavated further east during the reign of

Rama I and Rama IV to expand the city and accommodate the growth of population. In early Rattanakosin the purposes of waterways were the same as in Thonburi. Hundreds of boats and floating rafts plied the *khlong,* the river, or were erected on stilts. More *khlong* were made and most were well maintained. Nearly all residential and commercial structures were built along the river and *khlong* served communities that were formed.

In the time of King Rama IV, in part as a result of the Bowring Treaty, Bangkok needed waterways to serve more for irrigation and transport and less for defensive function (Piyanat Boonnak, 1982). This also forward to the time of King Rama V. Therefore a new form of *khlong* was initiated to develop land for irrigation, mostly on the east side of Bangkok where the land was fertile. King Rama V also established a department responsible especially for the maintenance of *khlong* called *Grom Khlong* in 1902 (Piyanat Boonnak, 1982; Brummelhuis, 2007). It was a golden time for *khlong*.

In the time of King Rama VI, the concept of *khlong* changed. No new *khlong* was excavated. The development of city shifted increasingly from water to land development. The policy in regards to *khlong* was mainly to maintain and solve the new and previously existing problems. Problems that were obvious at the time were the encroachment of *khlong*, the problems of shallow *khlong* and water quality. One shallow *khlong* "solution" was to pile up the *khlong* and make a road instead.

From that time *khlong* in Bangkok decreased in importance. As many *khlong* were filled in not many *khlong* were left and connected. The main purpose of *khlong* was for drainage. At the present time priorities of life in Bangkok do not involve *khlong* anymore. Bangkok has turned its back to *khlong.*

The decline of *khlong* in Bangkok was not evident to the public until the big flood in 2011. The enormous rush of water covered most part of Thailand, across 65 of 77 provinces, including Bangkok. The flood began in the north of Thailand in May 2011 and was widespread in July 2011. In some areas the flood persisted until mid January 2012. The result was devastating, resulting in more than 680 deaths and more than 13 million displaced or otherwise affected people. The World Bank has estimated the recovery and reconstruction at 1.5 trillion baht over five years (The World Bank, 2012). The flood was due to heavy rain, combined with multiple tropical

storms. For Bangkok, the city was for the most part protected by the government. Still, the flood also affected various sectors, as the water had nowhere else to go. According to the Thai Real Estate Information Center (REIC), as many as 300,000 homes were damaged in Bangkok (Aon Benfield, 2012). The city that once was rice paddles and where life was deeply related to the water could no longer cope with the water.

**What is going on with numerous numbers of *khlong* in Bangkok? Where did they go? Why aren't they doing their roles for the city?**

Sadly neglect, encroachment and misuse of *khlong* has left *khlong* in a dry, dirty and seemingly hopeless condition. The Bangkok Metropolitan Administration (BMA) has investigated in its 50 districts and found that more than 23,500 buildings and houses encroach upon the public space of *khlong* (Dailynews, 2014). The Bangkok population, estimated at over 10 million, creates about 2.4 million cubic meter of wastewater per day and with not enough wastewater treatments plants. The BMA has estimated the capacity of current wastewater treatment plants to only 42 percent of the overall wastewater. The remaining work is flittered (Department of Environment, BMA, 2012). The level of water is monitored in most of the main *khlong* for flood prevention purposes. But for most other *khlong* that blend in communities, many lack water altogether.

Apart from the flood and other water issues, Bangkok development has increased the number of other issues too. These include population density, loss of community and culture, traffic, pollution, lack of green open spaces, decrease of the quality of life, etc. Also, seeking for more development projects and using more resources does not seem to solve Bangkok's chaos.

Many government agencies, NGOs, private sector organizations and companies, scholars and communities have turned back to *khlong*, the resource that Bangkok currently has is ruined, damaged, or just remain as a shadow of their former origin. *Khlong* seem to lie deadly in communities. But what if *khlong* can ease those issues? Along with the trend of nostalgia, ideas and projects about *khlong* have begun to rise. These initiations range from big to small, undertake by government and by the community. But what will be the direction of the revitalization?

Bangkok is not alone in the idea of revitalization of waterways and canals. Many other cities had also faced this issue of declining waterways, mostly due to the development of railways and roads. Those ideas and projects have had some successes; some still face challenges. What are these stories of revival? Can Bangkok stories generate similar stories? Can Bangkok find the answer of "**What is the realistic revitalization potential of *khlong?"***

**2. Goals and Objectives**

1. To study the history of *khlong*
2. To study the present condition of *khlong* in Bangkok
3. To seek examples and lessons of other waterways revitalization
4. To propose revitalization guideline for *khlong* in Bangkok and make suggestions

**3. Methodology**

The study is a qualitative research. Initially, the study started with the survey of available waterway revitalization resources from books, proceedings of conference, journals, abstracts, articles, reports, and internet.

The data collection included literature, individual interviews, observations, and participant observations. The research design is flexible, advising to evidence process of research.

The literature includes the relevant topic of canal history and *khlong* history from a range of studies from the past to the present and from books, photographs, maps, websites, research papers, journals and reports in Thai and English.

Individual interviews were arranged with the key persons related to the research. These include personnel from the Department of Drainage and Sewerage, the BMA, personnel from the Bangkok Tourism Division, BMA, luminaries in the wisdom of water management in the delta area of the Gulf of Thailand, and key persons from communities along the selected *khlong.*

Observation included site surveys of physical conditions and uses among various *khlong* in Bangkok in both by land and by water. It also included observations of activities at *talad nam* (floating market) and *talad rim nam* (markets next to waterways).

Participant observations included hands on experience activities of *khlong* such as the transportation experience from Saen Saeb ferry and Pasi Chareon ferry, tourism including cultural and eco-tourism, festivals, such as Loy Krathong and Tak Batr Phra Roi, and other form of recreation.

The study also looks at other revitalizations projects to learn from. These two cases from outside of Thailand were selected. These were projects in the Netherlands and Korea.

The project from Amsterdam, Netherlands was selected because Amsterdam and Bangkok are similar in many ways. Both are located near the shore and face many similar problems. The development of water management in Bangkok and Thailand also developed from the Dutch. As time passed, Amsterdam also used to fill canals, much like Bangkok but revitalizations have brought Amsterdam to the next chapter of continuing use.

Cheonggyecheon stream restoration project in Korea is a recent mega project in Asian context. It was selected because of many interesting facts of the project, which will be described in Chapter 6.

The information and data used then arranged, analyzed, and synthesized. The issues of *khlong* were listed and analyzed from the information and data. Together, this process was designed to meet the research objectives. The eight chapters of the research meet the objectives of the overall projects

**4. Scope of Study**

Scope of area is in the area of Bangkok Metropolitan Administration area. It includes both natural and man-made *khlong*. Clarifications of both terms are included in topic 5.

**5. Definitions of *Khlong***

The section explains the meaning of *"khlong"* in Thai language, which is close to, but slightly different from the word "canal" the translation most often used.

The word *"khlong"* or *"klong"* (คลอง) derives from a Mon word, commonly meaning "waterways" or sometimes simply "ways" (The Royal Institute of Thailand, 1962). It often translated to "canal" in English, although the definition is

slightly different.

*Khlong* in the Dictionary of the Thai Royal Academy (2015) is (n.) waterways or stream that is either natural or excavated to link with a river or sea (translated by the researcher) (Office of the Royal Society, 2015) while canal in the Oxford Dictionary of English is (n.) an artificial waterway constructed to allow the passage of boats or ships inland or to convey water for irrigation (Oxford University Press, 2015). The Information Document on Heritage Canals defines canals as a human-engineered waterway. It may be of outstanding universal value from the point of view of history or technology, either intrinsically or as an exceptional example representative of this category of cultural property. The canal may be a monumental work, the defining feature of a linear cultural landscape, or an integral component of a complex cultural landscape (UNESCO, 1994).

The main difference in these definitions is that *khlong* can be referred to either natural or artificial while a canal is artificial, meaning made by humans.

In general usage, the word *khlong* has a wider meaning extending to other waterways or even streams. It might link to a river or sea or may link to other *khlong* for example a *khlong* links from *khlong* to *khlong* like Khlong Lot in Bangkok. Some *khlong* are natural and some are man-made too. Therefore sometimes the suffix dig which is *"khud"* (ขุด) *is* used along as *"khlong khud"* to clarify this issue (The Royal Institute of Thailand, 1962).

There are also other terms of waterways in Thai such as *kwae (*แคว*)*, *khu (*คู*)*, *lamkradong (*ลำกระโดง*)* and *lamrang (*ลำราง*)*. *lamkradong* is a small waterway excavated from the large waterways to induct water to the rice field or field. *Lamrang* is a small waterway that was excavated from the large waterways to induct or drain water out of the rice field. Sometimes *khlong* is used together with proverb as *khu khlong (*คูคลอง*)* and *lam khlong (*ลำคลอง*)* too.

"Moat" (n.) is defined by the Oxford Dictionary as a deep, wide ditch surrounding a castle, fort, or town, typically filled with water and intended as a defence against attack (Oxford University Press, 2015). Moat is referred as "*khu meaung"* or "*khlong khu meaung"* in Thai.

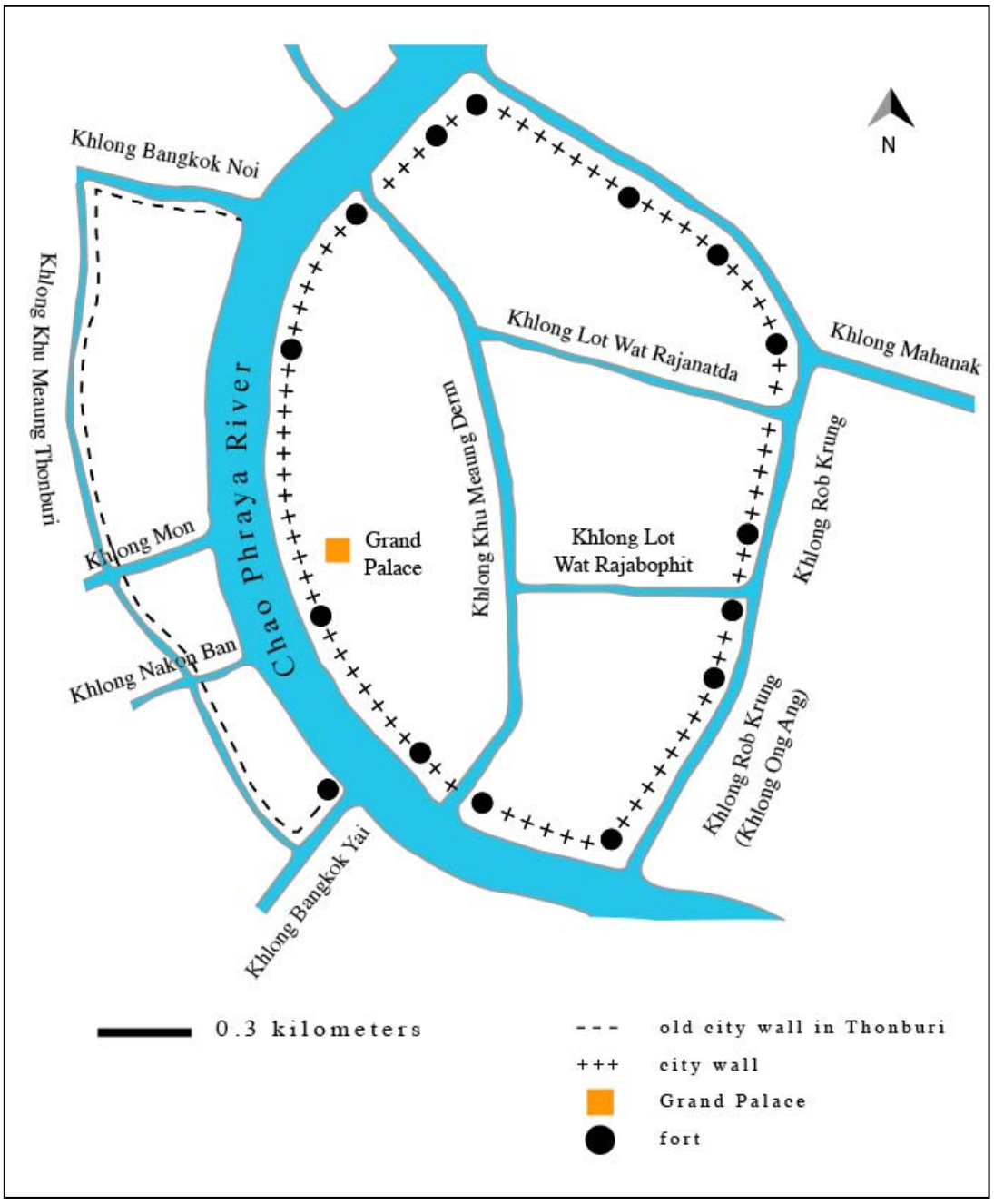



Figure 1 Khlong Lot Wat Rajanatda and Khlong Lot Wat Rajabophit that links from *khlong* to *khlong*

Source: Dolruthai Jiarakul, 2016

**6. Structure of the Study**

Chapter 1: The introduction gives background on the study including the statement of the problem, goals and objectives of the study, methods used, the scope of the study and the structure of the study.

Chapter 2: Canals and *khlong*. World history of canals trace back from the ancient time to the modern time. The second part of this chapter describes *khlong* history from Sukhothai and Ayutthaya. It also discusses the concept of canal as a heritage.

Chapter 3: Development of *khlong* in Bangkok, which looks at the history of *khlong* in Bangkok. How this history is important and how it relates to the city and cultures.

Chapter 4: Current *khlong* in Bangkok. This chapter produces a picture of the situation of *khlong* in Bangkok, including their physical condition, their role in Bangkok, and other issues.

Chapter 5: Discussion. This includes issues related to the declined *khlong*. What are the needs of Bangkok? And, what can revitalization bring?

Chapter 6: Waterway Revitalization. The chapter deals with trends in waterways revitalization. It looks at the revitalization attempts in Netherlands and Korea.

Chapter 7: Proposal. This chapter discusses future needs in research.

Chapter 8: Conclusions and Recommendations shows what has been learnt, and also notes down the limitations and recommendations for further studies.

## Chapter 2

## Canals and *Khlong*

### 1. History of Canals

Before the early civilizations were established people lived in caves and camps where they can get food and close to the drinking water, which is essential for life. The water is usually comes from springs and lakes. When food and water were insufficient people moved. As time passed populations increased and developed. People started living together near the source of water for survival. And later people developed agriculture for food supply. Canals were developed for irrigation and to control water. The first civilization to arise and do so was in Mesopotamia (4,000 BC), followed by Egypt (3,000 BC), the Indus valley (2,500 BC) and China (1,200 BC).

In later instances canals were used for more than just irrigation. They were also be used for navigation and transportation. Between 520 and 510 BC the Persian Emperor, Darius I built a canal linking the Nile to the Red Sea in Egypt. This later became the Suez Canal. Another well-known canal that combine the functions of irrigation and transportation was the Grand Canal in China. It also was and still is the longest canal today.

Many canals in Western Europe were built in the Middle Ages because of commercial expansion (commercial revolution) in the twelfth century. In nineteenth century France, Belgium, Holland and Germany developed inland waterways system by building canals to connect their rivers (Columbia University, 1963).

Similarly, Russia connected the Baltic to the Black and Caspian seas by rivers, lakes and canal systems. Later Soviet Union built a canal between the White Sea and the Baltic (Columbia University, 1963).

In United States, which was not settled until the waterways in Europe had been used for many years, the Erie Canal in New York was built in 1817 and opened in its entirety in 1825. The canal transformed New York into a leading port of the

United States (New York State Canal Corporation) and facilitated the development of the western states.

Canals were the part of commercial expansion and industrial evolution worldwide. Many technologies were developed for the building and operation of these waterways such as locks, dams and bridges. Construction extended the community along the canals and made up new ports. With the development of railways, canals started to decline. Some canals were abandoned and railways lead as a mean of transportation until the arrival of the motor age.

**1.1 Ancient Canals**

a. Mesopotamia (4000 BC)

The oldest known canals built for irrigation were in places where the civilization began. These included Mesopotamia (History World, n.d.), in what is now Iraq and Syria, where the remains of pre historic work still exist (Water Encyclopedia). The development of canals dated back to as early as fourth or fifth millennium B.C.E (Garrett, 2014). This played an important role in the development of Mesopotamia civilization.

The land of Mesopotamia is supplied with surface water by the two major rivers, the Tigris and Euphrates Rivers. These waterways drained rugged highlands of Anatolia and Zagros Mountains of Iran (Douglas L. Johnson, 2007). The land was fertile with muddy alluvial soils that the stream brought, supporting date palm and reeds. The land did not have much rainfall and had a limited water supply. In some times, since they were located between the rivers, they faced floods. Both floods and droughts were dramatic and unpredictable so the effort to control or manage water was needed. Earthen walls were built along the rivers to hold back the floodwater. The large canals were dug for water to get to their farms and smaller irrigation ditches were dug to water their crops. Gates were put to control the water from the canals to the field (Mollylarge, 2011). Irrigation systems were developed and there was better access to water source throughout the year. This resulted in more crops and harvests each year.

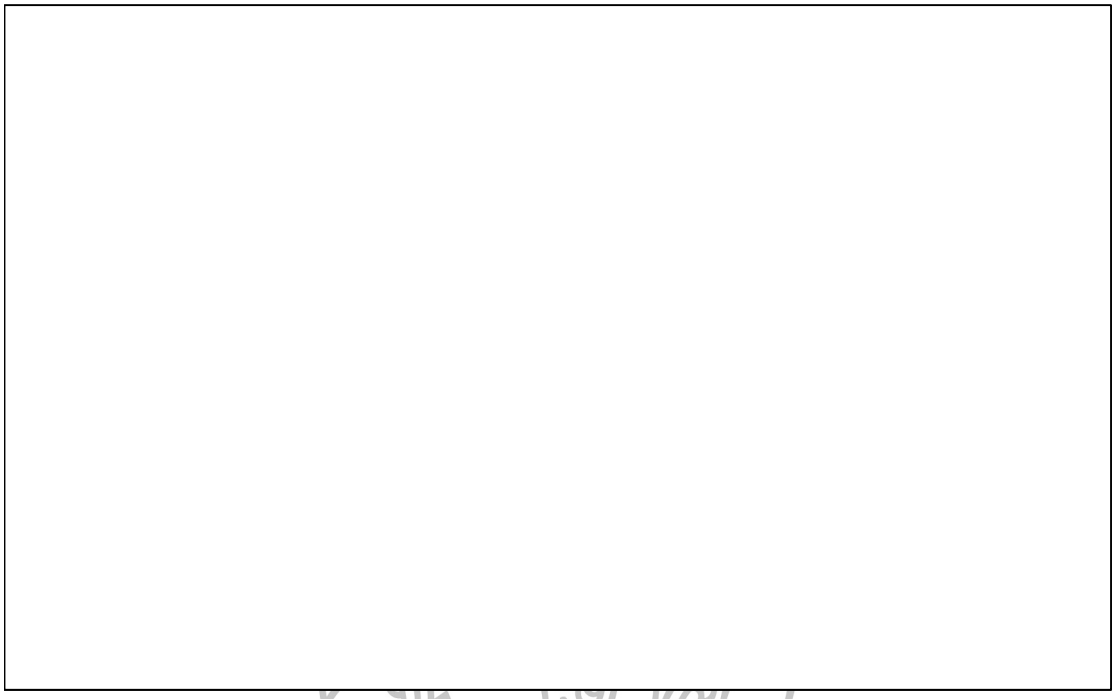


Figure 2 Fertile area between the Tigris and Euphrates River in Mesopotamia
Source: Accessed October 28, 2015, Available from http://arthistoryworlds.org/wp-content/uploads/2013/10/sumer_map_big.jpg.

Figure 3 Illustration shows the Sumerians in southern Mesopotamia built city walls and temples and dug canals for irrigation
Source: Accessed October 28, 2015, Available from http://www.slideshare.net/daminik/mesopotamian-irrigation-system.

Long use of the same method affected the soil. Silt built up in the riverbeds and made the rivers higher than the surrounding plain. Also water moved through the canals to their field by gravity and got locked. As a result, they could not be drained. Once the water evaporated salt was left behind. Also salt raised upwards from the lower level soil. Scholars claimed that the soil became toxic and crops productions were reduced by the late of third millennium (Collapse, why do civilizations fall?: Mesopotamia, n.d.; Mesopotamia: Economic and Agriculture; Pollock, 2004). The fields then were abandoned. Irrigation had unintentionally transformed the landscape of Mesopotamia to vast salty wastelands (Pollock, 2004).

b. Egypt

The Nile runs through the eastern part of the Sahara desert. Soil along the Nile is fertile and could be farmed. Egypt was divided into two parts. The upstream part in the south is called “Upper Egypt” The downstream is called “Lower Egypt,” now “the Delta” (Mieroop, 2011). The people depended on the monsoonal rains in the mountains of Ethiopia on the south to bring floodwater and fertile sediments to the Nile River Valley so they could farm. As the population increased the need of food increased. Egyptian built up dikes and irrigation canals to spread water to more land and grow more food.

Figure 4 Earthen jug depicts King Scorpion cutting the first irrigation canal (now display in the Ashmolean Museum, Oxford, England)

Source: Principles of Water Resources: History, Development, Management and Policy, Thomas V. Cech, p.6


Figure 5 Map of Ancient Egypt, the location of the Nile River, the Upper Egypt and the Lower Egypt

Source: Accessed October 28, 2015, Available from www.mapsofworld.com.

In ancient Egypt, canals were used for irrigation and also for transportation. Egyptians were the first to have a man-made canal across its land. This was later rebuilt many times before becoming the present “Suez Canal.”

Pharaoh Senusret III may have built the first canal connecting the Red Sea and Nile River around 1850 BC using the east - west route (Andrews, 2014; Fisher, 2015). Subsequently the canal was neglected, silted up and rebuilt many times. Throughout this over thousand years of changes it facilitated the trade from the delta to the Red Sea rather than to the Mediterranean (Fisher, 2015).

Later, around 600 BC, a new canal construction had begun from Pelusian branch of the Nile River to the northern end of the Bitter Lakes. At that time the Suez Gulf extended further north, the canal needed to reach up to shore, the present Great Bitter Lakes. The final canal was completed by the Persian King Darius (550-486 BC) who had conquered ancient Egypt (Encyclopedia Brittannica, 1974). As the Suez Gulf receded southward the additional canal was required. The first completion was during the reign of Ptolemy II Philadelphus (285-246 BC). Again it was filled by silt and abandoned and later revised during the time of Roman Emperor Trajan (98-117 AD) (Peter Saundry, 2013). It then too became abandoned, silted and reopened, again, many times.

The Suez Canal is an important international navigation canal. Its geographic location helps in saving the distance, time and operating cost which makes it special for Egypt and for the world (Importance & Advantages of Suez Canal, 2014).

Figure 6 Suez Canal

Source: Accessed October 28, 2015, Available from www.britannica.com

c. China

The history of the Grand Canal in China is representing of both the ancient and the modern waterways because of its long and grand development. It is the world longest man-made waterway, with the length of about 1,800 km long (Grand Canal: Canal, China, 2014). It passes through four provinces from north to south, Hebei, Shandong, Jiangsu and Zhejiang (Perkins, 2013). It is called “Da Yunhe” in Mandarin Chinese, meaning the “Bridal on the Dragons,” because it run across China’s five major west-east rivers and helps in controlling the floods in those regions (McColl, 2005).

The oldest section of Grand Canal was made to transport soldiers from the north to fight the Kingdom of Qi, present Shandong province, around 486 BC. This was during the Zhou Dynasty and was to enterprise of King Fuchai of the State of Wu, present Jiangsu province (Perkins, 2013). This first effort was to connect the Yangtze River and the Huai River that run west to east.

Between 605-618 AD Yangdi, the second emperor of the Sui dynasty, connected many rivers and small canals to extend the Grand Canal from Hangzhou north across the Yangzi to Yangzhou and the northwest to the capital city of Luoyang. By 609 AD Grand Canal barges could transport from lower Yangzi region up to northern China to strengthen the North and feed the capital area (Perkins, 2013). This took six years and the labors of thousands of peasants to complete (McColl, 2005).

After 763 AD, during the Tang dynasty (618-907 AD), the Grand Canal was the lifeline of the Chinese Empire. Kaifeng, the capital city of the Northern Song dynasty (960-1127), was located near the junction of the early Grand Canal and the Yellow River (Perkins, 2013).

The Grand Canal was completed in 1293 during the Mongol, Yuan dynasty (1279-1368 AD). The first Yuan Emperor, Khubilai Khan restored and shortened the distance from north to south by making two new waterways through the south of Shandong province. Parts of these waterways were constructed over the top of the mountain, demonstrating advance hydraulic techniques of Yuan engineers (Perkins, 2013). The canal was also extended north to feed the capital and the armies with rice from the south (McColl, 2005).

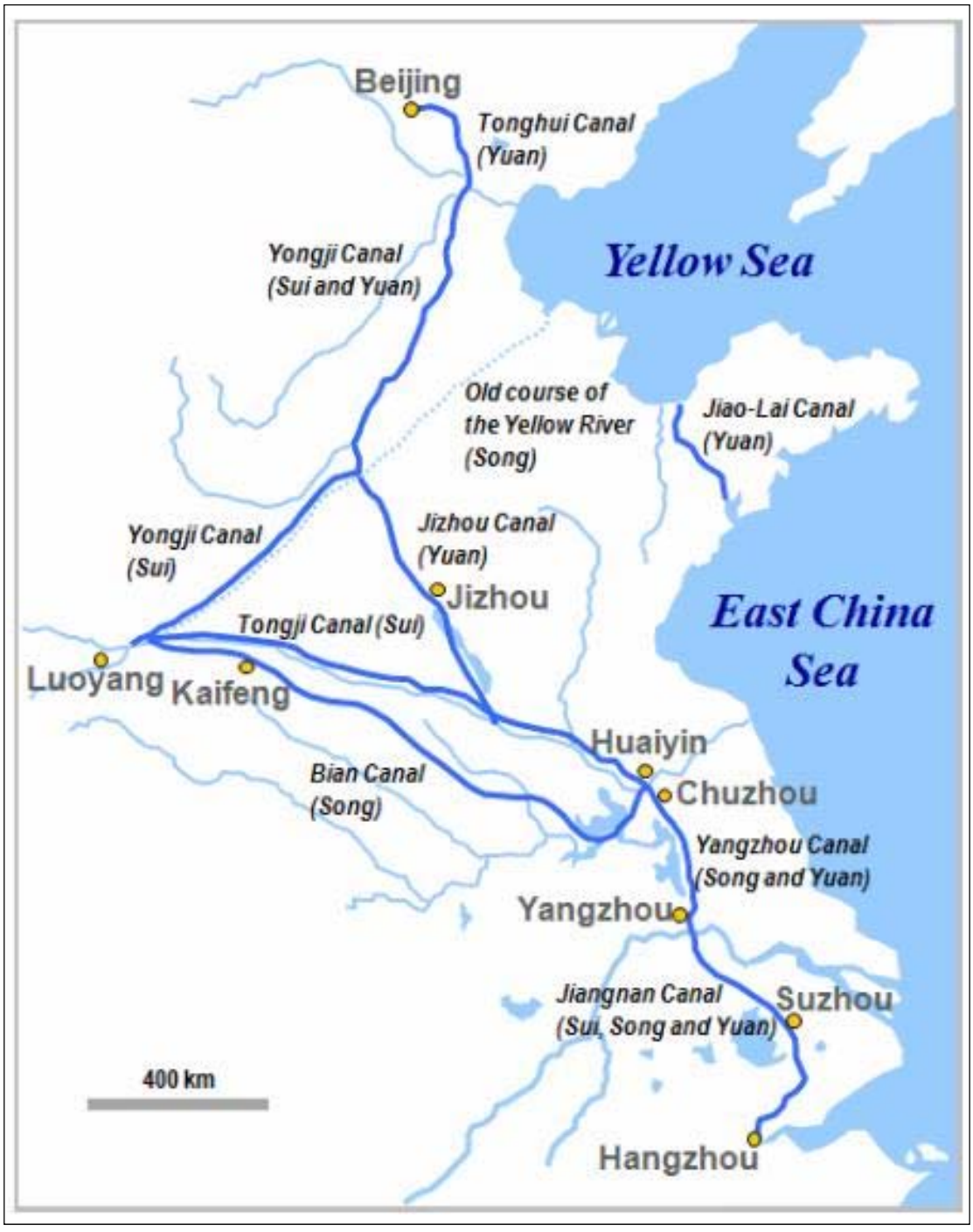



Figure 7 Map of the Grand Canal, China

Source: Accessed October 29, 2015, Available from https://people.hofstra.edu/geotrans/eng/ch2en/conc2en/grandcanal.html.

As Yuan got weak, the Grand Canal fell into disrepair. But Emperor Yongle of Ming dynasty reconstructed the canal and the canal was widened and deepened (Perkins, 2013).

In 1411, Song Li solved the water flow problem by building a mile-long dam with sluice gates. It formed a reservoir divided into sections by fourteen locks. The gate could be opened and closed to control water (Perkins, 2013).

After the growth of railways in the late nineteenth century, the Grand Canal fell into disrepair. The frequent flood of the Yellow River also damaged the Grand Canal (Perkins, 2013).

The Grand Canal is still in use today. The southern part of canal, especially the section from Hangzhou to the Yangzi River near Zhejiang, is heavily used by barges to transport goods. The section north of Tsinan in western Shandong has not been used since the eighteenth century because of heavy silt. Near Tuanjin, Grand Canal is a major trade route with dams and locks to control the water and assist the boats. North of Tianjin, it flows along the shallow Pai River to Dongzhou. The northern sections of the Grand Canal freeze during the winter (Perkins, 2013).

Figure 8 Grand Canal passing through Hangzhou city

Source: Accessed October 28, 2015, Available from http://www.youlinmagazine.com/story/grand-canal-of-china/NDI0#sthash.G2oZOZvg.dpbs,

In 1958, the Grand Canal Committee was established under the Minister of Communication. By 1963, dams had been built on a 250-mile section of the canal in northern Jiangsu province. It still facilitates navigation and provides drainage, flood control, irrigation and water supply. Today most coal and industrial goods are transported on the canal (Perkins, 2013).

In 2014, the Grand Canal of China was added to the heritage list. It follows the (i) (iii) (iv) (vi) criteria (UNESCO).

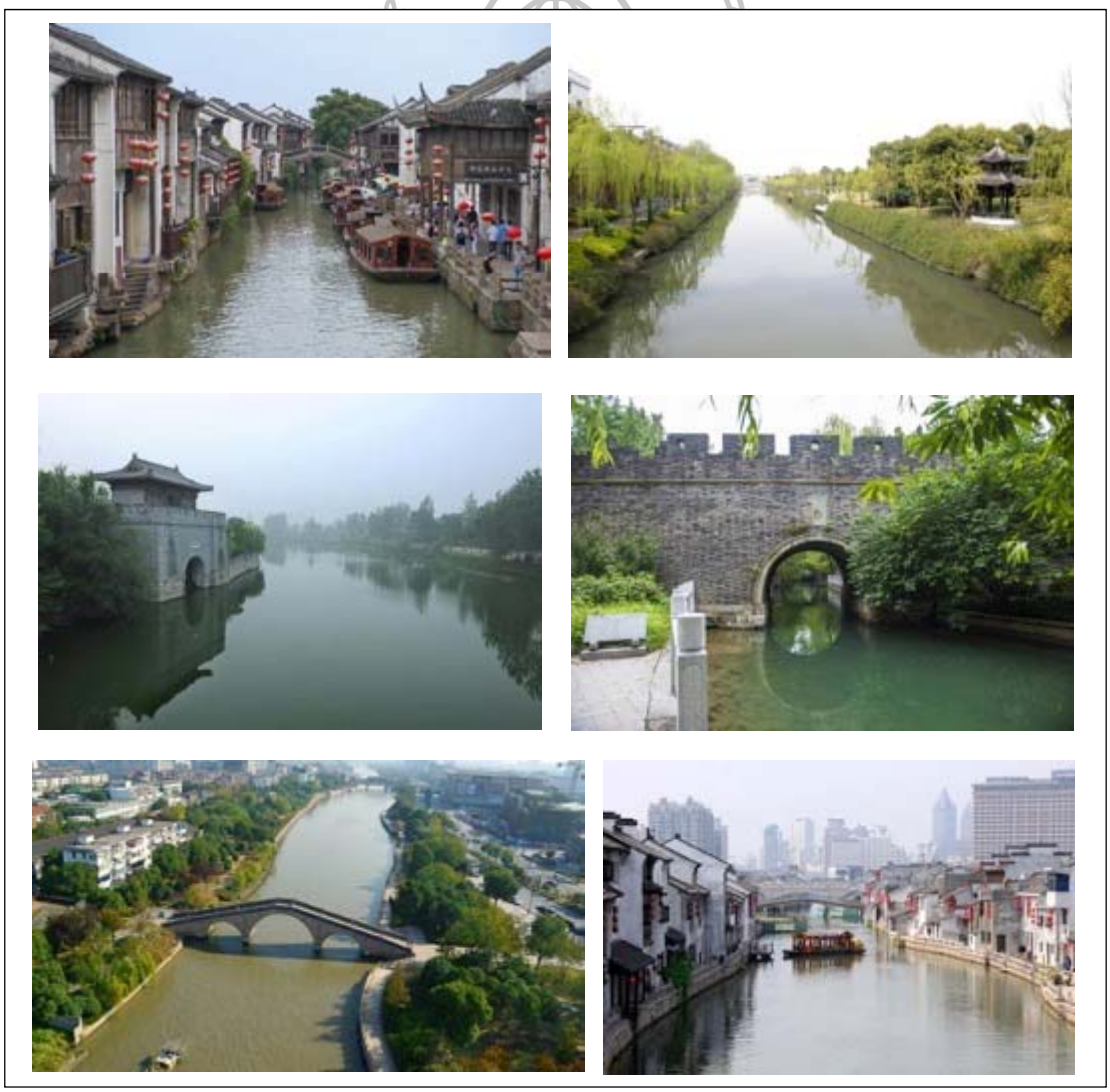


Figure 9 Grand Canal, China

Source: Accessed October 9, 2015, Available from http://whc.unesco.org/en/list/1443.

### 1.2 Modern Canals

a. Europe

Canal building in Europe seemed to slip away after the Roman Empire (Encyclopedia Brittannica, 1974). It was revived in the twelfth century by the commercial expansion. Riverborne transportation increased and followed with demographic and economic growth. The early navigable waterways were developed to transport coal, timber and ore as well as to improve market links (Bella S. Galil, 2006).

A number of new technologies eventually emerged. There were the use of stanches or flash locks, which helped to carry vessels over the shallow places. The Low Countries uses the drainage of Marshland to develop the canal system. The first example of pound lock was probably built at Vreeswijk, The Netherlands, in 1373 at the junction of the canal from Utrecht with the River Lek. This system became widespread in the fourteenth century. By the fifteenth century, the lock gate system improved with additional paddles to control the flow of water in and out of the lock chamber (Encyclopedia Brittannica, 1974). The sophisticated modern canal engineering evolved in France in the sixteenth century, culminating in the Canal du Midi, arguably the world's greatest civil-engineering project since the constructions of the Roman period. This, in turn, inspired the Duke of Bridgewater to construct the first heavily engineered canal of the Industrial Revolution in Great Britain (TICCIH, 1996).

Figure 10 Canal du Midi, France

Source: Accessed December 29, 2015, Available from http://whc.unesco.org/pg.cfm?cid=31&l= en&id_site=770&gallery=1&&maxrows=19.

The explosion in waterway construction that followed in Britain resulted in the construction of some 1,331 kilometers of navigation that gave England the first integrated national system for the bulk transport of goods and materials in a modern industrialized economy. A second frenetic outburst of activity occurred in Britain in the period between 1789-1798 (stimulated by the Industrial Revolution) and produced a further 1931 kilometers of artificial waterways. This generated so much excitement that the climate was termed the "Canal Mania". The scale of civil engineering applied to canal construction also grew ever more intense. Britain had built some 58 kilometers of canal tunnel far more than existed in the rest of the world at that time. Large iron and masonry aqueducts also form part of the heritage of that first blooming of heroic-scale structures. These included the great Pontcysyllte Aqueduct, at a height of 38.4 meters above the river Dee, still the loftiest navigable canal aqueduct ever built (TICCIH, 1996).

Figure 11 Pontcysyllte Aqueduct

Source: Accessed December 29, 2015, Available from http://www.pontcysyllte-aqueduct.com/trevor.html.

b. United States of America

The first canals and the canal building technology in the United States came from Europe. They were small and took long time to build (Shaw, 1990). The first large-scale canal project in the United States was the Erie Canal on July 4,

1817 at Rome (Martin Morganstein, 2004). It was popularly known as “Grand Canal” in its first year. The canals enhanced many cities along it. These included Utica, Rochester, Syracuse and Buffalo. By 1840, New York had been transferred into an important port of the United States (Murray, 2005). The success of the Erie Canal encouraged further canal building. The technology was brought to other states.

Figure 12 The great success of Erie Canal
Source: Erie Canal, Julie Murray, p.17

The canal era in the United States represented a major phase of the nineteenth century economic boom known as the market revolution (Martin Morganstein, 2004). Canals lowered transportation costs, connected eastern and

western markets, fueled economic growth and in some cases generated waterpower for manufacturing.

The importance of the Erie Canal faded with the coming of the railroads in the 1850s (Martin Morganstein, 2004). In 1903, the State of New York join four canals together and the Erie Canal became part of the Barge Canal System that opened in 1918 (Murray, 2005).

**1.3 Impacts of Railways**

With the development of rail transportation in the nineteenth century, canals were threated, especially in the United States. The railways could carry more people and more goods in less time compared to canals. In the latter nineteenth century, rail companies made more profit and started buying the canals companies in Great Britain. Canals were able to occupy only the niches markets that railways were not able to access.

Canals were the main carriers in the United States and Great Britain. But in continental Europe the impact was less because Europe consists the natural rivers linked by artificial waterways. It makes for an international network that was able to provide international transport without transshipment.

In other places canals could not compete with railways. The railway dominated succeed in transportation up until the arrival of the motor age (Encyclopedia Brittannica, 1974).

**2. History of *Khlong* in Thailand**

Water has a long history of a dominant role in the development of Thailand and Bangkok in which many cities were considered water towns. This is due to the fact that the landscape is alluvial and water is naturally abundant. *Khlong* were used to control water, for transportation and later for agriculture. History suggests that *khlong* construction in the Chao Phraya Delta dates back to at least early 1300's before the Europeans discovered the existence of the American continent (Hubbard, 1977; Pamornprawat, 2011).

**2.1 Geography of Thailand**

The geography of Thailand is characterized by large, medium and small river basins, each of which consists of natural water resources in various forms, such as

pond, swamps, rivers and *khlong*. The land along the water is fertile and also useful in many ways, a factor significant in the settlement of Thai people (THAICID, 2002).

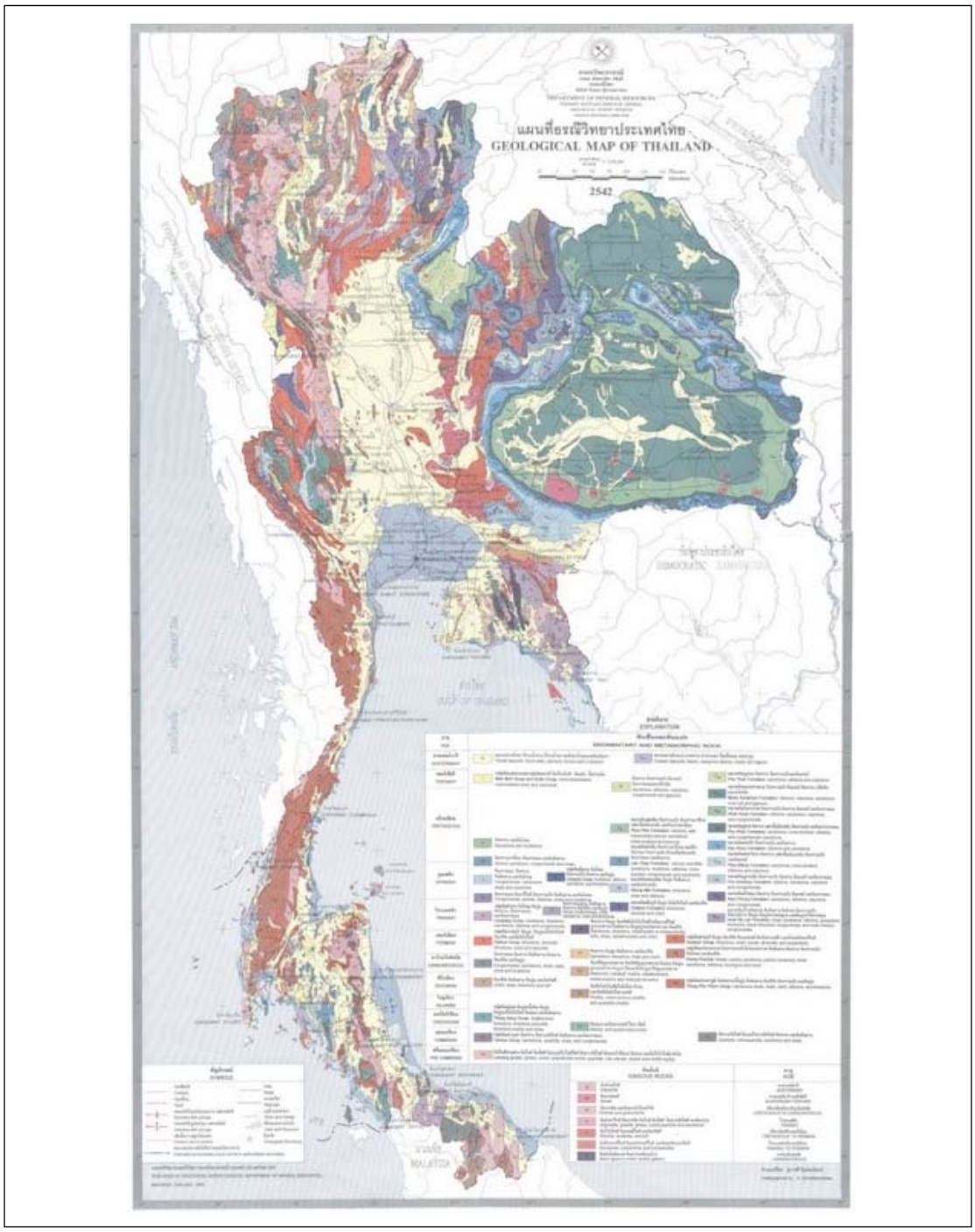



Figure 13 Geological map of Thailand

Source: Accessed September 29, 2015, Available from http://www.mapofthailand.org/geography-map/geological-map-of-thailand.

Thailand divides to six geographical regions according to the geological features and culture as shown in the table below (Royal Institute, 1982).

Table 1 Six geological regions of Thailand.

| | features | Provinces | Map |
|---|---|---|---|
| North region | Parallel north-south oriented hills and high mountains which are source of several important rivers | Chiang Mai, Chiang Rai, Lamphun, Lampang, Mae Hong Son, Nan, Phayao, Phrae and Uttaradit (9 provinces) |  |
| Northeast region (Northeast Plateau) | High and semi arid plateau | Amnat Charoen, Bueng Kan, Buriram, Chaiyaphum, Kalasin, Khon Kaen, Loei, Maha Sarakham, Mukdahan, Nakhon Phanom, Nakhon Satchasima, Nongbua Lamphu, Nong Khai, Roi Et, Sakon Nakhon, Sisaket, Surin, Ubon Ratchathani, Udon Thani and Yasothon (20 provinces) |  |
| Central region (Central Plain or Chao Phraya Plain) | Large plain | Ang Thong, Ayutthaya, Bangkok, Chainat, Kamphaeng Phet, Lopburi, Nakhon Nayok, Nakhon Pathom, Nakhon Sawan, Nonthaburi, Pathum Thani, Phetchabun, Phichit, Phitsanulok, Samut Prakan, Samut Sakhon, Samut Songkhram, Saraburi, Sing Buri, Sukhothai, Supan Buri and Uthai Thani (22 provinces) |  |
| East region | Plains and valleys with some small hills | Chachoengsao, Chanthaburi, Chonburi, Prachinburi, Rayong, Sa Kaeo and Trat (7 provinces) |  |
| West region | Long high mountains, step river valleys | Kanchanaburi, Phetchaburi, Prachuap Khiri Khan, Ratchanaburi and Tak (5 provinces) |  |
| South region | Peninsula between the Andaman sea with hills and mountains | Chumpon, Krabi, Nakhon Si Thammarat, Narathiwat, Pattani, Phang Nga, Phatthalung, Phuket, Ranong, Satun, Songkhla, Surat Thani, Trang and Yala (14 provinces) |  |

Source: Map, Available from: https://en.wikipedia.org

Bangkok is part of the Central Region, also known as “Chao Phraya Plain” or “the heart of Thailand” (Thosarat, 1998).

**2.2 Ancestors Footsteps**

Thailand has history related closely to water. Thai ancestors developed ways to live along the water effectively. Making *khlong* was one way in which people changed or adapted the landscape to manage a land comprised of plain and swamp. There are great numbers of *khlong,* natural, man-made and intermixed, of several types according to function and form. Water also influenced how many towns were from in the past - many followed the Khmer cosmological model, which waterways represent the cosmic ocean. Hydraulic engineering was the most important part of physical factors for those ancient Khmer planners (Jumsai, 1997). The reasons behind man-made *khlong* and how they were used reflected believes and life of cities in the past.

**a. Sukhothai**

Sukhothai is a city located far from the sea. It is located on foothill plains between three rivers, the Ping, Yom, and Nan. But still water is not abundant. Therefore Sukhothai developed a system to make water available throughout the year. There were barrage and small dams to collect water from the rainy season and keep them in *khu meaung* (moat) and ponds in the city.

Sukhothai has mountainous soil, which is hard and crumpy unable to store water. Also there were no springs underground. Water humps are available in some area. The fact that Sukhothai is located 12 kilometers away from Yom River, and other rivers nearby are small and short added to its difficulties. Sukhothai area is relatively dry (Department of Drainage and Sewerage, BMA, n.d.). Sukhothai also faced problems about water: no water in a dry season, and floods in wet seasons. Therefore, to solve the problem of water management, Sukhothai developed both water conservation and irrigation systems. The solutions were versatile that it can also be used for transportation, agriculture, and defensive purposes (Maimanee Raksaphromraj, 2011). Sukhothai used *“sarid phong,”* a barrage or dike, to divert or control direction of water from the mountain in the southwestern part to the city. The water was then distributed to *“threephong”* and later to ponds called *“traphang.”* (THAICID, 2002; Department of Drainage and Sewerage, BMA, n.d.)

***Sarid phong***

*Sarid phong* is a barrage used to stop water from crossing an area. It is also used to control the direction as well as to control the force of the tides to a city. *Sarid phong* were found in many areas in Sukhothai. The first *sarid phong* was found 2 kilometers away from Sukhothai city wall. It was a ridge between two mountains to keep the water in a reservoir and control it to *khu meaung.* The inhabitant called this *sarid phong* "Tamnop Phraruang" because they believed it was built from the power of Phra Ruang. But archaeologist and historians believe that it was ancient structure built in Sukhothai period. Later, after more studies on Sukhothai, the evidence of other *sarid phong* was also found.

Tamnop Phraruang is now restored and maintained by the Irrigation Department in its original form. It is built higher up to 10.50 meters and 487 meters long. The reservoir is 140 rai, holds up to 380,000 cubic meters. It is given a new name "Ramkhamhaeng Reservoir" (THAICID, 2002).

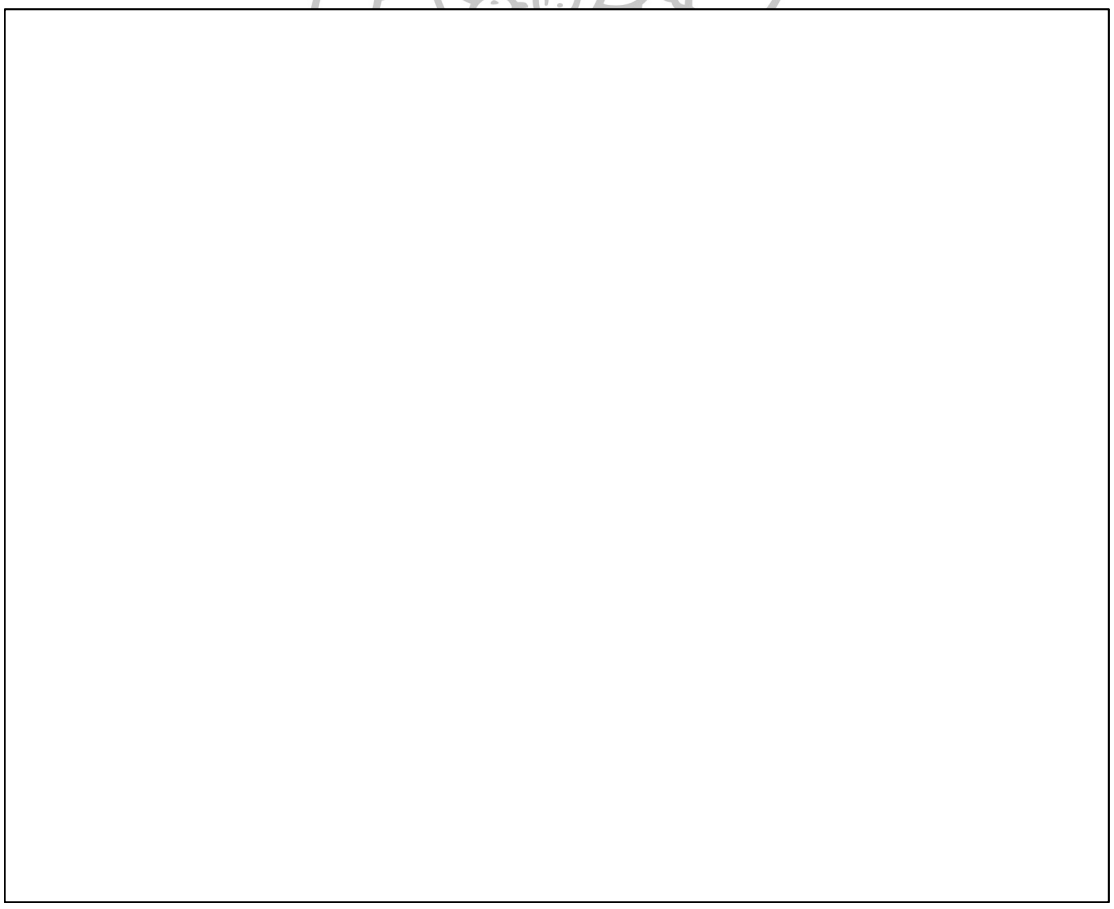


Figure 14 Sukhothai

Source: Legend of Siam Irrigation, Department of Drainage and Sewerage, p.12.

***Threeboon***

*Threeboon* is a rampart that consists of three clay walls and three *khu. Threeboon* is a rectangular shape. The inner wall was built from laterite while the other two are built from clay. It was a big structure with the height of 8 meters and *khu* was 30-40 meters wide. At the middle of each side there were an entrance and fort.

The rectangular city plan systematically related to the location of a religious site as well as the water management. At the center of the city is Wat Mahatat. It was (and is) the symbol of Mount Meru, which is the center of the universe in cosmological believes. *Khu* and walls are the symbols of Mahanatee Sitandon and Satbripan.

In addition to its religious symbolism, *threeboon* was also used to protect the city from the enemy and to take and drain water in the city. The water was transferred via *threeboon* to many big ponds in the city to be an available water resource throughout the year (THAICID, 2002).

***Traphang***

*Traphang* are big ponds in the city of Sukhothai. It is used to keep water and as a territory of some religious sites.

There were four *traphang* in Sukhothai: Traphang Ngen, Traphang Traguan, Traphang So, and Traphang Thong. They were located in the middle of the city, occupying between 400 to 1,600 square meters. The water was transferred from *khu meaung* to Trapang Ngen, Traphang Traguan, Tranphang So, and Traphang Thong through pipes made from glazed clay. The pipe at the entrance is 45 centimeters wide while it is 18 centimeters wide on the exit. There was another type of pipe found with equal width on both sides, so that both ends could be put together (THAICID, 2002).

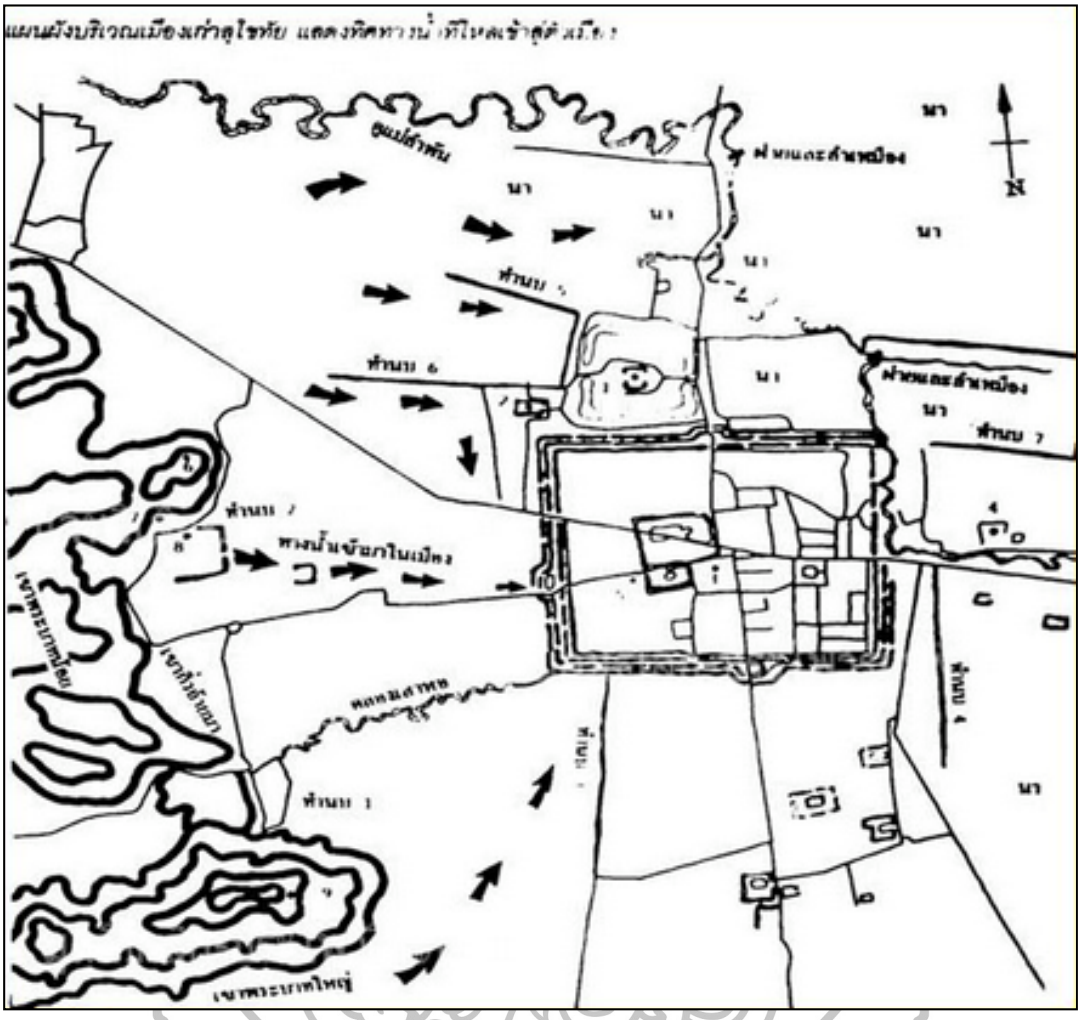


Figure 15 Map of Sukhothai that shows the flow of water to the city

Source: Accessed October 2, 2015, Available form http://www.lek-prapai.org/watch.php?id=487

**b. Ayutthaya**

Its long prosperous period of 400 years as a kingdom demonstrates that Ayutthaya was well located and well managed. Because Ayutthaya is located at the confluence of the three rivers, the Chao Phraya, Pasak and Lopburi River, it is an island. In the water season water covers the area surrounding the capital. As a result of its situation, Ayutthaya developed many ways to deal with water and was in deeply connected to water.

In 1350, King of U'Thong selected a location for the new capital on the crest of the three rivers, Chao Phraya River, Pasak River, and Lopburi River. Ayutthaya later influenced the later capitals, Thonburi and Rattanakosin.

**Archetype of Ayutthaya as a water city**

Srisak Valipodom (2012) suggested that the archetype of the water city of Ayutthaya is from Nakon Chaisi ancient city. He studied Nakon Chaisri and found that Nakorn Chaisri was a big settlement compared to other cities during the time of Dhavaravadi. The boundaries measured 3,600 x 2,000 meters, with the Padhone Pagoda located at the center of the city. Nakon Chaisri was located in the riverine area and used rivers and *khlong* as transportation. It was the foundation of a waterfront settlement. *Khu khlong* and other ancient settlements also had a relationship to the city (Khunsong, 2010). Nakon Chaisri was a city with a river passing through the middle like Ayutthaya and Bangkok (Valipodom, Federal Dhawarawadi, 2015; Maimanee Raksaphromraj, 2011). It was also a port city like Ayutthaya and Bangkok as it located at the border of the old delta (Valipodom, Federal Dhawarawadi, 2015). The two rivers flow pass the city was Bang Kaew River that used to be a big river in Dhavaravati period. Later on the river area shallower and shifted its location, resulting in the movement of people to other sites (Valipodom, Krungthep Dhavaravati Sri Ayutthaya, 2012) and the Bang Khaem Stream. The comparison of Nakon Chai Si and Ayutthaya city is shown in the figure below.

Figure 16 Satellite pictures of Nakon Chaisri (left) and Ayutthaya (right)
Source: Meaung Boran Journal Vol.38 No.3 July - September 2012 p.87

Both Nakon Chaisri and Ayutthaya are located on the river, which is the major means of transportation and communication. Both cities were surrounded by water. And extensive uses of *khlong* are also found in both cities. They also both possessed waterways that link to the seas to enhance the foreigners for trade and new settlements. (Valipodom, Krungthep Dhavaravati Sri Ayutthaya, 2012). *Khlong* were primarily made for the everyday life, transportation and defence.

**Ayutthaya, water city**

Ayutthaya measures about 5,500 rai, and is 3.5 kilometers wide and 4 kilometers long. The management challenge for water in Ayutthaya was to maintain the natural course of water and make *khlong* to connect those natural courses, and to create a water network inside and outside the city. This resulted in an effective drainage system that protected the city from the force of water from the north and also provided a fast drain out of the city.

The life of the people of Ayutthaya closely relate to the landscape. People in Ayutthaya grew rice that was suitable for the areas that flooded and experienced higher water levels than normal. Houses were elevated on stilts. Boats and rafts were made for transportation. Therefore, even in a long month of floods in Ayuthhaya, people were not much affected. The overall impact of *khlong* on the city of Ayutthaya was evidenced by a total length of 140 kilometers of *khlong*, while roads were totaled only of 53 kilometers (Department of Drainage and Sewerage, BMA, n.d.).

Before the establishment of Ayutthaya, three rivers - Lopburi River in the north, Pa Sak River in the east, and Chao Phraya River in the south - bound Ayutthaya. This was recorded in a note by Francois Henri Turpin (Department of Drainage and Sewerage, BMA, n.d.). The note also mentioned that in some years there was little rain yet, Ayutthaya was never lacked water. Later, there was *khlong* excavation connecting the north and south. It was not only to use for transportation but also for defence and trade. It was because of its location and its extensive that Ayutthaya became an important port in that time.

*Khlong* in the city were made to quickly drain water in the rainy season as well as to bring water into the city during the dry season. *Khlong* followed grid system, north to south and east to west. Every *khlong* was connected to the river to support the flow of water.

There were 99 city gates in Ayutthaya all located at the conjunction of *khlong* and rivers (Department of Drainage and Sewerage, BMA, n.d.). The grid system divided land into many small square plots. Temples, palace, and houses followed an overall order pattern. Roads, soil roads and brick roads, were built parallel to *khlong* to ease land transportation. There were also bridges built across *khlong.*

The book *Histoir naturelle et politique du royaume de Siam* by Nicolas Gervaise, French visitor to Ayutthaya, describes Ayutthaya as "Venice of the East." He mentioned that Ayutthaya became a port city not only because of its location but also the wise water management of the king. *Khlong* were made to connect the big rivers around the city as well as to other nearby settlements. These eased the sea journey and inland journeys for both westerners and local inhabitants (Department of Drainage and Sewerage, BMA, n.d.).

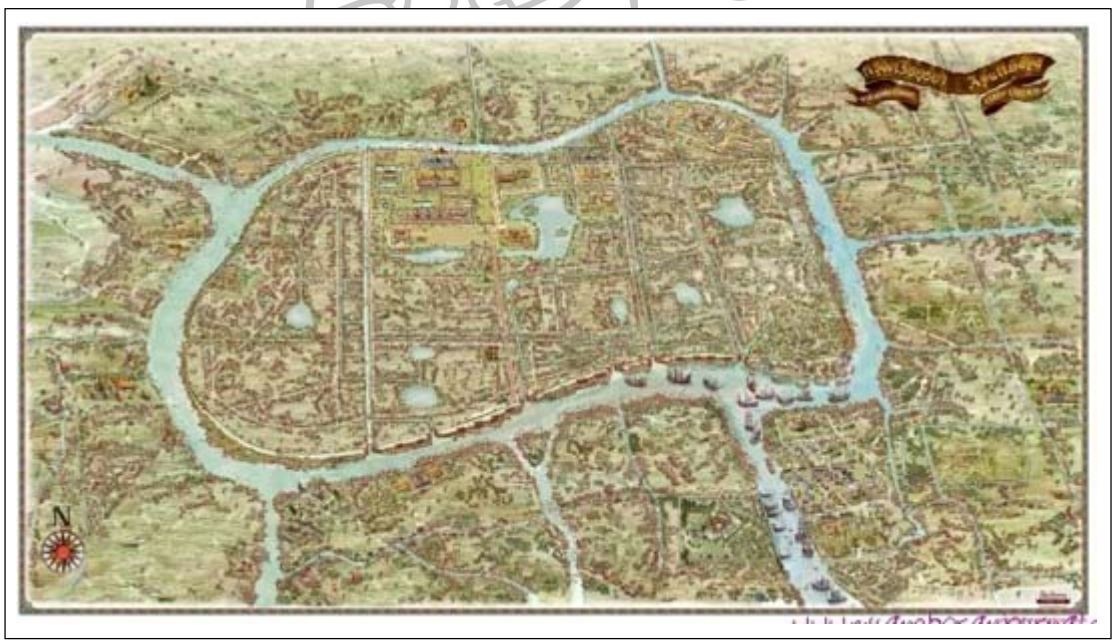



Figure 17 Drawing of Ayutthaya shows water around the city as island and many *khlong* passing through the city

Source: Accessed October 2, 2015, Available from www.muangboranjournal.com.

**Origin of Bangkok**

Even though Ayutthaya had a good water management system, the journey along the Chao Phraya River to and from the sea was not convenient. Because the land was a low lying plain, the river was unpredictable (Department of City Planning, BMA, 2009; Tanabe, 1977). Therefore, king of Ayutthaya had ordered *khlong lat* (short cut canal) to be made to straighten and shorten the distances.

Bangkok's first major *khlong lat* is Khlong Lat Bangkok Yai, excavated in 1522 during the reign of Phra Chaiyarajadhiraj (Piyanat Boonnak, 1982; Department of City Planning, BMA, 2009; Tanabe, 1977; Department of Drainage and Sewerage, BMA, n.d.). The excavation started from Pak Num Khlong Bangkok Noi, in front of the present Bangkok Noi Railway Station to *Khlong* Bangkok Yai, in front of Wat Arun. It is known as Khlong Lat Bangkok Yai. Later, the main channel of the river shifted to *khlong lat* and left the old course of Chao Phraya River as a smaller channel, the present Khlong Bangkok Noi and Khlong Bangkok Yai (Pisanbut, 2001; Department of Drainage and Sewerage, BMA, n.d.).

This major *khlong* excavation played an important role in the development of Ayutthaya and later capital cities, Thonburi and Bangkok. It shortened the distance of the journey for a day, or about 2.2 kilometers. This new channel also shortened the distance for ships from Portugal and China to Ayutthaya (Prakraiwan, 2012).

During the Ayutthaya period the area of present day Bangkok considered of extensive *khlong* making in the area of Bangkok. Mostly this was for transportation. New *khlong* were built to make it easier to move to and from Ayutthaya and to shorten the distance of the natural waterways and to connect to other waterways.

> A story was told that before the Khlong Lat Bangkok Yai was made, a man stopped and made breakfast on the bank of Chao Phraya River, which is present Pak Khlong Bangkok Noi. After breakfast he traveled south along Chao Phraya River to the area that is present Pak Khlong Bangkok Yai, which took him a full day. As he prepared for dinner he found out that he had forgotten a wood which was use to lock the lid when pure water out. He then cooked the rice and walked across the land back to

get his wood. When he came back the rice was just cooked and about time to use his wood. The story was told to imply that it took a day to reach present Pak Khlong Bangkok Yai by water but waking took as little time as to cook rice.

There are four other *khlong lat* excavation along the Chao Phraya River excavations in Ayutthaya Period (Piyanat Boonnak, 1982; Tanabe, 1977). These are shown in the table 2.

Table 2 Reign, year and location of *khlong lat* excavation of Chao Phraya River in Ayutthaya Period

| No | Name | Reign of excavation | Year of excavation | Location |
|---|---|---|---|---|
| 1. | Khlong Lat Bangkok Yai | Phra Chaiyarajadhiraj | 1522 | From present Pak Khlong Bangkok Noi to Wat Arun |
| 2. | Khlong Lat Bang Kruai | Phra Maha Chakrabatr | 1538 | From Wat Chalorm to Wat Khi Lek |
| 3. | Khlong Lat Kret Yai | Phra Chao Songtham | 1608 | At Tai Sam Kok from Pak Khlong Lad Prao down to Pak Khlong Bang Luang Chiang Rak |
| 4. | Khlong Lat Non | Phra Chao Prasat Thong | 1636 | From Pak Khlong Mae Num Aom Non to Wat Khema |
| 5. | Khlong Lat Kret Noi | Phra Chao Tai Sa | 1722 | Pak Khlong Bang Bua Thong bight |


Figure 18 Six *khlong lat* of Chao Phraya River (including the sixth *khlong lat* which was made later in Rattanakosin)

Source: Adapted from Khlong in Bangkok, Piyanat Boonnak, p.19.

There were also *khlong* excavations linking Chao Phraya River to other rivers not far from Bangkok. Khlong Samrong and Khlong Mahachai (Khlong Mahachai Chonlamarg or Khlong Phra Buddha Chao Lhuang) were excavated transversely for communication between Ayutthaya from the Chao Phraya River's main channel, to the east and west, which contributed the development of communication to and from coastal provinces and capital (Piyanat Boonnak, 1982; Tanabe, 1977). These two *khlong* allowed traffic to move easier. Both *khlong* were excavated across the barren coastal area with very few populations during that time (Tanabe, 1977; Brummelhuis, 2007).

Khlong Samrong, which already existed in that time, according to the chronicle (Tanabe, 1977), was improved in 1498, during the reign of Phra Rama Thibodi II (Piyanat Boonnak, 1982; Tanabe, 1977) linking the east bank of Chao Phraya River to Bang Pakong River.

Khlong Mahachai, on the west, was excavated during the reign of Phra Chao Seua and finished in the reign of Khun Lhuang Tai Sa. It linked the west bank of Chao Phraya River to the mouth of Tha Chin River. There was a famous legendary story told about the reason of this *khlong* excavation:

Phra Chao Seua visited Khlong Khok Kham in 1704, which was known for its unwieldy and strong current. Pan Tai Norasingh, who was controlling the vessel, struggled to maintain control over Ekkachai Royal Barge. In result, the vessel's bow hit a tree and broke down into the water. According to the law, Pan Tai Norasingh must be decapitated. But Phra Chao Seua understood the situation and did not want to punish Pan Tai Norasingh. But Pan Tai Norasingh insisted that there should not be an exception against the law. So Phra Chao Seua had to order a decapitation of Pan Tai Norasingh. After that, Phra Chao Suea called for shrine to be built for Pan Tai Norasingh as his loyalty, honesty, integrity, and discipline to be respect and recognized by the next generation. Also he ordered the straightening of *khlong* to connect with Ta Chin River. The *khlong* was first known as Khlong Sanam Cha and later renamed to Khlong Mahachai (Council of Cultural Affairs of Bang Khun Thein, 2006).

Figure 19 The picture of Pan Tai Norasingh shrine and Goddess Srinual taken in 1987
Source: Accessed November 22, 2015, Available from http://www.sujitwongthes.com/ suvarnabhumi/ 2013/12/ suvarnabhumi-society-culture26122556.

The land also had advantages for irrigation because the level of water in the river and paddy field was not much different. Dredging of *khlong* from river to the required area was enough to get the water to every farm plot. The cultivation in Ayutthaya was aimed at domestic consumption and irrigation was implement only to support this requirement. The late time of the Ayutthaya period, rice was exported to China and the nearby regions, except in the years of low cultivation, when rice was saved for domestic consumption (THAICID, 2002).

Khlong Tub Nang was dug in 1498, during the reign of Phra Rama Thibodi II, to link Khlong Samrong between Chao Phraya River to Bang Hia River to south and to drain at the Gulf of Thailand at Bang Plee, Samut Prakarn Province.

The evidences of making *khlong lat* (short cut canals) and *khlong cheum* (linking canals) implied that Bangkok was receiving attention from the rulers of Ayutthaya, long before it was established as a capital. These *khlong*, along with the

natural *khlong* in the area had made communication to Bangkok and other cities easier, a factor that also influenced the capital location selection of Bangkok in later time (Piyanat Boonnak, 1982).

## 3. Canals and *khlong* as Heritage

Canals can be considered as heritage. They have significance and values in many categories. This section demonstrates recognition of canals as heritage.

### 3.1 Information Document on Heritage Canals

The Information Document on Heritage Canals was established after a meeting of experts on heritage canals in September 1994 to explore the nature and extent of canals, and to examine the components of significance. The following section cited from Information Document on Heritage Canals (UNESCO).

**Areas and Values of Significance in the Canal Heritage**

**A Technology**

Canals can serve a variety of purposes: irrigation, navigation, water-power, flood mitigation, land-drainage, defence, and water-supply. The following are the areas of technology that may be of significance:

1. The lining and waterproofing of the water channel;
2. The engineering structures of the embankments with reference to comparative structural features in other areas of architecture and technology;
3. The development of sophistication in constructional methods;
4. The transfer of technologies.

**B Economy**

Canals contribute to the economy in a variety of ways, e.g. in terms of economic development and the conveyance of goods and people. Canals were the first effective man-made carriers of heavy bulk cargoes. Canals are of continuing economic and recreational use. The following factors are important:

1. Nation building;
2. Agricultural development;
3. Industrial development;
4. Generation of wealth;
5. Development of engineering skills applied to other areas and industries.
6. Tourism

**C Social Factors**

The building of canals had social consequences:

1. The redistribution of wealth, with social and cultural results;
2. The movement of people and the interaction of cultural groups.

**D Landscape**

Such large-scale engineering works had and continue to have an impact on the natural landscape. Related industrial activity and changing settlement patterns cause visible changes to landscape forms and patterns.

**Authenticity and Integrity**

A. Authenticity depends holistically upon values and the relationships between these values.

B. One distinctive feature of the canal as a heritage element is its evolution over time. This is linked to how it was used during different periods and the associated technological changes the canal underwent. The extent of these changes may constitute a heritage element.

C. The authenticity and historical interpretation of a canal encompass the connection between the real property (subject of the Convention), possible movable property (boats, temporary navigation items) and the associated structures (bridges, etc.) and landscape.

**The International Canal Monument List**

In 1996, the International Canal Monument List was prepared under the auspices of the International Committee for the Conservation of the Industrial Heritage (TICCIH) as one of a series of industry-by-industry lists for use by ICOMOS in providing the world Heritage Committee a lists of “waterways” sites recommended as being of international significance. The list is mainly concerned with waterways whose primary aim was navigation and with the monuments that formed each line of waterway.

The list mentioned that internationally significant waterways might be considered for World Heritage listing by conforming to one of the four monument types:

1. Individually significant structures or monuments along the line of a canal or waterway;

2. Integrated industrial areas, either manufacturing or extractive, which contain canals as an essential part of the industrial landscape;

3. Heritage transportation canal corridors, where significant lengths of individual waterways and their infrastructure are considered of importance as a particular type of cultural landscape.

4. Historic canal lines (largely confined to the line of the waterway itself) where the surrounding cultural landscape is not necessarily largely, or wholly, a creation of canal transport

The record of these documents shows that the designation of canals was in the interest of UNESCO from 1994. But the focus on canals was more on industrial purpose canals, which originally were aspects of inland navigation. These canals were later made more focus along with the industrial heritage movement (ICOMOS).

**3.2 *Khlong,* Part of UNESCO World Heritage**

It is interesting that two important ancient cities mentioned earlier, Sukhothai and Ayutthaya, have been listed in the UNESCO World Heritage list for their outstanding universal values, which include the hydraulic management system. The hydraulic management system also consisted the use of canals. They are listed in the names of “Historic Town of Sukhothai and Associated Historic Towns” and “Historic City of Ayutthaya.”

For the Historic Town of Sukhothai and Associated Historic Towns, part of the brief synthesis outstanding universal value mention as follow;

> In addition to being the place of pioneering achievements in architecture and art, language and writing, religion and law, the historic towns of the Sukhothai Kingdom were home to accomplished innovators in hydraulic engineering. They modified the landscape of the kingdom in such a way that water was dammed; reservoirs, ponds and canals were constructed; flooding controlled; and water was brought to serve a variety of agricultural, economic and ritual functions as well as to provide the towns’ inhabitants with water for their daily lives, avenues of communication, and protection in the form of city moats. From that day onwards until the Rattanakosin period, the kings of Thailand have been acknowledged for their ability to control the kingdom’s water.
>
> (UNESCO)

For Historic City of Ayutthaya, part of the brief synthesis outstanding universal value mention as follow;

> Well-known from contemporary sources and maps, Ayutthaya was laid out according to a systematic and rigid city planning grid, consisting of roads, canals, and moats around all the principal structures. The scheme took maximum advantage of the city's position in the midst of three rivers and had a hydraulic system for water management, which was technologically extremely advanced and unique in the world.
>
> (UNESCO)

Both outstanding universal values have mentioned the hydraulic management system, including canals and moats. It recognizes the connection of canals and moats to the cities as well as the importance role of canals and moats to the cities in Thailand history. The connection of *khlong* and city also inherit to Bangkok.

**4. Conclusion**

Canals were part of community life from the rise of civilization, although in different areas and different times, canals were developed differently. People have long manipulated their living landscape for the convenience of their societies. With the rise of civilization, canals were mainly used for consumption, agriculture, and to protect from floods. They were a means to adapt and control water for living. Later in Europe and the United States, canals were used mainly in transportation to support the growth of the industrial development. The section on the world history of canals shows a sequence in time from canals in a city context, rise of new technology, and intensingly use of canals. The cycle was often similar throughout the world - a tale of rise and fall. The history also demonstrated that canals and *khlong* are valued more than just for their function, but as heritage as well. For Bangkok, the importance of *khlong* dates back to the time before Rattanakosin, at least to the early 1300s. Native wisdom of the people in hydraulic management employed *khlong* in various ways. Recognition of the hydraulic management in the past capitals is also embedded in the UNESCO World Heritage lists as part of the "Historic Town of Sukhothai and Associated Historic Towns" and "Historic City of Ayutthaya." *Khlong* were one of the most important city elements in city planning for Thailand. *Khlong* continued to be important elements for Rattanakosin Capital. The history of *khlong* in Bangkok is presented in the next chapter.

# Chapter 3
# Development of *Khlong* in Bangkok

## 1. Early Development

Before the construction of Khlong Lat Bangkok Yai, Bangkok area was small village of agriculture, particularly of fruit. Ship journeys from Ayutthaya had to pass through Khlong Bangkok Noi to Khlong Bang Rama and Khlong Dao Kanong before exiting to the sea and not through the mouth of Chao Phraya River (Nonnat, 2012). Khlong Dan, connection of the old course of Chao Phraya River and the Tachin River was an important waterway. Khlong Dan was used in transportation, trade, and military route in wars. Literature shown that Khlong Dan was used as a route the sea since Ayutthaya period (Council of Cultural Affairs of Bang Khun Thein, 2006).

The present area of Bangkok became more important after the Khlong Lat excavation because the new channel was convenient. With the introduction of more fertile land, settlement moved to this area. Until 1557, during the reign of Somdej Phra Maha Chakrabatr, the area was promoted to be “Meaung Thonburi Sri Maha Samutr.” (Department of City Planning, BMA, 2009)

There are several foreign records of Bangkok after it had increased in importance. De La Loubere, the French ambassador, who travelled Ayutthaya by ship during the reign of King Narai Maharaj, noted that Bangkok was located about seven leagues from the sea, and that the Siamese were not like to built their house along the coasts, although it was located only a few days from town, but preferred to live along the rivers that provide convenient transportation for trading with customers from the sea. He also noted that fruit orchards in Bangkok extended along the river and comprised numerous kinds of fruit (Department of City Planning, BMA, 2009).

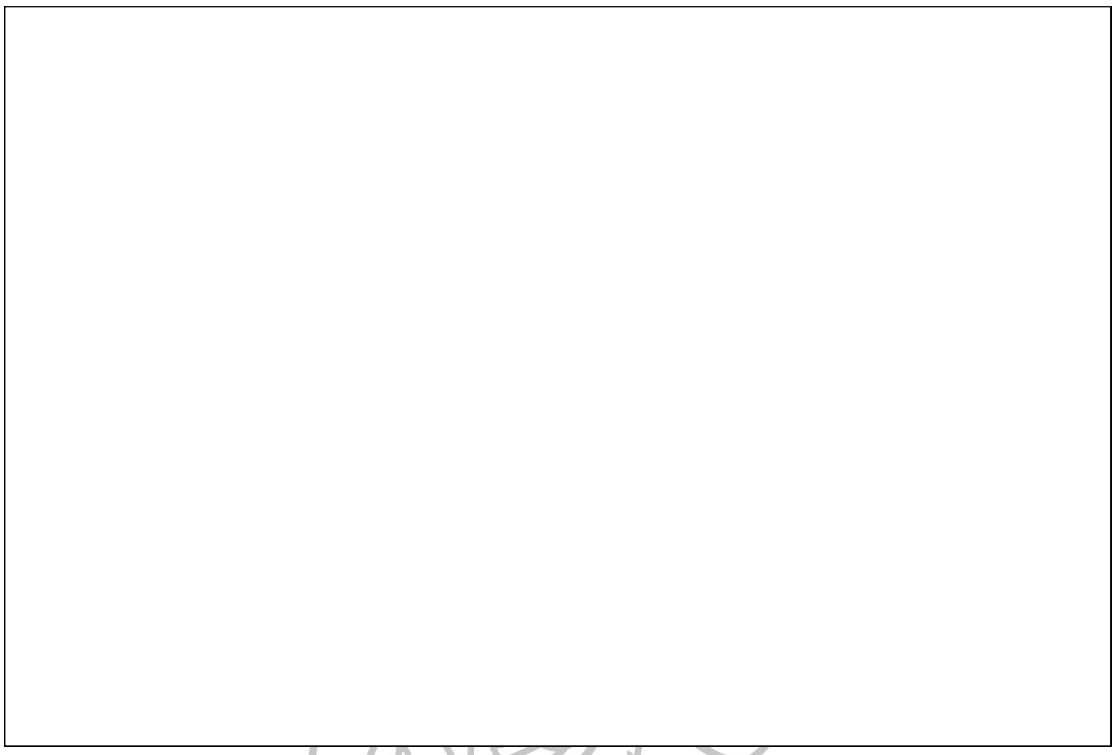


Figure 20 Bangkok Plan by La Loubre in 1687 shows the square city wall on the left. On the right is Bangkok Fort or Wichaiyen Fort, built in the reign of King Narai Maharaj. This map reflects the importance of Thonburi or Bangkok during Ayutthaya

Source: Legend of Siam Irrigation, Department of Drainage and Sewerage, p.74

**2. Thonburi**

After the fall of Ayutthaya, it was difficult to revive the capital. Therefore, King Taksin founded the new capital called "Thonburi Sri Mahasamut" in 1767. The idea of water and *khlong* for the new capital was not much different from Ayutthaya. It too was closely related to the water. Water management was also similar to the time of Ayutthaya in its abundant network of *khlong.* Also, Thonburi was an important city since the time of Ayutthaya.

Thonburi was located southward of Ayutthaya on both west and east banks of the Chao Phraya River. It had the new course of the Chao Phraya River, formerly Khlong Lat Bangkok Yai, across from the city. It is located in Chao Phraya Plain so in the rainy season water floods into the plantation areas and makes the land fertile and suitable for agriculture.

The land on the west bank was more upland compared to that on the east. Therefore, it was suitable for fruit plantation such as lychee and mangoesteen (Department of Drainage and Sewerage, BMA, n.d.). The initial development of the city was therefore more on the west bank. Settlements were more in that side of the city initially too because there were numbers of *khlong*, such as Khlong Mon, Khlong San, Khlong Ton Sai, Khlong Bang Lumpu Lang, Khlong Bang Yee Khan, and Khlong Bangkok Noi-Bangkok Yai. The west bank also consisted of many small *khlong* connecting to each other, suitable for transportation, irrigation, and trading.

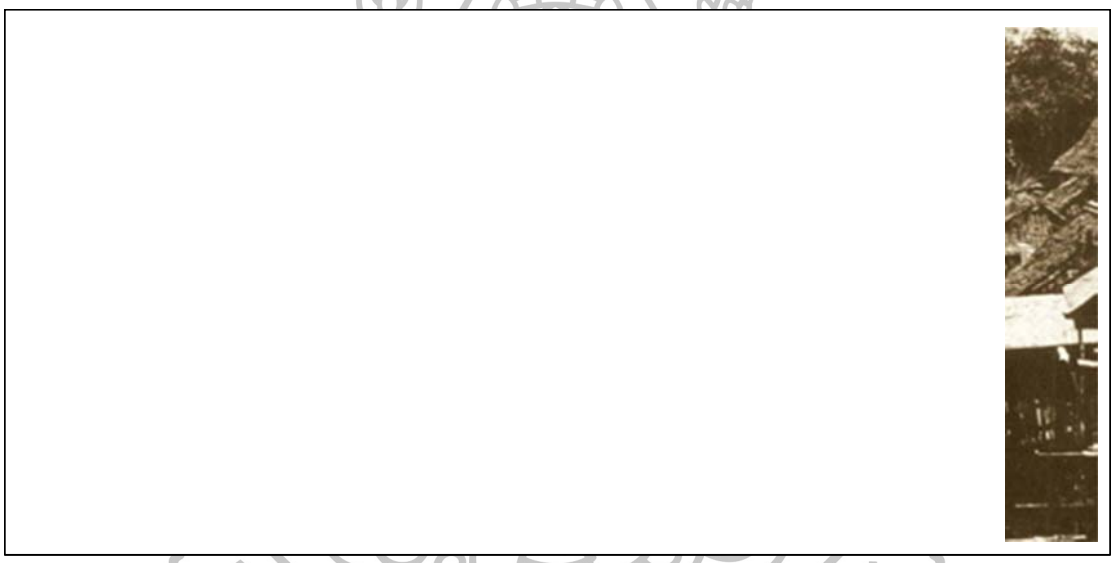


Figure 21 Khlong Bangkok Yai in the past. There are settlements at Khlong Bangkok Yai from Ayutthaya period. In the reign of King Taksin, it was the location of nobility, especially the Chinese who previously served King Taksin. Therefore the people call it “Khlong Bang Kha Luang” or “Khlong Bang Luang” (*kha luang* means nobility)

Source: Legend of Siam Irrigation, Department of Drainage and Sewerage, p.76-77

The east bank was low flat land and easily flooded. Therefore, it was suitable for rice fields. It can be seen that there were many water fields in this area, for example Woi Lampong Water Field, Phayatai Water Field, Mahamek Water Field, and Bangkapi Water Field.

**Khlong Khu Meaung**

To be an established capital, Thonburi needed to expand the city in order to provide for people who had escaped from war. And it also needed to adjust the land to serve defensive purposes.

Therefore “Khlong Khu Meaung” or “Khlong Rob Meaung” (city moat) were dug on both sides of Chao Phraya River in 1771 (Chaikong, n.d.). The city wall was also constructed along the *khlong khu meaung* (city moat) (Department of City Planning, BMA, 2009). *Khlong khu meaung* was made to indicate the territory of the city and as water resource for the community (THAICID, 2002). But mainly this later canal was made for defensive purposes, though in the ten times of the war with Burma fighting was never close to the capital. So Bangkok’s defensive works had never had to serve their original purpose. *Khlong* were called differently according to their location. These included Khlong Baan Noen, Khlong Baan Chang Lho, Khlong Baan Kamin, Khlong Baan Moh and Khlong Wat Tai Talad (Department of Drainage and Sewerage, BMA, n.d.; Department of City Planning, BMA, 2009). The total length was about four kilometers. (Department of City Planning, BMA, 2009). Khlong Baan Noen starts from Khlong Bangkok Noi to the Thonburi train station. Khlong Baan Chang Lho starts from the later Thonburi train station to Khlong Wat Rakung. It is called Baan Chang Lho because it flows past the Chang Lho community (*chang lho* means caster). The Chang Lho community cast Buddha statues. Khlong Baan Kamin starts from Khlong Wat Rakung to Khlong Mon, passing community that made *kamin* and *din so pong (kamin* means turmeric, *din so pong* is white clay filler). Khlong Baan Moh starts from Khlong Wat Chaeng (Wat Arun) to Khlong Bangkok Yai (Department of Drainage and Sewerage, 2010).

Khlong Khu Meaung on the East side of Chao Phraya River which was later named Khlong Khu Meaung Derm (*derm* means old, the name Khlong Khu Meaung Derm is used at the present indicating that there is a new city moat which is Khlong Rob Krung) started from the Pak Khlong in the north to Chao Phraya River a little north of Pak Khlong Bangkok Noi and south of Pak Khlong to Chao Phraya River at a little south to Pak Khlong Bangkok Yai near the former Vichaiprasit Fort (Department of City Planning, BMA, 2009). There was no description of the length of this *khlong* (Thai Encyclopedia for Youth, n.d.).

After the excavation of both *khlong khu meaung*, Thonburi was surrounded with water just like Ayutthaya. During the short period of fifteen years (1767-1775) as a Kingdom, Thonburi was intended as a fortress town, protecting the city and the creation of the nation. *Khlong* were a center part of its planning.

Figure 22 Khlong Khu Meaung Derm, excavated during the reign of King Taksin, Thonburi period. It was an important transportation route for trading in the inner city

Source: Legend of Siam Irrigation, Department of Drainage and Sewerage, p. 82-83.

Figure 23 Khlong Khu Meaung of Thonburi and the city wall

Source: Dolruthai Jiarakul, 2016

**3. Rattanakosin before the Bowring Treaty (1782 – 1855)**

From his accession to the throne in 1782 when King Rama I established Rattanakosin, river and *khlong* played an important role to the city. They were vital to life of both the people and the city. They were mainly used in daily consumption, transportation, and trading. They were also the foundation of the economy of Siam (Department of Drainage and Sewerage, 2010). Therefore, water management was one of the main tasks facing King Rama I, as well as in the reigns of King Rama II and King Rama III.

Rattanakosin grew to the east side of Chao Phraya River. It overlapped the previous capital of Thonburi (Wongthes, 2005). The reasons recorded in the Royal Chronicle edited by Chao Phraya Thipakonrawong Mahakosathibodi (Kham Bunnag) were that the location was better in war time as the area was a cape, while the west bank was as eroding river bend. Also, the royal palace on the west bank was blocked by Wat Chaeng (Wat Arun Rajawararam) and Wat Tai Talad (Wat Molilokayaram), which made expansion difficult (Department of City Planning, BMA, 2009).

It took three years to complete the building of Rattanakosin. Soldiers were recruited to construct the Grand Palace and Bawonsathanmonkol Palace (the Crown Prince Palace). Some bricks are from the old city wall of Ayutthaya were also utilized. The east fort (Vichayen fort) and the east wall were demolished to extend the city (Department of City Planning, BMA, 2009).

Rattanakosin was built to be surrounded with water - in a way a replica Ayutthaya. Because King Rama I had served Ayutthaya before it was destroyed, he was familiar with the strategy of King Taksin. He noticed the uses and advantages of the city as an island like Ayutthaya (Piyanat Boonnak, 1982). Rattanakosin would share a number of traits with Ayutthaya. These include its location related to the river, the location of the palace, the location of the crown prince palace, the location of *wat*, the Golden Mount of Khlong Mahanak, and the division of land according to land use. Moreover, the names of places were also adopted from Ayutthaya (Department of City Planning, BMA, 2009; na Ayuthya, 2004).

Figure 24 The scenery of water-based community in Early Rattanakosin period. The communities were settled along the banks of rivers and *khlong*.
Source: 225 years of Rattanakosin, Department of City Planning, p.59

**3.1 Reign of King Rama I**

**Khlong Khu Meaung (Khlong Rob Krung)**

The first *khlong* to be made during the reign of King Rama I was Khlong Khu Meaung (city moat) to form a city moat for defensive purposes, as in Ayutthaya and Thonburi (Piyanat Boonnak, 1982; Department of Drainage and Sewerage, 2010). The old city wall was removed to extend to the north, east, and south. The former Khlong Khu Meaung (Khlong Khu Meaung Derm) was dredged for transportation uses. In 1785, the new Khlong Khu Meaung was excavated from Bang Lumpu to Wat Sampleum called Khlong Rob Krung. Khlong Rob Krung (canal surrounding the city) was excavated by thousands of Khmer soldiers. It was 7.098 kilometers length, 20 meters width, and 2.5 meters depth (na Ayuthya, 2004). It was

the first barrier against enemies in the wartime before the city wall and the Grand Palace wall (Piyanat Boonnak, 1982).

More than just for defensive purposes, Khlong Rob Krung was also of use in draining water, transporting people along the *khlong*, and as a boundary for the city.

King Rama I gave the name of Khlong Rob Krung but the people often refer to the *khlong* according to the places along it. The book *Thai Live along the Canal* (2002) noted the names of Khlong Rob Krung as follows;

> …From the beginning of the canal at Wat Bang Lam Phu Bon (Wat Sangwet Wisayaram) down to Wat Saket, the canal was known as Khlong Bang Lam Phu after the temple Wat Bang Lam Phu.

Figure 25 Photograph of *Khlong Rob Krung* took at Damrong Satit Bridge to the Golden Mountain by Chao Gawilawong Na Chiangmai

Source: Accessed October 30, 2015, Available from http://www.sujitwongthes.com/?attachment_id=11390.

The second stage of Khlong Rob Krung from Wat Saket to its outlet at Wat Bophit Phimuk was known otherwise as Wat Choeng Lan - hence the name of this part of the canal. Then the king ordered a wooden bridge joining Wat Sam Pluem to Sampeng District. The bridge span pivoted so as to allow free passage of boats of all sizes and soon became known as Saphan Han (turnable bridge). With the ever increasing popularity of the bridge, the name of Khlong Saphan Han or Khlong Taphan Han soon replaced the old name altogether.

Another factor were ethnic Mons of Sam Kok district, who carried their jars and basins in their boats to the market at the entrance of Khlong Wat Choeng Lan. There were times when people wanted to buy jars and basins and that was the place to go. Pottery market of the time was established in Nirat Suphan, a famous poem (Suphan Buri bound) written by the famous Thai poet Sunthon Phu.

With a multitude of jars and basins in that market, the name of Khlong Wat Choeng Lan or Khlong Saphan Han was to suffer the same fate as those before them. Khlong Saphan Han soon gave way to the name of Khlong Ong Ang - meaning the canal of jars and basins. This was the last name that survives to our time even though there were no jars and basins on sale there any more.

Figure 26 Khlong Ong Ang

Source: Centennial Memorial of Bangkok, Pitrpreecha, S.V., p.28

**Khlong Lot**

There were small *khlong* made to connect Khlong Rob Krung to the former Khlong Khu Meaung. The two *khlong* are Khlong Lot Wat Rajanatda and Khlong Lot Wat Rajabophit. *Khlong Lot* means a straight *khlong* linking the two other *khlong*. The purpose of Khlong Lot was to provide water for people in the city walls (Plainoi, 2002). "*Inao,*" a Thai literature by King Rama II mentioned about the plentiful water of these Khlong Lot as follows:

> "Khlong Lot stretches as far as the eyes can see, knows no shortage of water even during an ebbing tide"
>
> (Plainoi, 2002)

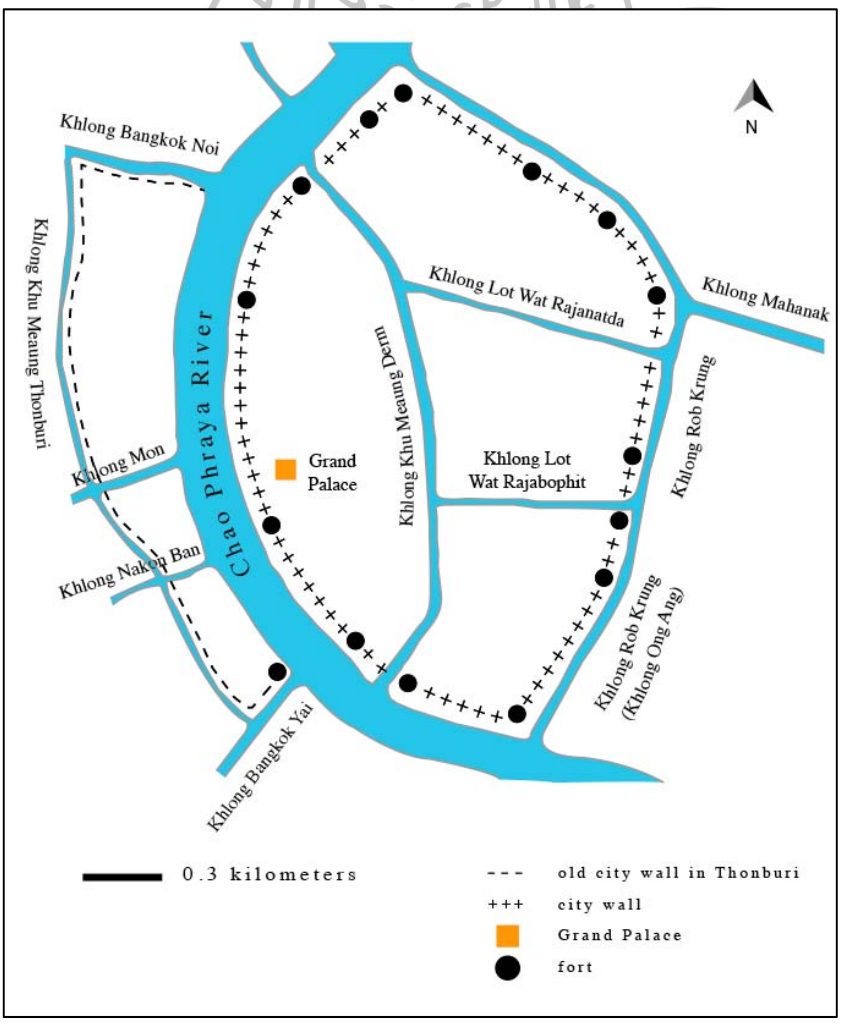



Figure 27 Location of Khlong Rob Krung, Khlong Lot Wat Rajanatda, Khlong Lot Wat Rajabophit, and Khlong Mahanak

Source: Dolruthai Jiarakul, 2016

**Khlong Mahanak**

King Rama I not only made *khlong* for defensive and transportation purposes, the king also made Khlong Mahanak near Wat Sakae (Wat Saket*)* for public water festivities, as had been popular in Ayutthaya (Piyanat Boonnak, 1982; Wongthes, 2005). This *khlong* was not included in the defensive strategy. This *khlong* is well documented. The astrologer's archives recorded that "In the year of small serpant, in the Thai lesser era of 1159, coinciding with B.E. 2340 (1797), the digging of Khlong Mahanak began" (Plainoi, 2002). The Rattanakosin Royal chronicle of King Rama I by Chao Phraya Tipakormwong (Kham Boonnak) noted "…it is place for Phra Nakorn people to gather by boat and play songs and *sakkawa* in the rainy season, just like in Ayutthaya…" (Department of Drainage and Sewerage, 2010).

Khlong Mahanak also links the suburb to the city at the conjunction between Khlong Mahanak and Khlong Rob Krung. It formed the market called "Talad Nam Pak Khlong Mahanak." The location is close to today's important fruit market, Mahanak Market, or Sapan Khao Market.

Figure 28 Life in the past at Pak Khlong Mahanak

Source: 225 Years of Rattanakosin, Department of City Planning, p.70

Khlong Mahanak served its purpose until the reign of King Rama V. At that time it was used as the mooring site for ships (Plainoi, 2002).

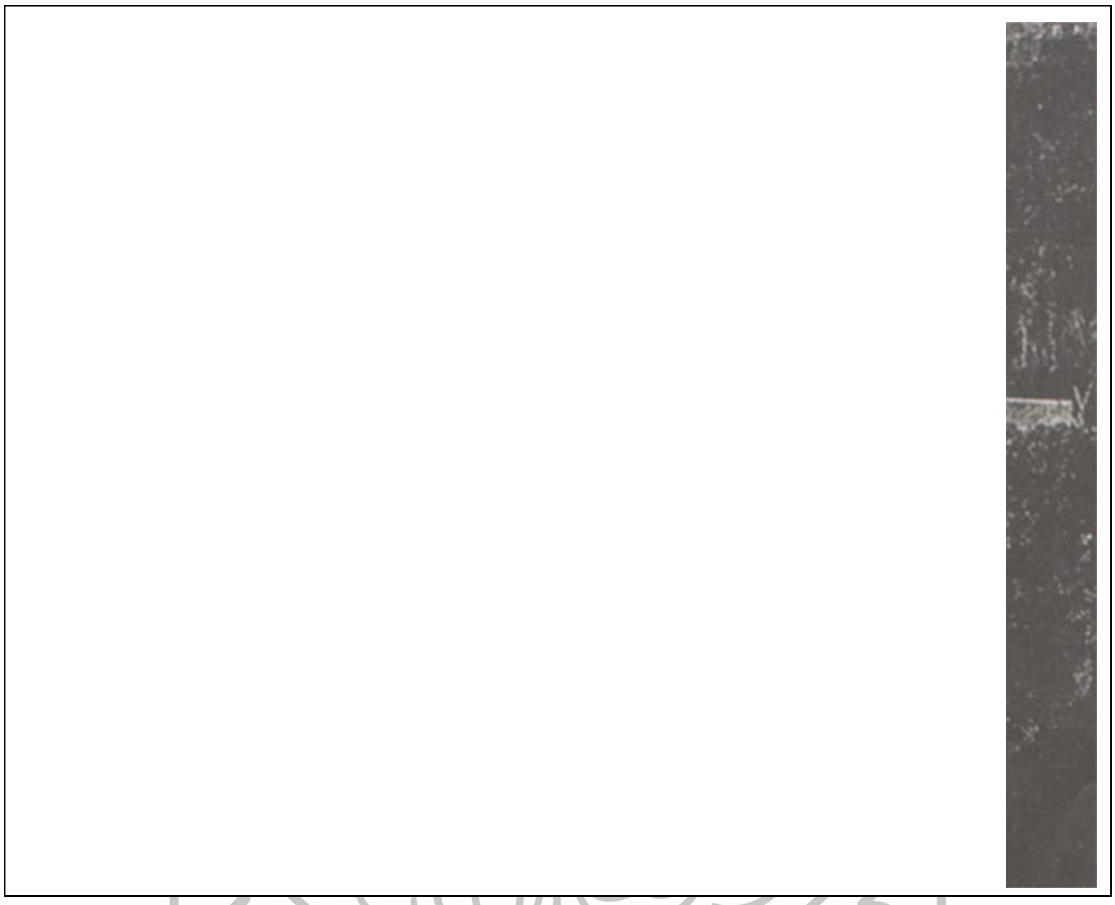


Figure 29 Bird's eye view of Khlong Bang Lampu from Wat Saket. Bridge across the *khlong* was only a small wooden bridge. Khlong Mahanak is on the right
Source: Centennial Memorial of Bangkok, Pitrpreecha, S. V., p.7.

**City Planning**

The degree that King Rama I used the land and *khlong* wisely was an interesting fact. *Khlong* were primarily also used as a boundaries. The former Khlong Khu Meaung lies at the heart of the city, Grand Palace and government buildings, lying between the former Khlong Khu Meaung and Khlong Rob Krung is the residence of vassal and the people. The area outside Khlong Rob Krung consists of rice fields, surrounding a small population. The Chinese, mostly merchants, were living down the south at the area called Sampeng. Every zone had *khlong* as defining

mark except the suburbs. All *khlong* were connected, which also underwrote commerce, and facilitated transportation. Bangkok was comprised of few people that time, so all the people live along Chao Phraya River and *khlong* had access to water for consumption and transportation (Piyanat Boonnak, 1982).

### 3.2 Reign of King Rama II

#### Khlong Lat Khuean Khan

During the reign of Rama II, evidence shows only one *khlong* made, which was Khlong Lat Khuean Khan. It was constructed to link Nakhon Khuean Khan to Khlong Ta Lao to Bangkok for transportation and communication. *Khlong* were built by Chinese wage labors instead of the proletarian labor (corvée) as before. This was because King Rama II decreased the time of proletarian service down to three months and the Chinese wage labors are available and more effective. The change introduced an economic revolution in Thailand. It shifted from “work to pay loyalty” to “work for wages.” It also demonstrates that King Rama II had used the people effectively, well employing their skills and potential. It took into account that Chinese wage labors were more effective in civil constructions and Thais were better as craftsman and agriculturists (Piyanat Boonnak, 1982).


Figure 30 Six *khlong lat* of Chao Phraya River

Source: Adapt from Khlong in Bangkok, Piyanat Boonnak, p.19.

### 3.3 Reign of King Rama III

In the time of Rama III, there were three *khlong* renovations - Khlong Sunak Hon, Khlong Bang Khun Thein, and Khlong Phra Kanong, and two new *khlong* excavations: Khlong Saen Saeb or Khlong Bang Kanhak and Khlong Nhue Meaung Nakhon Khuean Khan.

Khlong Sunak Hon and Khlong Nhue Meaung Nakhon Khuean Khan were important for communication and defence. Also, it was used in expanding the power of the government to collect raw material from hinterland. Khlong Sunak Hon linked Samut Sakhon and Samut Songkram and continued from Khlong Mahachai Chonlamak and Ta Chin River to Mae Klong River. Khlong Nhue Meaung Nakhon Khuean Khan linked Khlong Lat Khuean Khan. The latter was the first barrier for the enemy advancing from the Gulf of Thailand and was also used for communication (Piyanat Boonnak, 1982).

Khlong Bang Khun Thein, Khlong Phra Kanong, and Khlong Saen Saab was important for trading, especially Khlong Saen Saab, which also connected Bangkok to other nearby settlements. Even though the initial purpose was to use in war, the *khlong* was soon proven convenient to the people as well. Khlong Saen Saab was better maintained during the reign of King Rama IV and King Rama V (Piyanat Boonnak, 1982). Khlong Saen Saab retains its importance up until today. It is one of the few water transportation routes still used for transportation purposes in Bangkok.

The method used to deepen Khlong Sunak Hon in Rama III was to employ buffalos stepping in to the water. This method was probably applied to deepen other *khlong* during that time too (Piyanat Boonnak, 1982).

During the reign of King Rama III, there were many changes in methods and physical character of *khlong*. First, the construction was more closely related to military affairs. Secondly, Chinese labors were used, widely substituting for proletarian labors (Tanabe, 1977).

Figure 31  Khlong Saen Saab at Chalhermlok 55 Bridge, Pratunam

Source: Legend of Siam Irrigation, Department of Drainage and Sewerage, p.96.

### 3.4 Reign of King Rama IV (before the Bowring Treaty)

#### Khlong Padung Krung Kasem

The last *khlong* to be made before the Bowring Treaty (1855) was Khlong Padung Krung Kasem, built in 1851. It was made as a *khu meaung* (city moat) to facilitate the expanding population of that time. It was to be the last *khu meaung* of Siam (Department of Drainage and Sewerage, BMA, n.d.). It was built east of the former *khu meaung*, from south of Pak Khlong at Wat Kaew Jam Fah, and passed Khlong Mahanak to the Chao Phraya River at Wat Devaraj Kunshorn. Eight forts were also built along the *khlong* to make people feel secure and send a message to foreign powers. Khlong Padung Krung Kasem was the last *khu meaung* in Thailand (Piyanat Boonnak, 1982).

Colonization, however, would play an increasingly important role in that time. Western countries had advanced technologies and weapons. *Khu Meaung* was not very effective in wars, considering those technologies. Therefore, Khlong Padung Krung Kasem was never been used in war as was its primary purpose.

Figure 32 Khlong Padung Krung Kasem in the past

Source: Centennial Memorial of Bangkok, Pitrpreecha, S. V., p.82

Figure 33 Khlong Padung Krung Kasem at Wat Dhevaraj Kunchon

Source: Legend of Siam Irrigation, Department of Drainage and Sewerage, p. 112.

### 3.5 Life of the People

The life of the people during that time strongly related to waterways, or *khlong*. *Khlong* were used not only for daily consumption but also to move around, to trade and to connect to other cities and rural settlements as well.

The relation of people to water can be seen from the houses along the water. Houses were simply made of bamboo and other woods. There were also houses of rafts in the water. Trades in Bangkok were in water - houses on water made convenient to move around for trade. Not only that living on water is convenient for transportation, but also suitable during the time of floods (Wongchongchaiharn, 2004). Bishop Pallegoix, arrived Bangkok during the reign of King Rama III described Bangkok as follows:

> The city is located on both sides of the river amidst fascinating yearlong lush greenery. A number of sea vessels anchor in the river…Not a single vehicle can be found in Bangkok. Everybody travels by boat. Even in the center of the city or at a trading neighborhood only once in a while can a brick – covered footpath be found (na Ayuthya, 2004).

The landscape of Bangkok before the Bowring Treaty was divided into three sections by *khlong* and each section are also linked by *khlong*. This system allowed for convenience access to and from Bangkok, which also sponsored the sizable trading community called *"Talad Nam,"* or floating marking (Piyanat Boonnak, 1982). The canal system also linked with the other rivers on both sides of the plain. As *khlong khu meaung* were no longer important for defensive purposes, they were still important for transportation and for daily consumption.

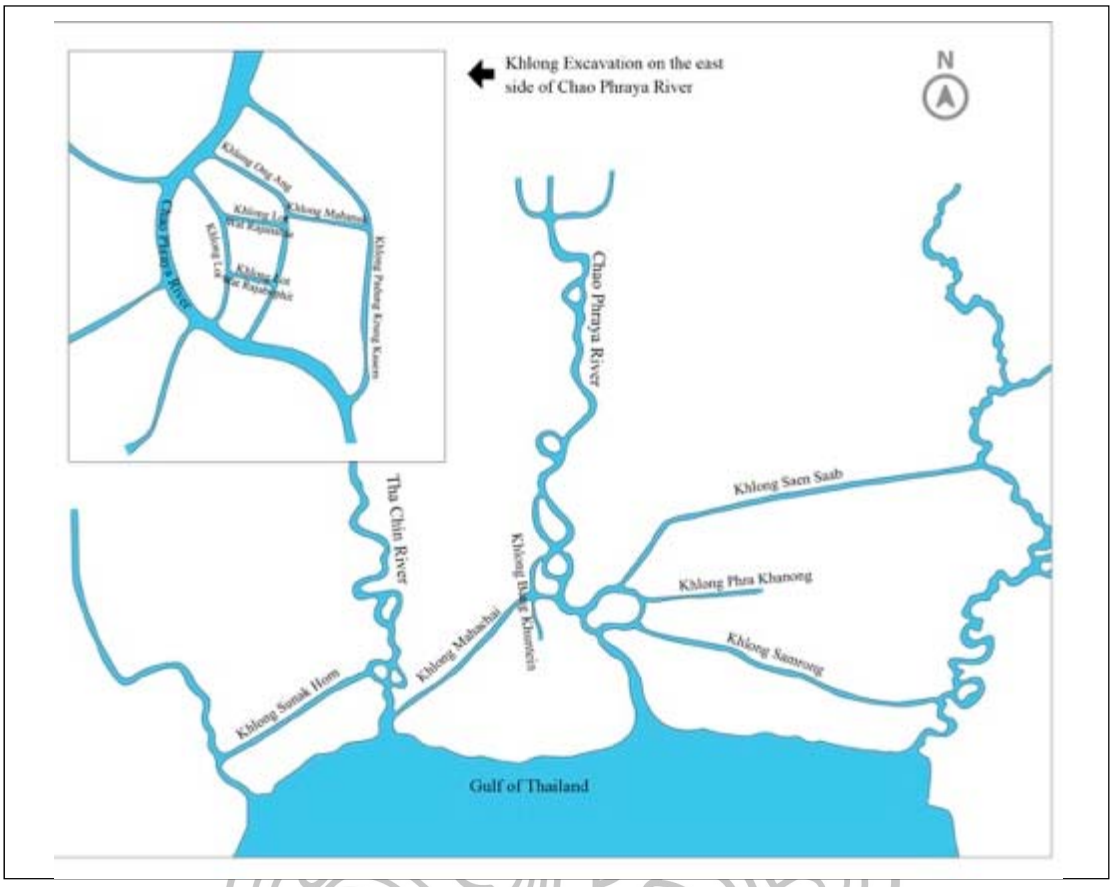



Figure 34 *Khlong Khud* in Rattanakosin before the Bowing Treaty
Source: Adapt from Khlong in Bangkok, Piyanat Boonnak, p.43

*Khlong* excavation in this period was the foundation of the water transportation network to connect to the nearby cities and towns, which make it more effective in both time and distance.

One point to mention is that in that time *khlong* were not intended primarily for drainage. It was characteristic of the plain to have a large amount of water. Despite the advantage for agriculture, however there were also disadvantages. The rivers flooded time to time. There were records of a large flood in 1785, during the reign of King Rama I. The tide was up to 8 feet 10 inches at Sanam Luang. And in October 1819, during the reign of King Rama II, a flood resulted in the famine. During the reign of King Rama III, in 1831, the flood covered the whole area of Rattanakosin. However, the flood did not affect the city since houses were largely elevated from the ground or many, in fact, floated on rafts. Transportation was already

mainly by water. Just the crops and agricultures were difficult to cultivate during flood periods. Also disease, much of it waterborne, became a new factor as well.

**4. Rattanakosin after the Bowring Treaty (1855-1868)**

In the middle of the nineteenth century *khlong* still maintained their use as transportation but served less for defensive purposes, which resulted in the end of construction of *khlong khu meaung*. *Khlong* during this period were made primarily to facilitate the growth of Thailand and Bangkok's economy.

Land on the east bank was further developed for agriculture during this period. Therefore, many new *khlong* were made. During the reign of King Rama IV, to open more land for sugar cane, Khlong Chedi Bucha, Khlong Pasi Chareon, Khlong Damnoen Saduak were made. Later, during the reign of King Rama V, when rice played an important role, more *khlong* were made to expand the rice cultivation area and also to facilitate transportation to the market. Major projects addressing these needs included Khlong Sawat Pream Prachakorn, Khlong Prawet Buri Rom, and Khlong Rangsit. As a result of increased production, Siam harvested more than four million rai of rice (Department of Drainage and Sewerage, BMA, n.d.).

**Bowring Treaty**

The Bowring Treaty was an agreement signed on April 18, 1855 between the United Kingdom of Great Britain and Iceland, and the Kingdom of Siam (Thailand). The treaty was named for Sir John Bowring, the treaty's negotiator and the governor of Hong Kong and Britain's envoy. One article of the agreement, number 8, resulted in a substantial increase in the size and number of *khlong* built during this time. Other articles promoted trade in Siam, with the promise that armaments must be sold to the government and opium must be sold to the opium farmer. Siam government reserved the right to prohibit the export of salt, rice, and fish when these articles were deemed to be scarce. An import tax was fixed at three percent on all articles and the export tax was also fixed. This agreement changed the economy from one of self sufficient to one focused on export. It shifted the economy from monopoly to liberalized trade, a more that helped usher in a new system of economics to currency (Piyanat Boonnak, 1982).

The Bowring Treaty granted extraterritoriality to foreigners in Siam. This measure further attracted the westerners to come and trade in Siam as well as to settle. The trading in and out of Siam was rapidly increasing. The number of cargo ships also rapidly increased. The existing means of water transportation was not enough for this expanded economy.

Bowring Treaty would have profound effects on Thailand, including Bangkok. It further allowed the ways *khlong* would be developed in new directions.

**4.1 Reign of King Rama IV (after the Bowring Treaty)**

**Khlong Tanon Trong**

As the result from the Bowring Treaty, many westerners came to Thailand. The government arranged for most westerners to live in the south of the city, along the east side of Chao Phraya River, making traveling to trade in the city inconvenient. As a result, westerners asked King Rama IV to locate a trading space in the area south of Pak Khlong Phra Khanong to Bangna and made *khlong lat* from Bang Khanak to Khlong Padung Krung Kasem. King Rama IV agreed, as he wanted to support trade and he took advantages of avoid small problems from the foreigners (Piyanat Boonnak, 1982).

Following these initiates, Khlong Tanon Trong was made in 1857, reaching from Khlong Padung Krung Kasem to Phra Khanong. Soil from the land was brought to make a road along the *khlong*, using the same name. The *khlong*'s construction utilized the Chinese wage labors. After the excavation, westerners did not move to this new area as planned (Piyanat Boonnak, 1982). Most preferred to live near the city center. The new *khlong* was also called Khlong Voui Lamporng. In the Reign of King Rama V, Khlong Tanon Trong changed the name to Khlong Hua Lampong.

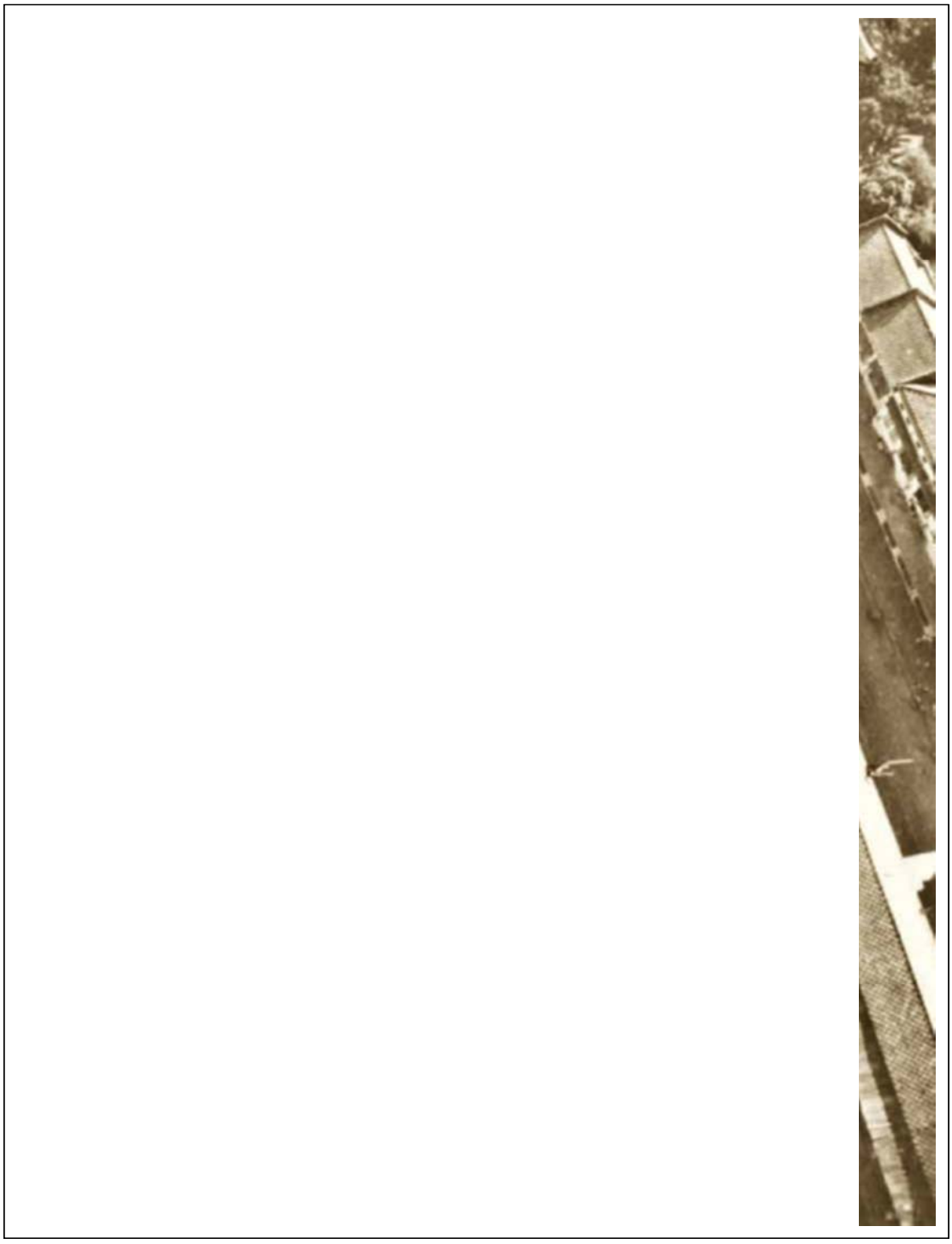


Figure 35 Khlong Tanon Trong when still in use for transportation

Source: Legend of Siam Irrigation, Department of Drainage and Sewerage, p.116.

**Roads and Bridges**

In 1861, the government made Chareon Krung Road and Silom Road, the development long requested by westerners. Khlong Silom was made parallel to the Silom Road during the same time. The government also constructed Bamrung Meaung Road and Fueng Nakhon Road.

As the making of roads was always parallel to the making of *khlong*, bridges were needed to allow for access both. The government solicited contributions to build bridges, approaching members of the royal family, members of the nobility, and local magnates. The feedback was great. The following were significant additions:

1. Phra Chao Luk Thoe Krom Mun Witsanat Niphathon for Damrong Stitya Bridge (Sapan Lhek)

2. Chao Phraya Borom Maha Srisuriyawong for Khlong Padung Krung Kasem Bridge (Pitayasatian bridge)

3. Chao Phraya Pollathep for the bridge at the end of Khlong Bang Rak

4. Phraya Chowdok Ratcha Sattee for the bridge over Khlong Wat Yan Nawa kang Neua

5. Lhuang Maitri Vanich for the bridge over Khlong Wat Lao (Khlong Wat Sutti Wararam) (Piyanat Boonnak, 1982)

This new transportation system was far more convenient for westerners. Bridges were used more than during the early Rattanakosin period.

**Reasons for Making *Khlong***

During this time many *khlong* were made to connect other cities such as Nonthaburi, Makhon Chaisri, Manut Sakhon, Samut Songkram, and Satchaburi. There were many reasons for building *khlong.* One reason was that King Rama IV was interested in visiting other cities, both to worship at significant religious places and to visit his people. Also, *khlong* improved the land and expand the rice cultivation. The water, which was brought in by *khlong*, could be used in people's daily life and also as a means of transportation. Sometimes, when there was not enough rain, people could use water from *khlong* for the rice cultivation as well (Piyanat Boonnak, 1982).

**Khlong Chedi Bhucha and Khlong Maha Sawat**

At the year after the Bowring Treaty, the export of rice did not increase. On the other hand, sugar became an important export product, a development dating to the Burney Treaty enacted during the Reign of King Rama III. The trade in sugar also gave good benefits. During the reign of King Rama III there were no significant increase in *khlong* construction to promote the sugar trading, but there was during the reign of King Rama IV. In fact, new *khlong* were made to support the sugar trade. The land along Nakhon Chaisri River was an important source of cane and sugar. Therefore, Khlong Chedi Bhucha was developed to facilitate the transportation of cane to sugar factory at Nakhon Chaisri River. The date of excavation and finishing is not certain.

In 1860, Khlong Maha Sawat was excavated to link the west bank of Chao Phraya River to the east bank Nakhon Chaisri River (Tha Chin River) and connect to Khlong Chedi Bhucha. The land along the *khlong* was given to the sons and daughters of the king. However, some were too young to manage the land thus the land was managed by representatives and much was left uncultivated, even though the king had exempted the tax.

Khlong Maha Sawat continued to serve for cane and sugar transportation from Nakhon Chaisri River and Khlong Chedi Bhucha to the west bank of Chao Phraya River for trading too.

**Khlong Pasi Charoen**

In 1866, Phra Phasi Sombat Boribun asked that *khlong* be made from Baan Don Gai dee (Donkadi) Samut Sakhon to Khlong Bangkok Yai for the purpose of trade. King Rama IV was not certain that later revenues would cover the cost of the excavation. But Phra Pasi Sombat Boribun suggested that the project not rely on money from government and proposed two ideas. One was to collect the money from the boats and rafts that enter the *khlong.* Another was to establish a gambling place in Nakhon Chaisri and Samut Sakhon for three years to collect the money for the *khlong* construction. And if it cannot cover the cost, the government might then assist. In the end, King Rama IV used money from the opium tax that Phra Phasi Sombat Boribun had to present to him. The King named it Khlong Pasi Chareon. The *khlong* turned out to be an important route for transportation and a link from cities along Nakhon

Chaisri River to Bangkok. Phra Pasi Sombat Boribun also used this route to support his own sugar trading from Don Gai Dee too (Piyanat Boonnak, 1982).

**Khlong Damnoen Saduak**

Towards the end of 1866, Chao Phraya Srisuriyawong was in charge of the Khlong Damneon Saduak excavation. The *khlong* was finished in 1868. Chao Phraya Srisuriyawong put up 80,000 baht and King Rama IV provided 32,000 baht for the excavation of Khlong Damnoen Saduak. Chao Phraya Srisuriyawong's contribution came from the money left over from the money presented by King Rama IV from the local sugar tax for the building of Petchaburi Palace. It was a remarkable idea to show people that tax from their sugar was returned to help the local economy, and a great example for the locals to develop their communities. When the excavation was finished, Chao Phraya Srisuriyawong gave the land along the *khlong* to his wife, siblings, descendants, and liegeman. Other people who wanted land had to pay him money according to the amount of land they want, even though he was not a king and the land ownership was not open to common people prior to the reign of King Rama V. Chao Phraya Srisuriyawong was able to do so because he played an important role to the politics in that time (Piyanat Boonnak, 1982).

Not only did Khlong Damneon Saduak link the Nakhon Chaisri and the Mae Klong River, it also link Khlong Pasi Chareon to the west bank of Chao Phraya River. Therefore, it eased the transportation along the Chao Phraya River, the Nakhon Chaisri River, and the Mae Klong River communities including Rachaburi, Samut Songkram, Samut Sakorn, Nakhon Chaisri, and Bangkok.

**Other *khlong***

There were several final projects during the reign of Rama IV. In 1868, Khlong Banglee, Khlong Lat Ok Yee San, and Khlong Lat Khun were built. The wealthy people requested permission from the king to make Khlong Banglee and Khlong Lat Ok Yee San as their contribution to the community. The government made Khlong Lat Khun as the last *khlong* built during the reign of King Rama IV (Piyanat Boonnak, 1982). As this time, *khlong* were primary constructed to enhance trade as the result of the Bowring Treaty and also exposed new land and made uncultivated land more valued. In 1867, just one year before the end of the Reign of King Rama IV, rice had become the top export products of the country - finally

fulfilling the hopes of the Bowring Treaty. *Khlong* excavations to create more cultivated land became more serious during the reign of King Rama V.

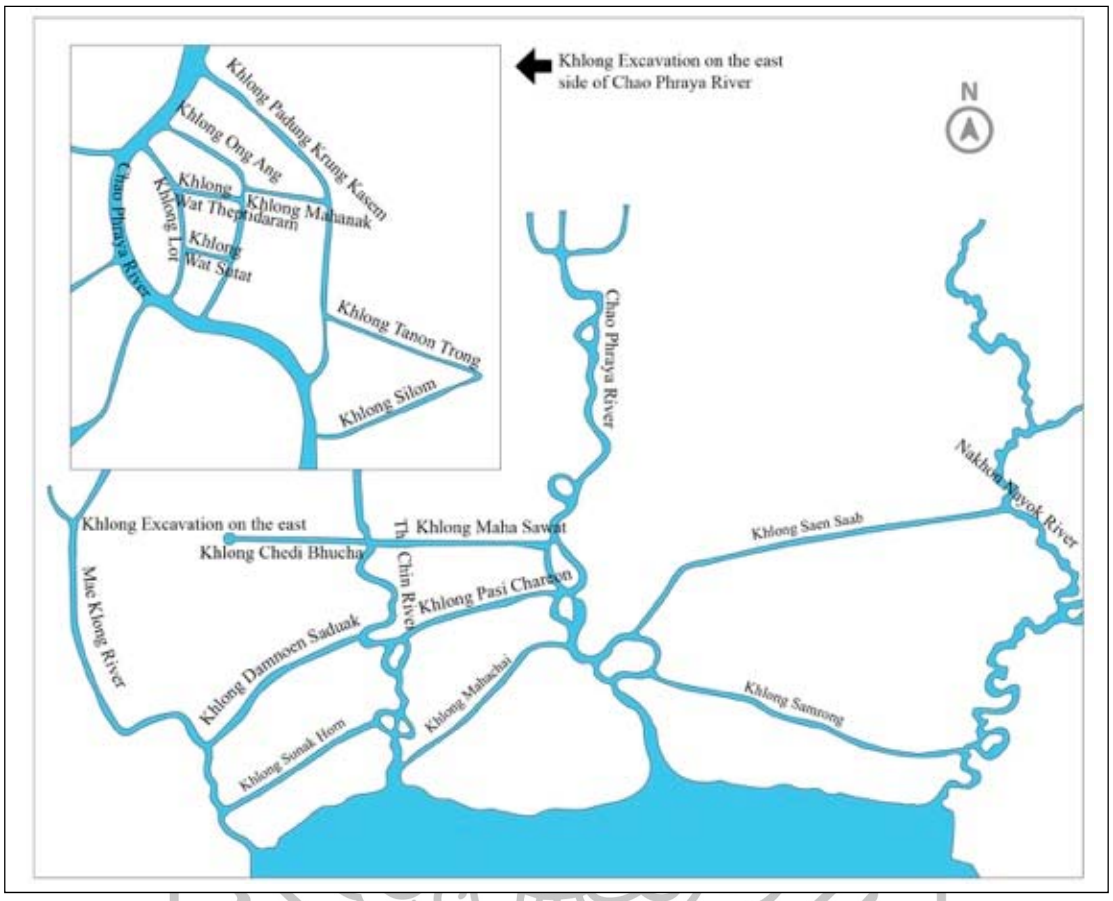



Figure 36 *Khlong khud* in Rattanakosin in the Reign of Rama IV after the Bowing Treaty

Source: Adapted from Khlong in Bangkok, Piyanat Boonnak, p.62

**Water Transportation Acts**

The existing *khlong* used for transportation in the city faced increasingly traffic issues due to large numbers of ships, boats, and rafts, as well as from bad traffic control and poor mooring conditions. These issues affected Bangkok especially. Therefore in 1857, King Rama IV enacted two acts about the water transportation. These were the first acts about water transportation in Thailand. This shows the final steps toward modernization during the reign of King Rama IV (Piyanat Boonnak, 1982).

### 4.2 Reign of King Rama V

King Rama V followed the modernization policy of Rama IV (Piyanat Boonnak, 1982). He was aware of the importance and the need of *khlong* for transportation, trade, and agriculture, as evidenced in a section of his speech, "…*Khlong* are important for the Kingdom of Siam. In each year, at least one *khlong* should be made since it will increase prosperity of the country, Even though it costs thousands and thousands baht, it is worth the investment…" (THAICID, 2002).

*Khlong* during this period were different than the earlier *khlong* in many ways. There was the new use of *khlong* as channels to for water supply, and the adaptation of western technology, including locks, reservoirs, and other innovations. It was during this time that large numbers of *khlong* were constructed and new departments and acts established. The period divides into two phases - the first phase starting from 1870, two years after Rama V's elevation to throne, and up to 1880; and the second phase starting in 1886, up to the end of the king's reign.

King Rama V emphasized the building of *khlong* over the making of roads. As shown above, the first *khlong* to be made during his throne was Khlong Sawadi Pream Prachakorn, built in 1870; the roads would wait until around 1887. The king also enacted the first act about *khlong* in 1870, just two years after the beginning of his reign. The king also ordered the act to be posted in newspaper for all the people to read. The act covered such problems as waste disposal and the mooring of boats and rafts. It stipulated that there be no settlement along the *khlong* to the city wall, limit traffic in the *khlong* and set out rules for the building roads along the *khlong*. The act also called for maintaining the banks and prohibited encroachment of trees into the *khlong.*

A significant reason for *khlong* coming before roads was because King Rama V noted that *khlong* were a traditional mean of transportation. They were accustomed to the people. The making of *khlong* and the maintenance will be easier than the new form of transportation introduced from the west, namely roads. However, there were new establishments of companies for *khlong* excavation and a new government department for managing the *khlong,* which were in fact the result of western influence (Piyanat Boonnak, 1982).

King Rama V was aware that *khlong* were not only of benefit for transportation and trade but also for the rice cultivation. This is due to the fact that from 1867, one year before assuming his crown, sugar in the world market decreased in price. Around that time, the Philippines took over the sugar trading by offering a lower price than Thailand. On the other hand, rice, which was a new export product at that time, had increased in importance according to the demands of the market. The income from the rice export was 3,510,000 baht in 1867; this increased to 6,520,000 baht in 1870 (Tanthai, 1977). Rice export had rapidly increased and rice became the leading export product (Brummelhuis, 2007; Piyanat Boonnak, 1982; Tanthai, 1977). Rice was also the major source of tax revenues (Brummelhuis, 2007). This made King Rama V put the effort in increasing rice production, including increasing amount of land put into the rice cultivation, managing the water supply for rice cultivation, and creating new transportation routes to the market in Bangkok.

The objective of *khlong* construction during the time of King Rama V was for transportation and agriculture and not for defensive purposes as in earlier times. Therefore, the new *khlong* appeared on the east side of Chao Phraya River, because the soil on the east side of Chao Phraya River was more suitable for rice cultivation than that on the west side (Piyanat Boonnak, 1982). *Khlong* projects in the reign of King Rama V involved new *khlong* construction and maintenance of the existing *khlong*, Khlong Prapa (water supply canal).

There were about one hundred new *khlong* built during this era. This included 17 important routes, 48 *khlong* branches of Khlong Rangsit and Khlong Prawet Buri Rom, and the construction of Khlong Udom Chonlajorn. Khlong Tha Kai was a new *khlong* made during the reign of King Rama V too; but there is no documentation of the excavation except in a note in the *History of Agriculture Ministry* (Piyanat Boonnak, 1982). There were many other *khlong*, but there is little documentation of their excavation. These *khlong* were all on the east side of Chao Phraya River. They were Khlong Samsen, Khlong Bang Khun Phrom, Khlong Orchon, Khlong Wat Phra Piren, Khlong Wat Jakrawat, Khlong Wat Sam Jeen (Wat Trimitr), Khlong Meng Seng, Khlong Baan Dokmai, Khlong Wat Somanus, Khlong Tok Tao, Khlong Som Poy, and Khlong Rang Ngeun (Piyanat Boonnak, 1982).

**First Five *Khlong***

The first five new *khlong* in the reign of King Rama V were Khlong Sawatdi Pream Prachakon, Khlong Nakhon Neaung Khet, Khlong Prawet Buri Rom, branch of Khlong Tawee Watana, and Khlong Nara Pirom accordingly. These five new *khlong*, constructed in the first five years of his reign, were made to connect Bangkok with the nearby cities on the north, east, and west (Piyanat Boonnak, 1982).

**End of *Khlong* Construction**

*Khlong* in that time were made for transportation as well as to increase rice cultivation. Hence, when the market price of rice decreased the government also stopped the *khlong* excavation projects (Tanthai, 1977; Piyanat Boonnak, 1982). There is evidence that *khlong* building was strongly related to the rice trade. During the period 1880-1884, the rice market price dropped (Ingram, 1971) and in those years there were no new *khlong* built (Piyanat Boonnak, 1982).

***Khlong* for Rice Cultivation**

*Khlong* excavation started again in 1886 after the rice market price increased again. There were 56 new *khlong*, 12 main *khlong* and other *khlong* branches, built from 1886 to the end of the king's reign. Most *khlong* were constructed on the east or north sides of Bangkok for transportation and expanding rice cultivation. Of this number only four *khlong* were built in Bangkok. They are made with the roads with the same name such as Rachadamri (Piyanat Boonnak, 1982).

During this second phase rice exportation was ascendant and demand for new cultivatable land increased. As a result, land became scarce (Brummelhuis, 2007). But the government did not have enough capital to invest in new *khlong* excavation to accommodate expansion. Hence, the government persuaded wealthy members of the royal family and government officers to invest in *khlong* excavation. In return, the government would give the land ownership along the *khlong* to them. And they would have rights to buy and sell those lands. Unfortunately, there was little interest because the project required a big investment and they were not sure of the return on capital (Piyanat Boonnak, 1982). Nonetheless, some members of the private sector asked for the authorization of two *khlong*: Khlong Lhuang Peng and Khlong Udom Chonlajorn, along with two branches of Khlong Udom Chonlajorn.

Soon afterward, other private investors focused on Phra Worawong Ter Phra Ong Chao Saai Sanithawong, Phra Patibat Rachprasong, Phra Nana Pith Pasi, and Lhuang Sathon Rachayut. Jorachim Grassi, an Italian engineer, was also interested in these projects. Together, investors established the Siam Lands, Canals, and Irrigation Company Limited.

In 1888, the government gave a sole concession the make *khlong* in Siam to the Siam Lands, Canals, and Irrigation Company Limited for twenty-five years. The government had to stop many *khlong* excavations in other cities in order not to contravene the agreement. With the completion of *khlong* Siam Lands, Canals, and Irrigation Company Limited would own the rights of the land along the *khlong*, depending on the width of *khlong* (Piyanat Boonnak, 1982). The company had rights to sell the land, priced by the width of the *khlong* on agreement with the government. From the beginning, the company enjoyed success in making *khlong*, especially Khlong Rangsit and its branches, for a total of 43 *khlong* (Piyanat Boonnak, 1982).

Khlong Rangsit was in Pathum Thani. It was once called Thung Luang but was renamed Thung Rangsit. The *khlong* was made by excavating *khlong* to link the Chao Phraya River with the Nakhon Nayok River as a main *khlong.* The project then constructed a *khlong* network system and regulators and navigation locks to control the water and transportation. The king gave the full name to the *khlong* that is Khlong Rangsit Phrayunsak. It was the first irrigation canal in Thailand (THAICID, 2002).

The Siam Lands, Canals, and Irrigation Company Limited enjoyed a good return but could not make sufficient number of *khlong* to match demand. This resulted in a stasis of Siam's economic growth. Therefore the government decided to change the agreement, which it achieved in 1890. The agreement opened an opportunity for other private agencies to make *khlong* (Piyanat Boonnak, 1982).

Later, the government approved the construction of Khlong Chareon, Khlong Phra Racha Pimon, Khlong Phraya Bunlue, Khlong Sathon, and Khlong Bang Plee Yai, also undertake by other private agencies (Piyanat Boonnak, 1982). In addition, the government made direct investment in Khlong Niyom Yatra, Khlong Rachdumri, and Khlong Pai Singto, as shown in the table below.

Table 3 Table shows different agencies and numbers of *khlong* made

| **Agencies making *khlong*** | **Number of *khlong*** | ***Khlong* names** |
|---|---|---|
| **Government** | 3 | Khlong Niyom Yatra, Khlong Rachdamri, and Khlong Pai Singhato |
| **Private Agencies** | 10 (8 main *khlong* and 2 *khlong* branches) | |
| **Siam Lands, Canals, and Irrigation Company Limited** | 43 (One main *khlong* and 42 *khlong* branches) | Khlong Rangsit (main *khlong)* |
| **Total** | 56 | |

The many new *khlong* excavations resulted not only in transportation, trading, and rice cultivation but also enhanced new communities and settlements. This is most obvious at Khlong Rangsit and its branch. After the excavation, a large number of people moved to the area. The government promoted the area in Thanyaburi in 1901. It was the same with Khlong Prawet Buri Rom and Khlong Udom Chonlajorn. Eventually there was not enough land for settlements, a factor that resulted in the making of other *khlong* branches.

**Khlong Prapa**

Khlong Prapa (water supply canal) was made during this time. Its purpose was to provide an adequate water supply to around 333,000 people during that time (Provincial Waterworks Authority, n.a.). There are three main reasons for making Khlong Prapa in the reign of King Rama V (Puangsomjit, 2006).

First reason was the pressure to develop the country into a modern nation. It was the time when westerners still considered further colonization in the region. Siam was threatened by France and Great Britain and could not maintain independence by the military forces alone but needed to rely on diplomacy (Suwannanon, 1975). One negotiating factor was to become “modern.”

Second, the demands for public utility increased with economics expansion. As many foreigners came to Siam, the number of houses, shops, palace, markets, temples, and communities expanded to the outer city. These were a crucial part of the Thai economy so that these new residents were in a position to make their own demands. These included records of taxes and access to city utilities such as electricity, water supply, roads, and health facilities (Sukhum, 2000).

Third, the densely of people in Bangkok and the high usage of water affected water quality and peoples' hygiene. Dr. Dan Bach Bradley mentioned in the *Bangkok Calendar Newspaper* in 1836 that houses along the *khlong* were densely encroaching into the water, making it easy to throw objects into *khlong. Khlong* gradually became giant sewage systems. Toilets situated along the *khlong* made the water even more dangerous (Piyanat Boonnak, 1982; Puangsomjit, 2006). Excrement migrated with the tides and polluted the eyes and noses. Newly residents used the water for washing and cooking. Cholera epidemics broke out in 1873, 1875, 1881, 1891, and 1900 during the reign of King Rama V (Puangsomjit, 2006).

As a result, King Rama V ordered the Sanitation Department to provide a proper water supply for the city. He provided 3,000,000 baht to the Sanitation Department. He also used western technology. In 1909, bringing an expert from France to conduct a survey and make suggestions on water procurement for Bangkok and initiate the project (Provincial Waterworks Authority, n.a.). The Sanitation Department initially bought the land and established a reservoir at Khlong Chiang Rak in Patum Thani. It then constructed *khlong* and installed water pumps in order to deliver water to the treatment plants in Sam Sen. Steel pipes were installed underground to distribute water throughout the city (Provincial Waterworks Authority, n.a.). The project was completed during the reign of King Rama VI along with the Water Supply Act to make sure that the people would not pollute the *khlong* (Piyanat Boonnak, 1982).

**Grom Khlong**

It was evident that the government needed specific department to manage the use and maintenance of the enormous number of *khlong*. As a result a new "Grom Klong" (Canal Department) was established under the Ministry of Agriculture on 13 June 1902. Homan Van de Heide, a Dutch expert from Java, was

recruited and assigned as the first Director General of *Grom Khlong* (THAICID, 2002; Piyanat Boonnak, 1982; Brummelhuis, 2007). He would be responsible for water resources nationwide. This included the dredging works in Khlong Pasi Chareon, Khlong Damneon Saduak, Khlong Saen Saab, Khlong Ta Gai, Khlong Bang Khanak, Khlong Samrong, Khlong Prawet Buri Rom, etc. Navigation locks were also introduced at *Grom Khlong* to make *khlong* navigable able throughout the year. New canals and locks made between 1904 and 1910 include (Wongsanuprapat, 1941):

Table 4 Table shows the locks made during 1904-1910

| ***Khlong*** | **Numbers of locks** | **Name of locks** | **Cost (baht)** |
|---|---|---|---|
| Khlong Saen Saab | 3 | Sra Patumwan, Bang Khanak, and Ta Khai with additional of a fee station | 243,800 |
| Khlong Pasi Chareon | 2 | Inner Pasi Chareon and Outer Pasi Chareon | 149,000 |
| Khlong Damnoen Saduak | 2 | Bang Yang, Bang Nok Kwak | 149,000 |
| Khlong Prawet Buri Rom | 2 | Phra Khahong and Tha Tua | 181,041 |
| Khlong Samrong | 2 | Samrong and Pak Ta Klong | 181,445 |
| Khlong Bang Hia | 1 | Bang Hia | 581,696 |

### ***Khlong*** Conservation Act Rattanakosin Era 121

The maintenance of existing *khlong* was also an important policy in the reign of King Rama V. The King proclaimed the "*Khlong* Conservation Act Rattanakosin Era 121" for the purpose of preventing *khlong* shallowness and the abusive use of *khlong* (Piyanat Boonnak, 1982; THAICID, 2002). The king also set new rules for vessel transportation and authorized the Minister of Agriculture to collect money from vessels passing for the maintenance *khlong.* This act is still applied up to the present (THAICID, 2002).

**Roads and *Khlong***

Although there were roads made during the reign of King Rama V, there was no filling of *khlong. Khlong* were well maintained in a way to coexist with roads. The king adopted a city planning strategy that insured the *khlong* would continue to benefit urban life. As a result, bridges were needed to link roads and to cross *khlong* that ran parallel to roads. Bridges were an important part of development during this time. They were developed to be both strong and beautiful (Piyanat Boonnak, 1982).

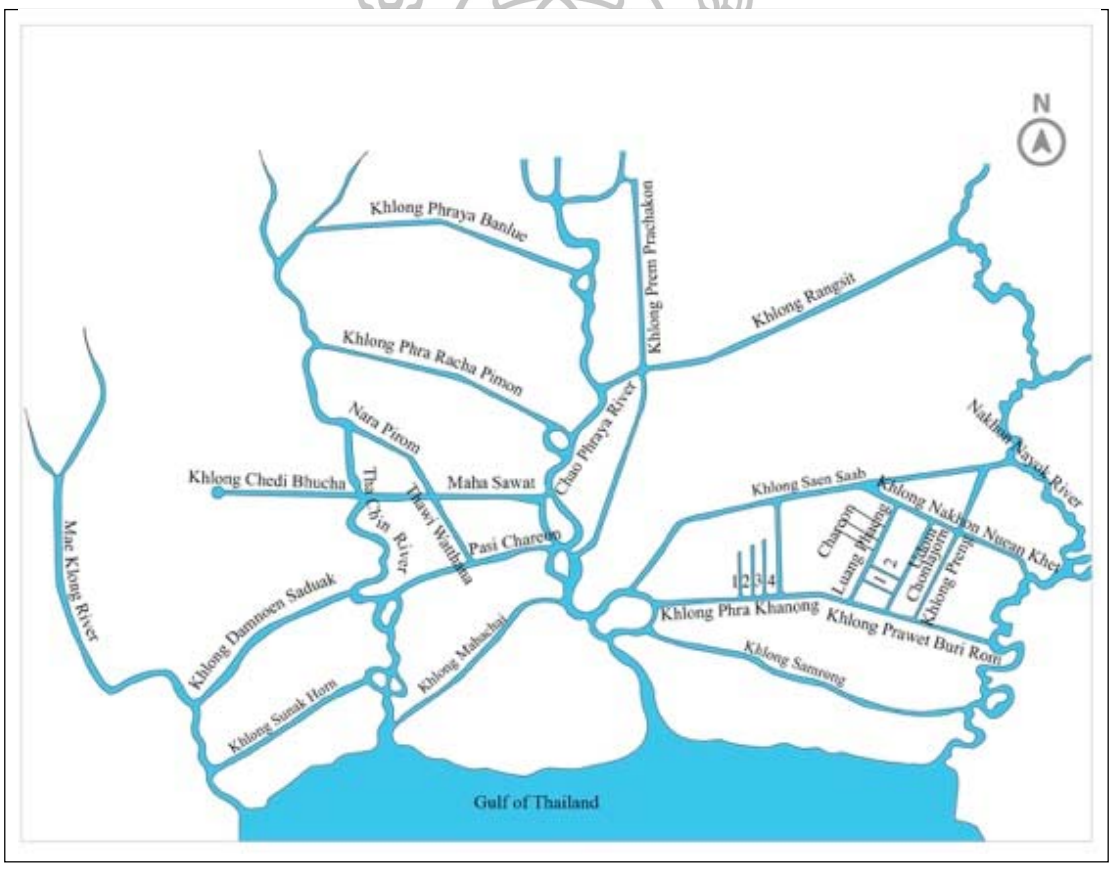



Figure 37 *Khlong Khud* in Rattanakosin in the Reign of King Rama V

Source: Adapted from Khlong in Bangkok, Piyanat Boonnak, p.87

### 4.3 Reign of King Rama VI – Reign of King Rama VII

During the reign of King Rama VI, the *khlong* policy changed dramatically. There was no new *khlong* in Bangkok during this reign (Piyanat Boonnak, 1982). But there were still maintenance of the existing *khlong.*

Maintenances of existing *khlong* were necessary because many were too shallow to use for transportation and agriculture, especially rice cultivation. The maintenance occurred mostly on the west side of Chao Phraya River, such as the 1915 maintenance of Khlong Band Cheung Nhung in Taling Chan, and the 1916 maintenance of Khlong Bang Lanae Yai and Khlong Bang Mod in Bangkhunthein. Work also occurred at Khlong Baan Sai and Khlong Wat Pho in Taling Chan (Piyanat Boonnak, 1982).

Drought continued to be a problem and rice cultivation was damaged. The king therefore appointed a committee lead by Luang Ratcha Buri Direkrit of the Ministry of Agriculture to solve the problems and to request technical assistance from the government of Great Britain (THAICID, 2002). Later Sir Thomas Ward, a British expert, purposed several irrigation projects. These consisted of subprojects that could be done one by one. This strategy allowed for gradual financial support. These subprojects are as follows (Piyanat Boonnak, 1982)

1. Scheme of South Prasak
2. Scheme of Supan
3. Scheme of Chiang Rak and Bang Hia
4. Scheme of Nakhon Nayok
5. Scheme of North Pasak

Problems of *khlong* also affected the people in everyday life. Even though water supply was improved it did not cover the whole city. Most was limited to Sampeng and nearby areas. These were also problems with the city's drainage system and supply of water in case of fire (Piyanat Boonnak, 1982).

Several *khlong* were constructed outside of Bangkok during this time but not inside Bangkok. Inside Bangkok the work on *khlong* was more involved with solving the problems of *khlong* encroachment, water quality, and the shallow of *khlong*, which increased day by day. Some *khlong* were shallow to the point that boats could not pass. The approach to problems changed during this period. This including not dredge *khlong* as before but filling them instead. This is due to the fact that the

government increasingly put roads ahead of *khlong.* This was in large part a response to the growing number of automobiles. The record shows 251 cars during the reign of King Rama V and just two years after the throne of King Rama VI the number increased to 622 private motorcars, 347 of hire car, and 2,698 of *rod-lark* (cart) (Piyanat Boonnak, 1982). And another factor was that people desired access to roads more than the often dirty and smelly *khlong.* As land prices increased, the owners of land pressed for the filling of more *khlong*.

The problems of *khlong* affected Bangkok in many ways. This included changes in transportation, which eventually affected trade as well. Even though the number of cars increased, automobiles were not sufficient to use for all trading transportation. Therefore in getting goods to Bangkok, people had to use many means of transportation, resulting in increases in delivery cost prices.

From the reign of King Rama VI, *khlong* decreased in importance but there were still some *khlong* in use. As land transportation was developed, bridges were needed. During the reign of King Rama VI included a series of "Chareon Bridge." They were Chareon Rat 31, Chareon Rach 32, Chareon Pas 33, Chareon Sri 34, Chareon Tas 35, and Chareon Sawat 36. Other projects included the construction of Racha Thewi, Urupong, Ubon Rat, Chang Rong Sri, Moo, Mon, Saowanee, Thai Utit, and Phra Ratcha Wang Suan Jitr Lada bridges (Piyanat Boonnak, 1982).

During the reign of King Rama VII, the problems of *khlong* and solutions to these problems were almost the same as in the reign of King Rama VI. No new *khlong* excavations or dredging occurred in Bangkok. Shallow *khlong* were filled to create roads. Only some maintenance of *khlong* was done outside of the city.

There were also new bridges connecting the west and east banks of Chao Phraya River. The Rama VI Bridge was built during the reign of King Rama VI. Phra Putta Yodfa Bridge was built in the reign of King Rama VII, on the occasion of the 150$^{th}$ anniversary of the establishment of Bangkok (Tungchontip, 2007). These connections enhanced the rapid development of the west bank of Chao Phraya River. These resulted in ten roads on the west banks during the reign of King Rama VII.

It had been shown that from the time of the reign of King Rama VI *khlong* decreased in importance in the city. In contrast, roads increased their role. During the reign of King Rama VII, many roads were made on both the east and west sides of Chao Phraya River. On the east side roads were made for the existing communities for

daily use. On the west side there were ten new roads made for transportation and to expand the city. Phra Phutta Yodfa Bride was the first land connection between the west and east banks of Chao Phraya River (Piyanat Boonnak, 1982).

### 4.4 The National Economic and Social Development Plan

After the World War II, the world, including Thailand was faced enormous economic problems. At the suggestion of the World Bank, the Thai government developed a National and Economic and Social Development Plan (Yothasmutr, 2008). The first National Economic and Social Development Plan was implemented in 1961-1966.

Before 1961, Thailand faced poverty and a lack of basic facilities. Therefore, the first National Economic and Social Development Plan emphasized economic growth by developing the industry and promoting private investment. It also focused on infrastructure development, such as transportation, energy, irrigation, etc. to support the growth of industry and the well being of the people.

## 5. Conclusion

The history of *khlong* in Bangkok dates back to the time of Ayutthaya. Since that time *khlong* have played an important role in Bangkok. *Khlong* history has reflected different influences, forces, and concerns of the city in many aspects.

The Khlong Lat Bangkok excavation during the reign of Phra Chaiyarajadhiraj, in the Ayutthaya period, is one of the most important changes made to the landscape that created Bangkok. The new convenient waterway course played an important role or the growth of Ayutthaya as well as the development of Bangkok from a small fishing and agriculture community to a tollgate and major shipping route and later a capital city of Thailand.

At the time of Thonburi and early Rattanakosin when Bangkok was established, *khlong* were used as an important element for city planning, including the use of transportation, city boundary, defensive and military purposes, communication, resources of water, and as a tool in expanding the city. There were some *khlong* used for the joy of the people as well, such as Khlong Mahanak. The idea of hydraulic management during this time derived from the city's predecessor, Ayutthaya. *Khlong* also made the people feel at home, following the tragedy of the war. Chinese labor for *khlong* excavation was introduced toward the end of this period, during the reign of

King Rama III. This time *khlong* reflected the strong relationship of people in Bangkok and water, just as in Ayutthaya.

Later during the reign of King Rama IV, as the city expanded, the idea of *khlong khu meaung* was still applied, but never really used. As the era of western colonization approached the region, the technologies of the westerners were too advanced for *khlong khu meaung* to effectively protect the city. Therefore, Khlong Padung Krung Kasem made during this time, would be the last *khlong khu meaung* made in Bangkok and Thailand.

After the Bowring Treaty in 1855, *khlong* were mainly made to support the growth of agriculture, at first sugar cane and later rice cultivation. *Khlong* were made to open more land for agriculture, especially land on the east bank, as well as to facilitate the transportation for trading those products. Western technologies were used to excavate *khlong.* Krom Khlong was undertaken by a Dutch expert, Homan Van de Heide, who was assigned as the first director of the national canal organization. Western ideas started to influence the water management.

*Khlong* enjoyed a golden age up until the shift of water to land around the reign of King Rama VI. Following this time, there were no new *khlong* excavations in Bangkok. Maintenance of *khlong* was not always dredging like before. When *khlong* faced too many problems, filling was the solution. It was “time of decline” for *khlong.*

The focus on economic growth with the National Economic and Social Development plan also changed management of the city and the approach to *khlong.* Many roads were made. Water resources from Khlong Prapa were widely expanded. People moved into Bangkok, with a resulting increase in population. More wastewater also was distributed to *khlong.* Gradually, people started to face away from *khlong.*

*Khlong* have been both on the rise and fall from the beginning of Bangkok. The function and form of *khlong* change according to city’s context and the needs of the city. *Khlong* were an important element of the city at the beginning. These were also important in the time of trading. Then eventually lost their importance as a result of the shift of water to land and increasing promotion of industrial development. Less maintenance and recognition resulted in regression. The current condition of *khlong* is described in the next chapter.

## Chapter 4

## Current *Khlong* in Bangkok

Despite their longtime neglected, *khlong* continue to have their special characteristics and role in Bangkok as well as other important impacts on everyday life. Each *khlong* has its own history, development, and changes, all of which result in their current state. Some characters are shared, and some are unique.

The importance of *khlong* has decreased since the reign of King Rama VI. With the filling and paving of *khlong* to provide roads following the first National Economic and Social Development Plan of 1961-1966, few *khlong* are left compared to the status they once had in history of Bangkok. Some *khlong* became drains for sewerage. Houses once open to *khlong*, which served also as a transportation system, now faced roads. In general, people and the city turned their back on *khlong.* As a result, the focus of development and maintenance was not on *khlong. Khlong* essentially became a source of pollution in the city, complete with the bad smell from the water, the floating waste, and bad water quality. They were not asset for the city.

This chapter looks at the current condition of *khlong* in Bangkok today. It demonstrates that even with modernization and the rise of land transportation, many *khlong* are still intact and posses water-based character. *Khlong* still support ways of life, vernacular architecture, and agriculture communities.

The chapter begins with a brief look at Bangkok and the Chao Phraya River. It then looks at *khlong* in terms of their numbers, size, lengths, patterns, physical appearance, uses, and agencies involved in their maintenance and repair.

### 1. Background Information of Bangkok

#### 1.1 Location

Bangkok is the capital of Thailand. It is also the center of the country. The city is located at latitude 13.45° North and longitude 100.28° East. It comprises the area of 1,568.75 square meters.

The city is defined by its bordering provinces. At the north are Nonthaburi and Patumthani. On the east is Chachengsao. On the south are Samut Prakarn and Gulf of Thailand. West are Samut Sakorn and Nakorn Pathom.

**1.2 Geography**

**Land**

Bangkok is located on a flat plain. Its elevation is 1.50 - 2 meters above the sea level. The land gradually slopes down to the Gulf of Thailand in the south. Alluvium has formed a delta, which is a part of the lower plain of Thailand. The land is exuberant, suitable for agriculture such as rice field and other plants (Bangkok Agricultural Extension Office, n.d.).

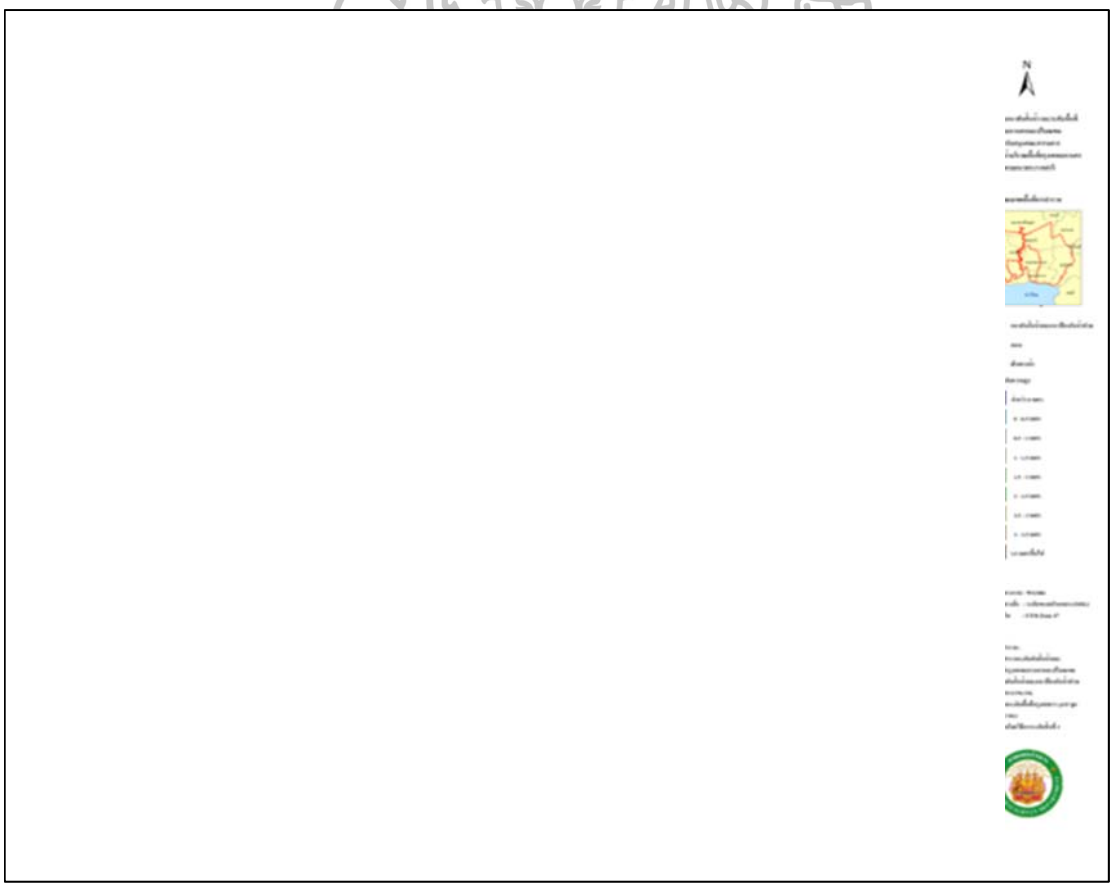


Figure 38 Map showing the level of land

Source: Accessed January 30, 2016, Available from http://www.unigang.com/Article/8911.

**Chao Phraya River**

The Chao Phraya River crosses and divides the city in to two banks, Phranakorn and Thonburi. The water from Chao Phraya River extends into both banks via *khlong lhak* (main canals), built originally for people's consumption and agricultural activities.

The Chao Phraya River, which is the origin of *khlong* in Bangkok, was also affected from the shifting from water to land. At the time that water was the main means of transportation, the shape of Chao Phraya had already changed due to *khlong lat* excavations. The current course of the river is shown in the following figure. The river's form influenced new routes and new settlements. With the rapid development of Bangkok, the Chao Phraya River was not the same. This applied not only to the course of the river, but the atmosphere of the river, the water quality, and much more, given its importance to the city.

Chao Phraya water was used extensively for daily consumption and economically to support the rapid growth of the city and amount of its population. Also, as agriculture and industrial development sped up, there was no earlier plan for the impacts in the long term. These now include the flooding, drought, water quality, brackish water, land subsidence, and many conflicts in the use of water.

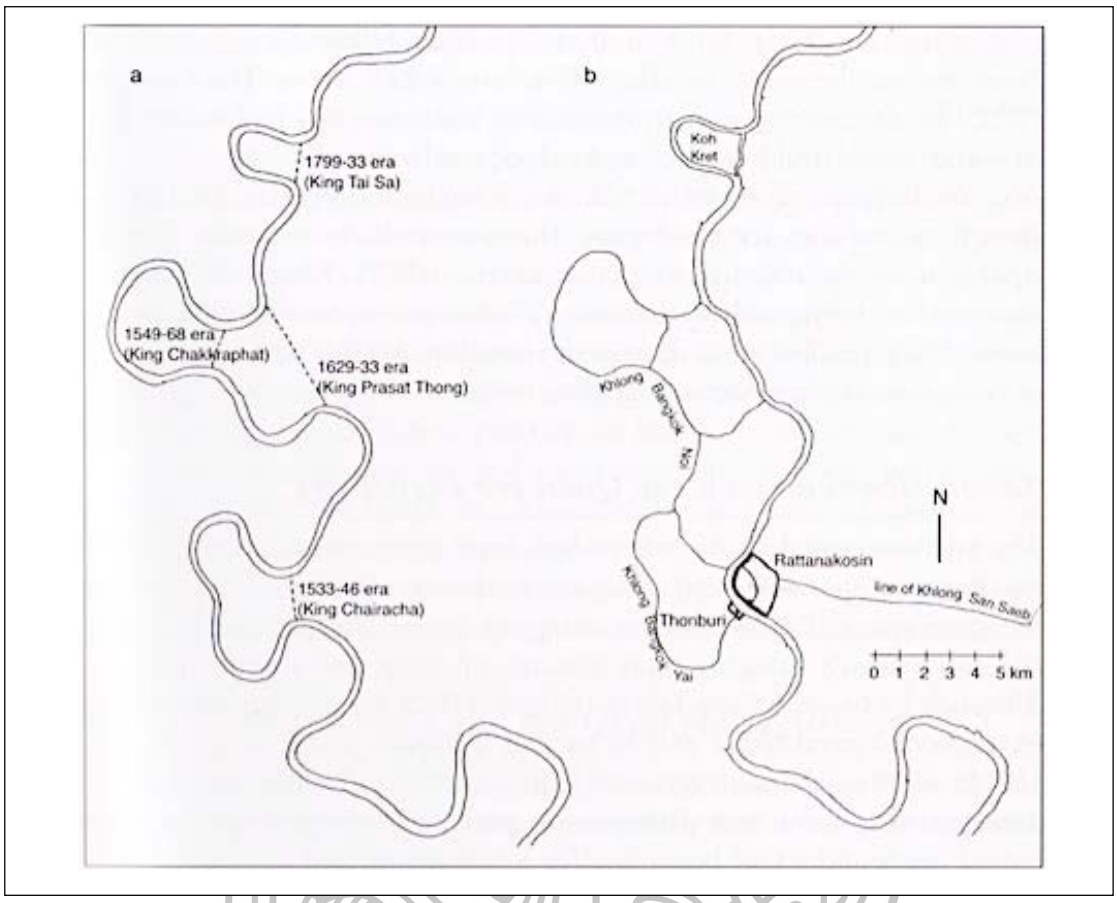



Figure 39 Chao Phrayra River: (a) the course prior to 1534 and subsequent excavation; (b) the present course

Source: Reading Bangkok, Ross King, p.3

**Climate**

Bangkok's climate is a humid tropical climate. It is influenced by two types of monsoon, the Northeast Monsoon and Southeast Monsoon. The monsoon allows for three seasons: summer, rainy season, and winter. Summer is from February to April. Rainy season is from May to October. And winter is from November to January. The average temperature taken in 2002 was 29.2 degrees Celsius. The highest average temperature is 38 degrees Celsius. The lowest average is 19.2 degree Celsius (Bangkok Agricultural Extension Office, n.d.).

Relative humidity in Bangkok is high throughout the year because of the city's location near the Gulf of Thailand. In 2002, the average humidity was 73 percent (Bangkok Agricultural Extension Office, n.d.).

### 1.3 Political

Bangkok is divided into 50 districts, 2,008 communities.

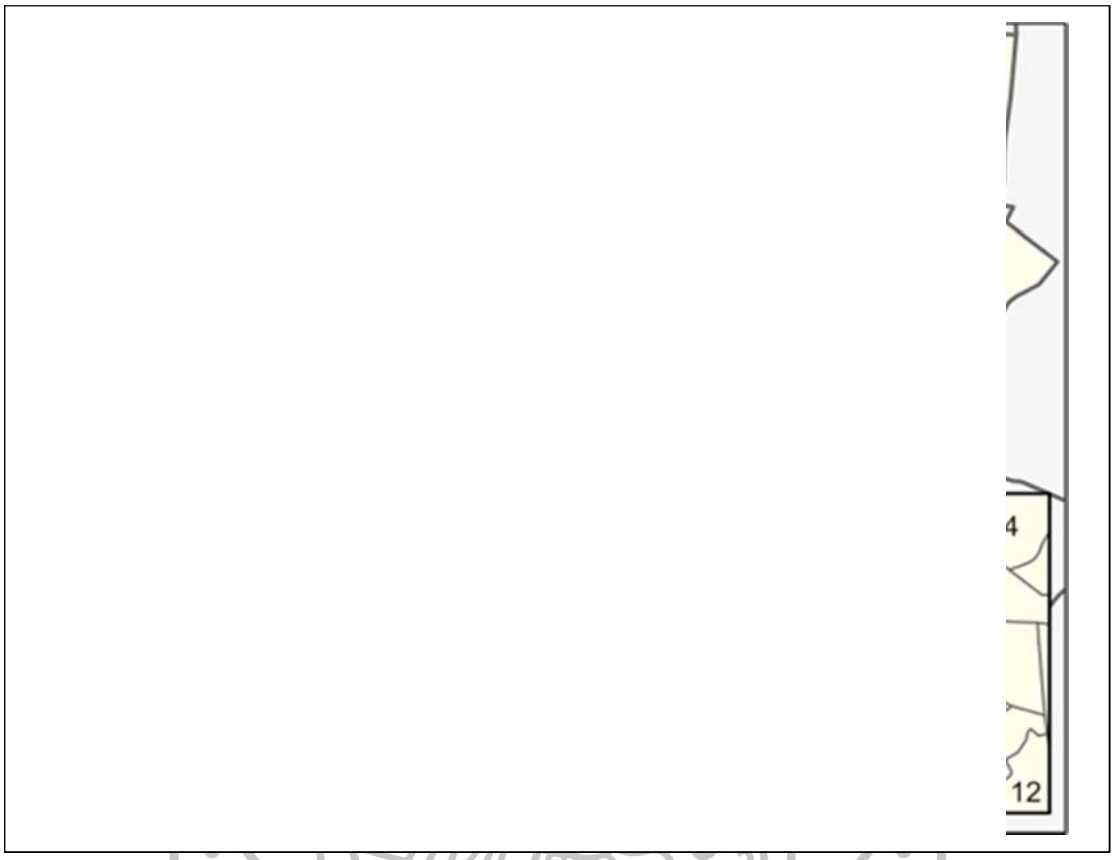



Figure 40 Map showing the 50 districts of Bangkok
Source: Accessed January 30, 2016, Available from http://en.wikipedia.org/wiki/List_of_district_of_Bangkok on.

## 2. Physical

### 2.1 Numbers, Size, Lengths, and Depth

*Khlong* in Bangkok vary in size, length, and depth. According to the information given in the Department of Drainage and Sewerage website there are 1,161 *khlong* and 521 *khu/ lamrang/ lamkradong* in Bangkok, with the total length of 2,604,032 meters. There are 512 *khlong* on the east side of Chao Phraya River (Phra Nakhon) and 649 *khlong* on the west side of Chao Phraya River (Thonburi). The responsible agencies are shown in the following table (Department of Drainage and Sewerage, 2010).

Table 5 Number and total length of Bangkok's *khlong, khu, lamrang,* and *lamkradong*

| Responsible agency | *Khlong* | | *Khu, lamrang, lamkradong* | |
|---|---|---|---|---|
| | Number | Length (meter) | Number | Length (meter) |
| Department of Drainage and Sewerage | 213 | 952,790 | 5 | 7,780 |
| Other District Office | 948 | 1,319,520 | 516 | 323,942 |
| Total | 1,161 | 2,272,310 | 521 | 331,722 |

Source: Available from http://203.155.220.231/klong2553/klong01.pdf

The longest *khlong* in Bangkok is the Khlong Sean Saab. It is about 90 kilometers long and is divided into two parts; originally the *khlong* stretched from Khlong Maha Nag to Hua Mak and from Hua Mak to Bang Pagong River. Because it runs across the city, the *khlong* is currently used as a secondary transportation route across the city on the east bank of Chao Phraya River.

Size of *khlong* in Bangkok can range from as small as 1 meter to about 80 meters (Department of Drainage and Sewerage, 2010). Many *khlong* in the city has been encroached upon and the overall size has become smaller than in the past.

Figure 41 Khlong Saen Saeb
Source: Dolruthai Jiarakul, 2015

**2.2 Water Quality**

Since the 1960s, Bangkok's development has focused on economic growth. The transportation system, by this period was on land. There were new roads made. *Khlong* were used for drainage. Infrastructure, such as Khlong Prapa reduced the importance of *khlong* as a water resource. Too much wastewater added to the *khlong* resulted in water pollution.

Bangkok was expanding continuously and producing an enormous amount of wastewater to the river and *khlong.* In 2012, the water usage in Bangkok amounted to 2.419 cubic meters (Metropolitan Waterworks Authority, 2013), while the wastewater capacity was 1,016,800 cubic meters per day, which was 42.02 percent of the total usage (Department of Environment, Bangkok Metropolitan Administration, 2013). This resulted in water pollution in many *khlong.* The dissolved Oxygen (DO) of *khlong* is below 1 mg/l but different in areas. The BOD of most *khlong* on the west bank of Chao Phraya River is between 4 – 10 mg/l. For the inner

and middle area of the east bank the BOD is more than 10 mg/l. In some high population areas, the BOD is up to 30 – 50 mg/l (Strategy and Evaluation Department, 2012).

Solid waste in Chao Phraya River, which is the responsibility of the Department of Environment, is about 18 tons per day. It starts from Rama VII Bridge to Bangna and extends a total distance of 34 kilometers. The department uses 50 small boats and 9 large boats (Paengie, 2015). The district offices are individually responsible for waste collection along the *khlong* in their district (Department of Environment, Bangkok Metropolitan Administration, 2013).

Figure 42 The polluted *khlong* in Bangkok
Source: Accessed December 24, 2015, Available from http://bkkcanalcare.com/about2.php

**3. Special Type of *Khlong***

**3.1 Historic Site**

Fine Arts Department lists 21 *khlong* in Bangkok as historic sites (Fine Arts Department, n.d.). They are Khlong Khu Meaung Thonburi, Khlong Dan, Khlong Ton Sai, Khlong Nakhonban (Khlong Wat Chaeng), Khlong Bang Yee Khan, Khlong Bang Lamad, Khlong Bang Lampu Lang, Khlong Bang Sakae, Khlong Bang

Sai Gai, Khlong Prapa, Khlong Pream Prachakon, Khlong Pasi Chareon, Khlong Mahanak, Khlong Maha Sawat, Khlong Mon, Khlong Maenam Aom, Khlong San, and Khlong Saen Saeb (Fine Arts Department, n.d.).

The list of individual *khlong* does not include the present course of current Chao Phraya River, which was once a *khlong* lat. This is the most significant *khlong* in Bangkok. It is the origin of Bangkok and has continued to be an important part of the city. But unfortunately, it is not yet listed in the Historic site in Ancient Monuments, Antiques & National Museums Act. So, Historic site in Ancient Monuments, Antiques & National Museums Act does not protect it.

**3.2 *Khlong* Listed in Ancient Monuments, Antiques & National Museums Act**

Three out of the above 22 *khlong*, Khlong Khu Meaung Derm, Khlong Rob Krung, and Khlong Padung Krung Kasem, are listed as national Historic Site under the Ancient Monuments, Antiques & National Museums Act, issue 93, section 68 on 29 April 1976 by the Fine Arts Department. These three *khlong* share a primary purpose serving the city as *khlong khu meaung* (moat).

Figure 43 Khlong Khu Meaung Derm with concrete embankments and walkways along the *khlong* next to road

Source: Dolruthai Jiarakul, 2015

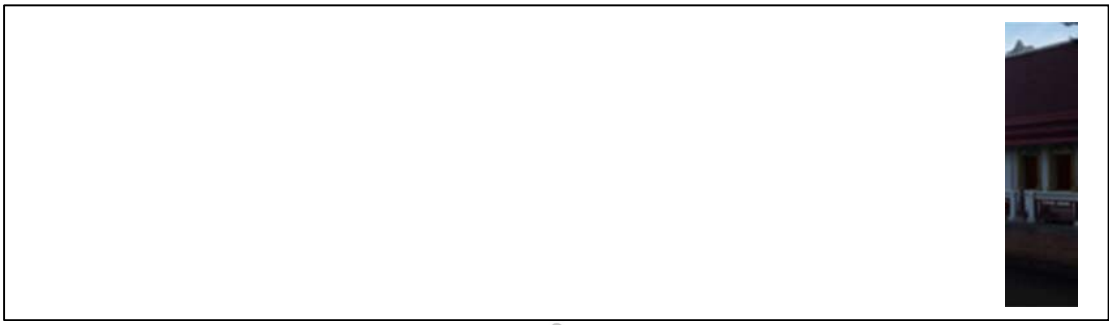


Figure 44 Khlong Bang Lampu, a section of Khlong Rob Krung with walkways along the *khlong*

Source: Accessed December 22, 2015, Available from http://www.tripadvisor.com/LocationPhotoDirectLink-g293916-d7084940-i113249907-Pipit_Banglamphu_History_Museum-Bangkok.html#111298208,

Figure 45 Khlong Ong Ang, a section of Khlong Rob Krung with walkways on each bank from the removal of Talad Sapan Lhek in 2015.

Source: Accessed December 22, 2015, Available from http://www.posttoday.com/analysis/report/401898,

Figure 46  Khlong Rob Krung (Khlong Ong Ang and Khlong Bang Lampu
Source: Dolruthai Jiarakul, 2015

Figure 47 Khlong Padung Krung Kasem
Source: Dolruthai Jiarakul, 2015

Existing *khlong* in Rattanakosin are Khlong Khu Meaung Derm, Khlong Rob Krung, Khlong Padung Krung Kasem, Khlong Mahanak, the two Khlong Lot, Khlong Lot Wat Rachanadda and Khlong Lot Wat Rachabopit, and Khlong Suan Lhuang. Three *khlong* are listed in the Historic site under Ancient Monuments, Antiques & National Museums Act. They are Khlong Khu Meaung Derm, Khlong Ong Ang, and Khlong Padung Krung Kasem (Division of Policy and Planning, Department of City Planning, 2011). These three *khlong* possess significant historical value for Bangkok. They were made originally for defensive use. They are all currently well maintained.

### 3.3 *Khlong* Filled or Covered by Roads

As transportation shifted from water to land, many *khlong* were filled, paved, and covered. One good example is Khlong Sathorn. Khlong Sathorn was built during the reign of King Rama V. It was named after Lhuang Sathorn who initiated the method of using soil from *khlong* excavation to make roads and sell the land along the *khlong.* Later, because the decline of *khlong,* a road was built on the *khlong.* The *khlong* could not be accessed anyway. It cannot be seen from the cars users either.

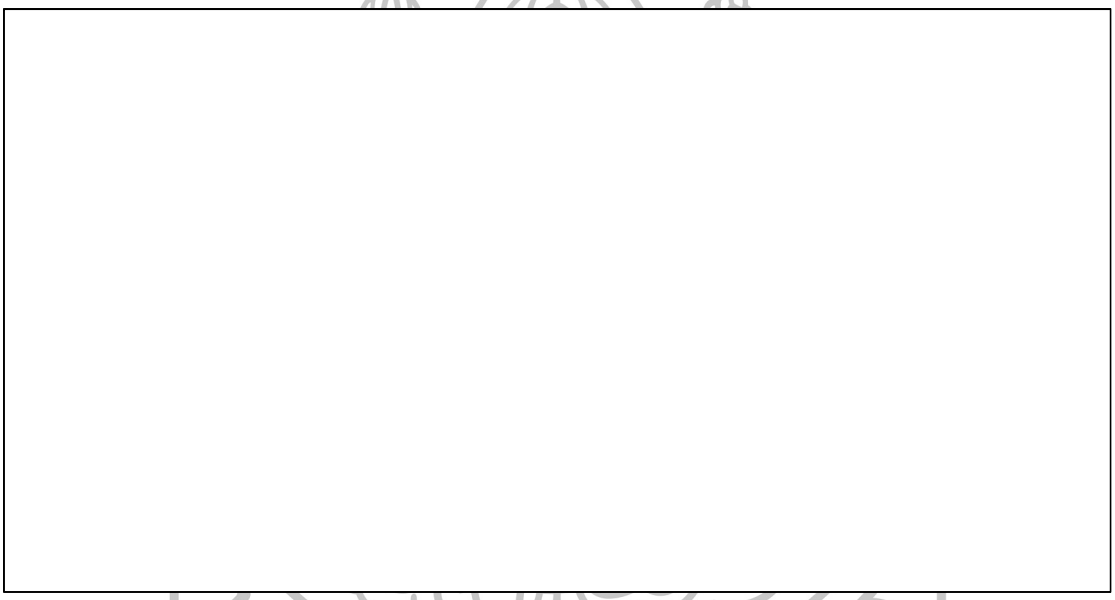


Figure 48 Khlong Sathorn in the old days
Source: Centennial Memorial of Bangkok, Pitrpreecha, S. V., p.39.

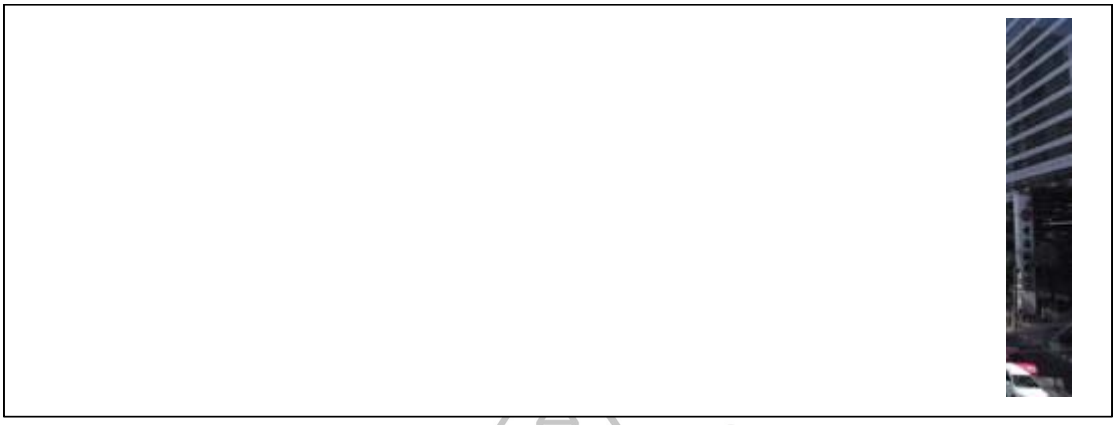


Figure 49 Khlong Sathorn view from the bridge
Source: Dolruthai Jiarakul, 2015

Figure 50 Khlong Sathorn view from the road
Source: Dolruthai Jiarakul, 2015

**4. East and West Banks**

Most *khlong* on the west bank of Chao Phraya River is natural waterways while the east are more man-made *khlong.* The communities on the west bank are more fruit orchards. *Khlong* on the east bank of Chao Phraya River are more urban. The management of the east depends much on the use of water gate.

There are also *khlong* with traditional style of water-based settlement in Bangkok, where houses are built directly in the water or along the banks of the rivers

or *khlong*. These types of *khlong* can still be seen both in the city and in the suburbs. The orientation of traditional houses is typically open to the water with traditional frontage. The normal order is pontoon, stairs, sala (pavilion), and verandah. Some houses still possess the complete set of elements of traditional vernacular houses and some do not.

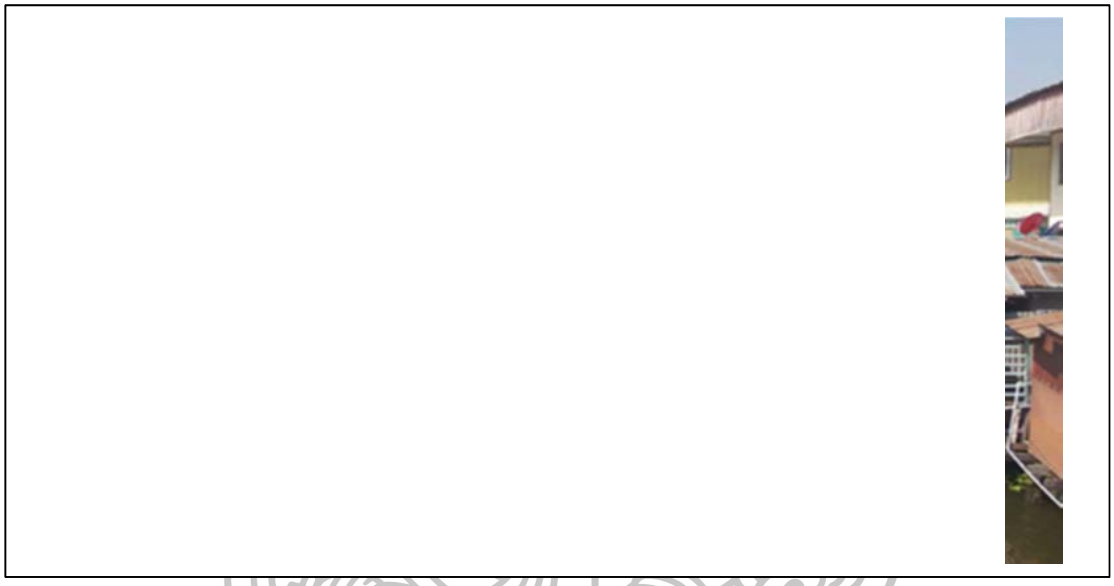


Figure 51 Khlong Bang Ramad
Source: Dolruthai Jiarakul, 2015

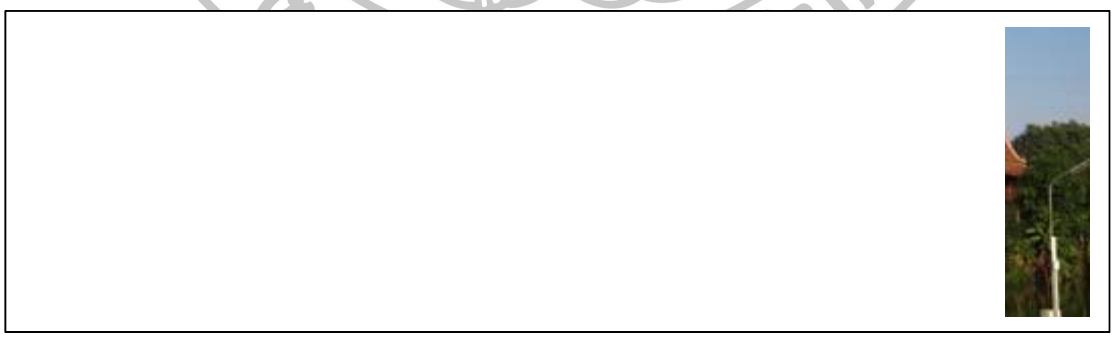


Figure 52 Khlong Don Meaung and the houses along the *khlong*
Source: Accessed December 29, 2015, Available from http://www.jakayanrides.com/gallery/bangkok/20150112-exploring-don-meaung-canals.

*Khlong* in areas with less population typically have more green area. They are mostly found in the suburb areas.

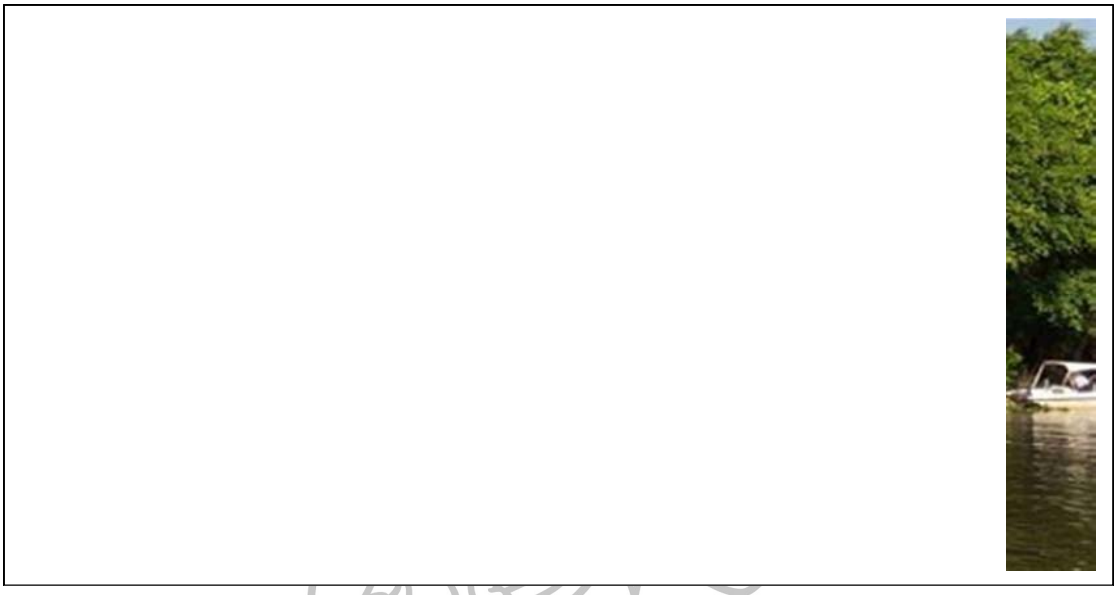


Figure 53 Khlong Lam Pla Thiew
Source: Dolruthai Jiarakul, 2015

**5. Pattern from the Influence of Westerners**

The pattern of *khlong* changed dramatically after the Bowring Treaty. The development of *khlong* during Rama V was for agriculture and shows a far more ambitious character in comparison to *khlong* in the previous time. *Khlong* built during this period were made for agriculture and irrigation use, following western ideas. This development was mostly carried out on the east side of the city. The new canals were more linear, compared to the previous existing *khlong* pattern, as shown in the figure 54.

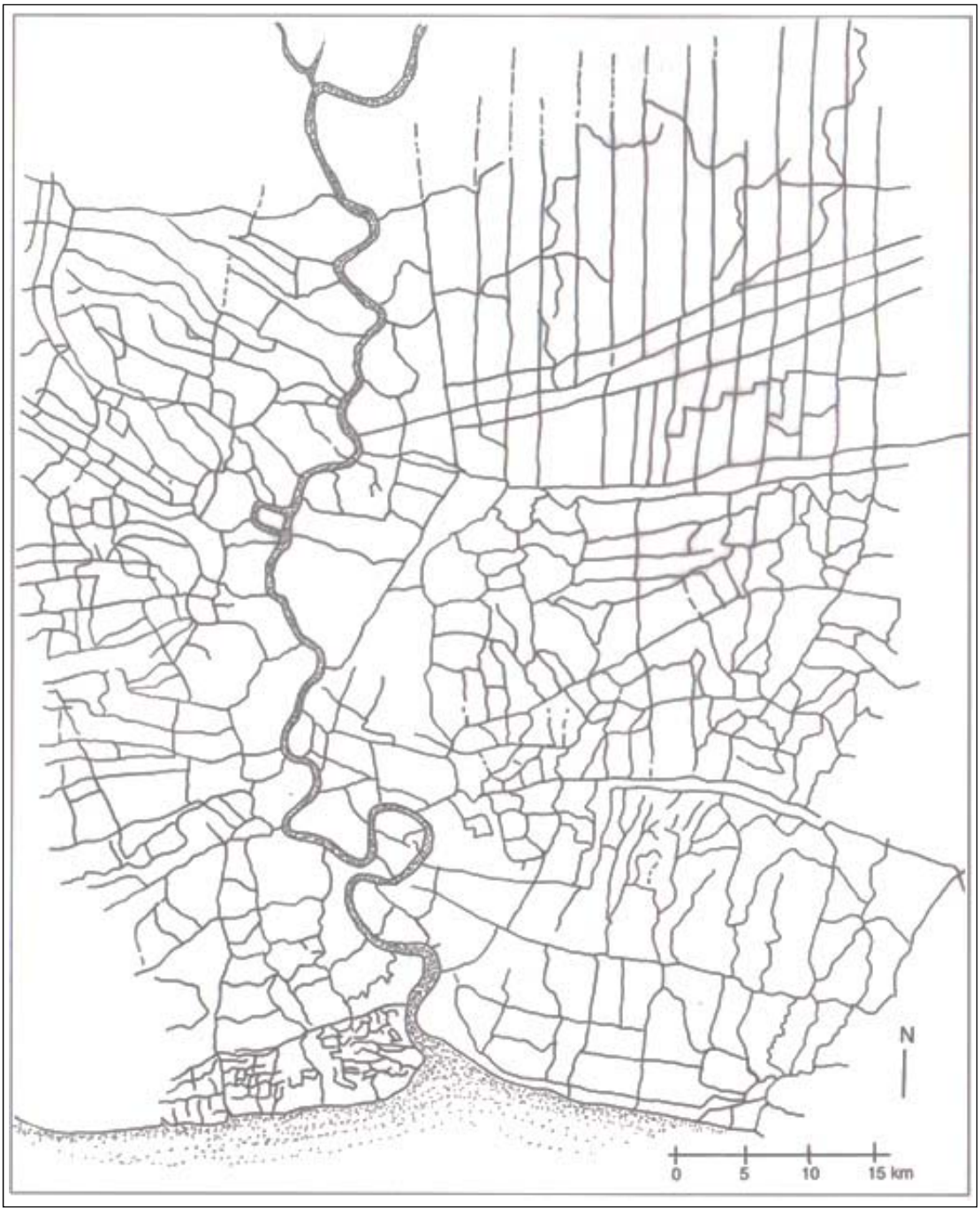



Figure 54 Contrast pattern of *khlong,* which was built during Rama V

Source: Reading Bangkok, Ross King, p.60

**6. Landscape Development and Infrastructures**

**Concrete**

An important point to mention is that many *khlong* have concrete banks, both along their course and connected to both sides. These make for strong banks but boats cannot pass. This has repercussion for the future opportunity of using boats along these *khlong.* Many small *khlong* are in this condition. And, some *khlong* are dry, with almost no water.


Figure 55 Khlong Wat Sang Krachai
Source: Dolruthai Jiarakul, 2015


Figure 56 Khlong Bang Sai Kai
Source: Dolruthai Jiarakul, 2015

Figure 57 A section of Khlong Wat Sang Krachai with almost no water
Source: Dolruthai Jiarakul, 2015

**Walkways and Bicycle Lanes**

There are a number of *khlong* with walkways or bicycle lanes. These are in both suburbs and in the city. Orientations of structures along this category of *khlong* vary. For most *khlong* in the suburban areas, structures tended to be oriented to the water, while in the city there are examples both oriented to water and not. Examples are shown in the following figures.

Figure 58 Khlong Saen Saeb with walkways or bicycle lanes along
Source: Dolruthai Jiarakul, 2015

Figure 59 Khlong in Tao Poon Area

Source: Accessed December 29, 2015, Available from http://www.jakayanrides.com/gallery/bangkok/20150503-exploring-klongs-in-tao-poon-area/ on

Figure 60 Khlong Bang Lam Jiek

Source: Dolruthai Jiarakul, 2015

Figure 61 Bicycle lane along Khlong Saen Saeb
Source: Accessed December 29, 2015, Available from http://www.jakayanrides.com/gallery/bangkok/20150103-cycling-klong-saen-saeb/,

**7. Uses**

*Khlong* in Bangkok may seem to have decreased importance but they still serve the city and the people in many ways. Being more than just an open space for the city, one of the important functions of *khlong* is to help in the drainage system and prevent floods. *Khlong* are also used for transportation, not as much as in the past, but they still play an important role in some areas. *Khlong* are consumption resources for agriculture and daily use. In their heritage aspect, *khlong* are significant cultural resources - the evidence of the origins, history, events, and growth of the community and the city. They are where many culture and wisdom are contained. They also provide tourism and recreation uses in many areas.

**7.1 Drainage and Flood Control**

*Khlong* are a part of the greater drainage system of Bangkok. This is the primary function of *khlong* today. The objective is to drain the water out of Bangkok in times of heavy rain (Department of Drainage, BMA, 2015).

Bangkok receives water from three primary sources: rain, streaming from the north, and backwater, due to changes in the sea level (Therakomen, n.d.).

These sources have made flooding a primary problem in Bangkok every year. The existing drainage system in Bangkok consists of the public drainage pipes with the total length of 6,188 kilometers, 1,682 *khlong* with the total length of 2,604 kilometers, 158 pumping stations with total capacity of 1,638 cms, 25 retention areas with the total volume of 12.88 million cm, 7 super giants tunnels with the total capacity of 155.50 cms, and flood wall with total length of 77 kilometers (BMA, n.d.).

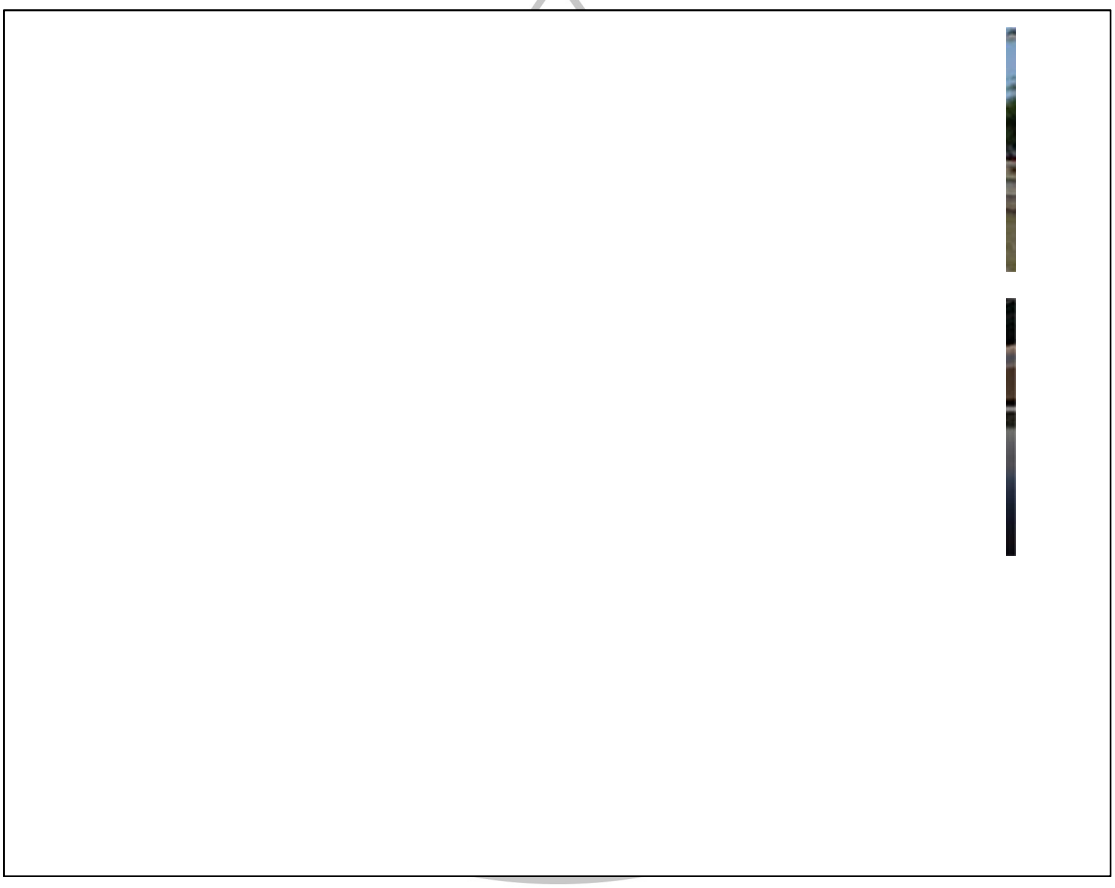


Figure 62 The drainage system in Bangkok, pipe, *khlong*, pump, retention areas, giant tunnels, and flood prevention wall

Source: Accessed January 6, 2016, Available from http://apcs.city. fukuoka.lg.jp/ download/ mayor/pdf/13_bangkok_10me.pdf.

### 7.2 Discharge Wastewater and Sewerage

Most wastewater is directly discharged to *khlong* without treatment. Also many *khlong* communities throw their garbage into the water, or *khlong*. This

has resulted in polluted water and an unsightly view for people passing by. In some areas, the water is black and smelly, especially in dense population areas. The garbage is not only unpleasant to see, but it also blocks the waterways for transportation and drainage.

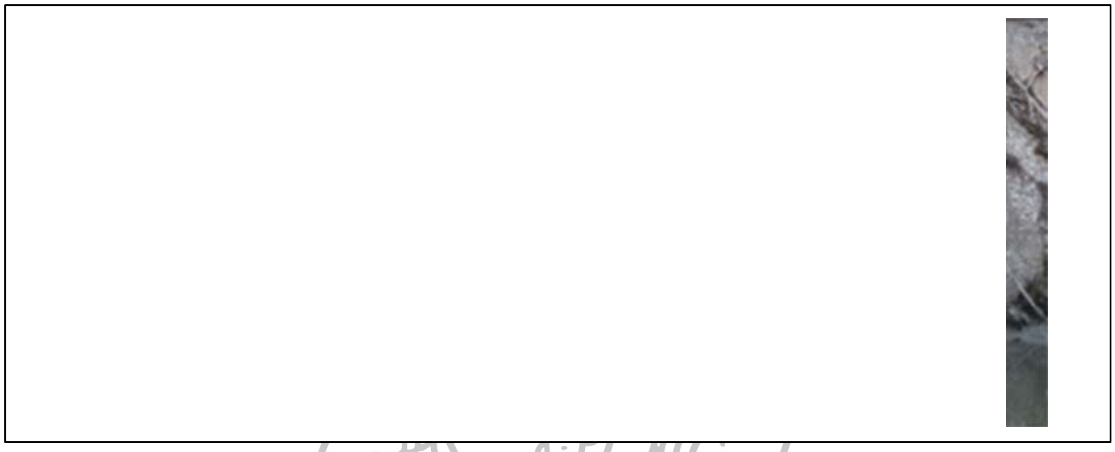


Figure 63 Pipe from household discharge to khlong
Source: Dolruthai Jiarakul, 2015

**7.3 Transportation**

There are both long distance and short distance transportation needs within the community. Only five *khlong* serve as public transportation in Bangkok. They are Khlong Saen Saeb, Khlong Saen Saeb Extension, Khlong Phra Kanhong, Khlong Baan Pa, and Khong Pasi Charoen (Daoreuk Communications Co., Ltd., 2015).

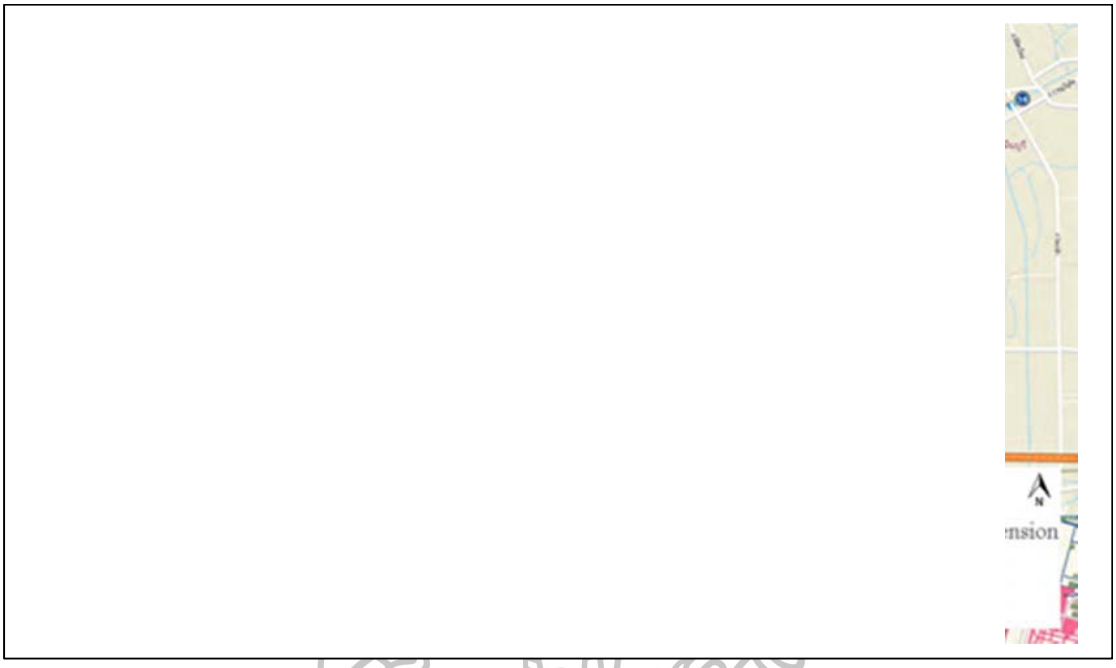


Figure 64 Map shows Khlong Saen Saeb, Khlong Saen Saeb Extension, Khlong Phra Kanhong, and Khlong Baan Pa ferry services

Source: Accessed January 20, 2016, Available from http://www.bangkokcarfree.com/travel4.php.

Some *khlong* have potential to serve as a secondary transportation means for Bangkok. This would require changes to present structures, such as bridges, and adding structures, such as piers. This is due to a change from a water-based city to land-based one. Transportation by roads is meant to be more convenient but there are people use *khlong* in their daily life or as part of their daily life. Roads traffic is unpredictable, while water traffic is more reliable.

**Saen Saeb Ferry**

*Khlong Saen Saeb* now serves as a fast and inexpensive means of transportation to avoid the traffic congested of Bangkok. It is a 17.24-kilometer route, stopping at 27 piers from west to east across Bangkok (Marine Department, 2013). It is operated by Family Transport (2002) Co Ltd since 1990 (TCIJ, 2014; Marine Department, 2013; Daoreuk Communications Co., Ltd., 2015). There are 70 boats running from 05:30 to 21:00 every day and departing every 1-12 minute. Fares start at ten baht and rise to twenty baht, depending on the distance. The duration of the route

is about one hour. There were a total of 17,272,179 passengers in 2013 (Marine Department, 2013).

The route starts from the Golden Mount Line at Panfa Leelard Pier near the Democracy Monument and Khao San Road and then continues to Nida Line at Pratunam Pier near the Central World and continues to Wat Sriboonreung Pier. The names of the piers are as follows: Panfa Leelard Pier, Talad Bobae Pier, Sapan Hua Chang Pier, Pratunam Pier, Chidlom Pier, Wireless Pier, Nana Nua Pies, Asoke Pier, Prasanmit Pier, Ital Thai Pier, Wat Mai Chonglom Pier, Baandon Mosque Pier, Soi Thonglor Pier, Charn Issara Pier, Vitjittra School Pier, Sapan Khlongtan Pier, The Mall Ram 3 Pier, Ramkhamhaeng 29 Pier, Wat Thepleela Pier, Ramkhamhaeng 53 Pier, Sapan Mit Mahadthai Pier, Wat Klang Pier, The Mall Bangkapi Pier, Bangkapi Pier, and Wat Sriboonreung Pier (Marine Department, 2013).

Although the Saen Saeb ferry does not connect to the Chaophraya River ferry its piers are connected to many roads, junctions, nearby BTS stations, and the MRT station. Baan Krua Nua Pier, for example, is near the BTS National Stadium station. Sapan Hua Chang Pier is near BTS Ratchathewi Station. Chidlom Pier is near the BTS Chidlom Station. Asoke Pier is near the MRT Petchaburi.

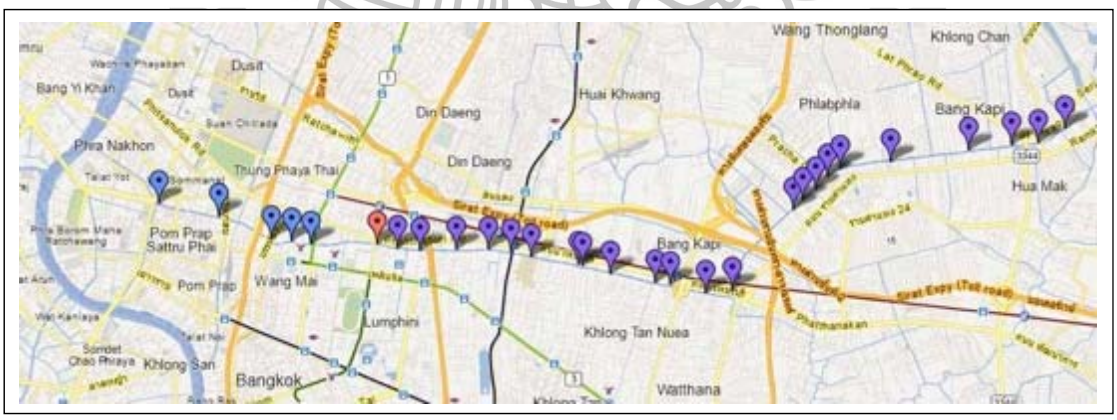



Figure 65 Map shows Khlong Saen Saeb ferry piers

Source: Accessed January 20, 2016, Available from http://khlongsaensaep.com/lines-route-map.html.

Figure 66 Bangkok people use Khlong Saen Saeb for transportation
Source: Accessed December 20, 2015, Available from http://tcijthai.com/tcijthainews/view.php?ids=3961retrieved.


Figure 67 Khlong Saen Saeb in the city area
Source: Accessed December 29, 2015, Available from http://depy-survivorthailand.blogspot.com/2015/09/where-yo-travel-by-saen-saeb-express.html.

**Saen Saeb Ferry Extension**

Eventually, Bangkok extended the Saen Saeb ferry to the Min Buri district. The all extension distance, with the extension was 11 kilometers with 14 piers. It was intended to take people from the suburb to the center more efficiently (Daoreuk Communications Co., Ltd., 2015).

**Phra Khanong**

The people living along Khlong Phra Khanong initiated the ferry service as an alternative means of transportation for the community during the traffic hours. The distance is now about 9 kilometers with 13 piers (Marine Department, 2013). It links with On Nuch BTS Station and Phra Khanong BTS Station (Daoreuk Communications Co., Ltd., 2015). There were 273,208 passengers in 2013 (Marine Department, 2013).

**Baan Pa**

There are two piers along this route. These are the Phra Khanong Pier and the Khlong Baan Pa Pier. These serve to transport people between Sukhumvit Road and the Khlong Baan Pa Community, Pattanakan Road. The *khlong* links with On Nuch BTS Station and Phra Khanong BTS Station (Daoreuk Communications Co., Ltd., 2015).

**Pasi Chareon Ferry**

This ferry is a new project that opened on April 24, 2014. It was originally a temporary project, aimed at assisting the road congestion on the west. Its total length is 11.5 kilometers. The route consists of fifteen piers: P1-Pratunam Phasi Charoen Pier, P2-U Rot Ma Sai 9, P3-Pracha Rath Bridge Pier, P4-Taksin Bridge – Petchakasem Pier, P5-Wat Ang Kaew Pier, P6-Petchakasem 31 Pier, P7-Wat Rang Bua Pier, P8-Petchakasem 35 Pier, P9-Petchakasem 37 Pier, P10-Petchakasem 39 Pier, P11-Wat Nimmanoradee Pier, P12-Kaset-Bang Khae Pier, P13-Kanchanaphisek Bridge Pier, P14-Wat Muang Pier, and P15-Petchakasem 69 Pier. A trip from Pratunam Phasi Charoen Pier to Phetchakasem 69 Pier takes about 50 minutes. The Taksin Bridge - Phetchkasem Pier is linked to the Bang Wa BTS Station. Ten boats are in service from 6:00 – 9:00 and 16:00 – 19:30 daily. Weekday boats depart every fifteen minutes and weekend boats depart every thirty minutes (Bangkokbiznews, 2014).

The Phasi Chareon Ferry limits the speed of the boat to ten kilometers per hour so as not to affect the houses along Khlong Pasi Chareon. It also utilizes GPS to locate each boat.

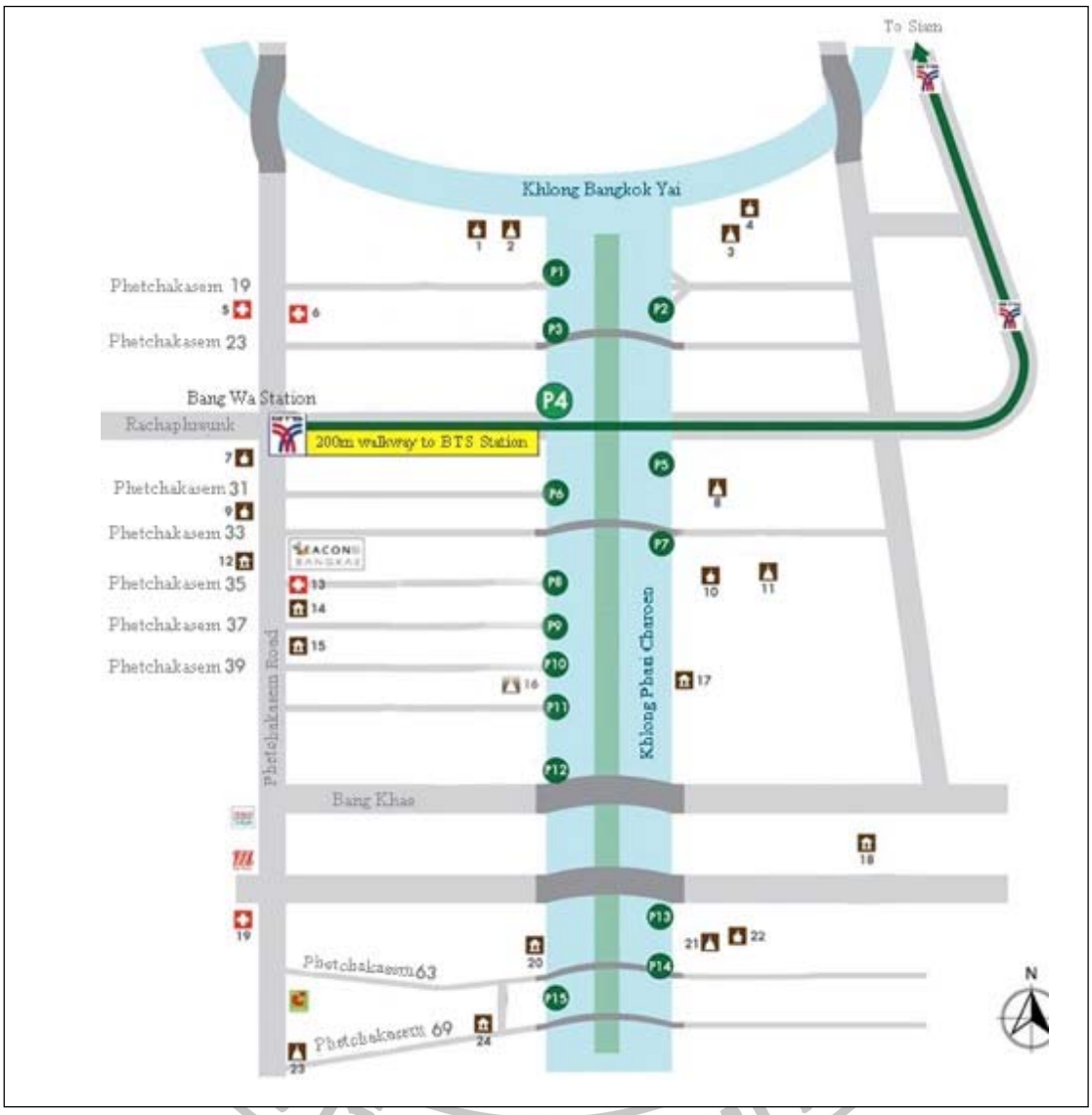



Figure 68 Maps shows Khlong Phasi Chareon Ferry Piers

Source: Accessed January 20, 2016, Available from http://www.bangkokcarfree.com/travel4.php.

Figure 69 Phasi Charoen ferry service
Source: Accessed January 20, 2016, Available from http://www.tour-bangkok-legacies.com/phasi-charoen-canal-boat.html.

In addition to the above-mentioned *khlong*, the transportation department identified 28 *khlong* with transportation potential. These were Khlong Pream Prachakorn, Khlong Bangkhen, Khlong Ladprao, Khlong Bang Sue, Khlong Huay Kwang, Khlong Samsen, Khlong Padung Krung Kasem, Khlong Mahanak, Khlong Lhum Pai, Khlong Jun, Khlong Tun, Khlong Phra Kanhong, Khlong Bangna, Khlong Prawet Burirom, Khlong Lad Bua Khao, Khlong Shong, Khlong Saen Saeb, Khlong Maha Sawat, Khlong Bangkok Noi, Khlong Chuk Phra, Khlong Bangkok Yai, Khlong Pasi Chareon, Khlong Dan, Khlong Bang Khun Thein, Khlong Dai Kanong, Khlong Bang Bon, Khlong Raja Montri, and Khlong Mahachai (Rhiraksapitak, 2015).

For shorter distances, many communities still use *khlong* to get from one place to another. For example, in Khlong Bang Prathun, Bang Khun Thein, a

morning boat takes children to school, just like a school bus. There are taxi boat cruises along the *khlong* all day. People in the community can call the taxi via his mobile phone and he will cruise to their house. Monks come in the morning to ask for alms. Postmen still deliver post by boat in some area.

Figure 70  Postman delivering post via *khlong*, Khlong Pasi Chareon
Source: Nawin Meebunjong, 2016

Figure 71 Khlong Bang Prathun
Source: Nawin Meebunjong, 2016

### 7.4 Resources for Agriculture

Even though Bangkok has been urbanized, agriculture activities can still be found in many areas. The data from Bangkok Agricultural Extension Office shows that 26 districts, Nhongjok, Lad Krabang, Klong Sam Wa, Minburi, Saimai, Prawet, Sapan soong, Bangkhen, Kanna Yao, Suan Lhuang, Beunggoom, Laksi, Don Meaung, Bang Kapi, Wang Thonglhang, Ladprao, Bang Khunthein, Tawee Wattana, Bang Bon, Toong Kru, Bang Kae, Jom Thong, Nhong Khame, Taling Chan, Pasi Chareon, and Rad Burana, still support agriculture. The number of agricultural households is 12,337, covering 180,305.49 rai. There are four types of agriculture in Bangkok: rice, horticulture, fishing, and livestock (Department of City Planning, 2012). Water, one main factor for agriculture, comes from Chao Phraya River through larger and smaller *khlong* to the fields.

Figure 72 Agriculture, Khlong Bang Prathun
Source: Dolruthai Jiarakul, 2015

### 7.5 Cultural and Natural Heritage Resources

This includes both tangible and intangible heritage. Tangible heritage is defined in the UNESCO Operational Guidelines for the Implementation of the World Heritage Convention, 2015 article 1 and article 2. Cultural heritage includes monuments, groups of buildings, and sites, while natural heritage is natural features and natural sites (UNESCO, 2015).

Tangible heritage of *khlong* are *khlong* itself, architecture along the *khlong*, vernacular architecture, bridges, water gate, and many other associated sites. Intangible heritage include skills, knowledge, food, occupation, and festivals – all associated with *khlong*.

Because the origin of the people of Bangkok is from water, the cultural resources are plentiful. The agriculture ways of rice, horticulture, fishing, and livestock are strong expressions of local wisdom.

Local wisdom extends from living around fruit orchards, rice fields, fishing communities, and the city. Each area has its own stories. Because the geography is different, the people react differently and different cultures result.

**Ways of Life and a Sense of Community**

The way of water people still can be seen in some areas in Bangkok, especially the suburb. They are such as the religion practice involving *khlong* and the daily life that involve *khlong*.

Figure 73 Monks in a boat asking for alms, Khlong Bang Prathun. He is the only monk that still ask for alms from water in Khlong Bang Prathun (information from the interview of Nawin Meebanjong)

Source: Accessed January 20, 2016, Available from https://www.facebook.com/ KlongBangPrathun

**Traditions and Festivals**

There are few well-known traditions in the *khlong* in Bangkok area. Examples include Tak Bat Phra Roi in Lad Krabang, and Chak Phra, in Thonburi, as well as Loy Krathong, which stretches across the country.

**Tak Bat Phra Roi tang Reua**

Tak Bat Phra Roi (Alms giving to hundred monks on boats) is a Mon tradition held on the first Sunday after the Buddhist Lent. This tradition passes from generation to generation of Mon residing along Khlong Lam Pla Thiew. The ceremony is held at Khlong Lam Pla Thiew, Wat Sutthaphote in Lad Krabang district. At the event, about a hundred monks in the area will board the boats and stop to receive flowers, candles, incense sticks, rice, other food, and desserts from the locals who gather along Khlong Lam Pla Thiew. The food offering practice is similar to *Tak Bat Devo Rohana* but instead of walking, boats are used (Tourism Division, Culture, Sports and Tourism Department, BMA, n.d.). Later in the day typical Mon meals are presented to the monks at Wat Sutthaphote. The food is served on antique tableware that locals brought from the homes. In the afternoon boat racing is held along Khlong Lam Pla Thiew.

Figure 74 People offering alms to monks on boat at Khlong Lam Pla Thiew on Tak Bat Phra Roi Tang Reau tradition

Source: Dolruthai Jiarakul, 2015

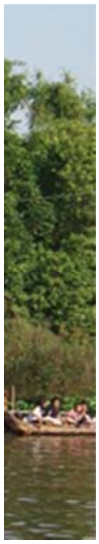


Figure 75 People offering alms to monks on boat at Khlong Lam Pla Thiew on Tak Bat Phra Roi Tang Reau tradition

Source: Dolruthai Jiarakul, 2015

**Chak Phra**

Chak Phra or Lak Phra is a festival for both Brahmins and Buddhists that have practiced for centuries (Tourism Division, Culture, Sports and Tourism Department, BMA, n.d.). The tradition is held in the south of Thailand and in Bangkok; it is held in Thonburi area at Wat Nang Chee, Khlong Chak Phra. Chak Phra means to carry a Buddha statue. It derives from the Buddha legend that on Ok Phansa Day, the end of the three-months Rains Retreat, the Lord Buddha came back to earth after preaching to his mother in heaven (Namo, 2002).

Chak Phra festival is held on the second day of the twelfth lunar month, according to the Thai calendar. During the event, a Buddha relic is placed on a moveable pavilion and carried on a boat in a parade. The ceremony begins in front of Wat Nang Chee and heads along Khlong Bangkok Noi to Wat Kai Tia and stays for few hours in the principal chapel, while the monks, novices, and the people eat lunch. Later the relic is taken back to the floating procession. The procession extends from Khlong Bangkok Noi to Chao Phraya River and to Wat Arun and down to Khlong Bang Lhuang then Khlong Dan. The relic returns to Wat Nang Chee at about 3pm (Culture, Sports and Tourism Department, BMA with reference to the Local Bangkok Museum Project, Chulalongkorn University, n.d.).

Figure 76 Buddha Relic was placed in to a boat and cruise by the Royal Thai Navy as part of Chak Phra Festival in 2015

Source: Accessed March 8, 2016, Available from http://www3.navy.mi.th/index.php/main/detail/content_id/9875.

**Loy Krathong**

Loy Krathong is a nation-wide festival. It does not take place at a specific location or waterway. The festival is on the full moon night of the twelfth lunar month. People will launch their *krathong* (circular floating object) on rivers, *khlong*, or ponds to pay respect to the Water Goddess for their plentiful uses of water as well as to ask for forgiveness in polluting the water.

Figure 77 Loy Krathong in 2015 at Khlong Bang Prathun

Source: Accessed March 11, 2016, Available from https://www.facebook.com/ KlongBang Prathun.

Figure 78 Loy Krathong in 2015 at Khlong Ong-Ang, first time after the removal of Talad Sapan Lhek

Source: Accessed March 12, 2016, Available from http://www.condotiddoi.com/บทความ_คลองโอ่งอ่าง_ที่ลอยกระทงแห่งใหม่--146

Figure 79 Loy Krathong at Talad Hua Takae, Khlong Prawet Burirom in 2015,

Source: Accessed March 12, 2016, Available from https://www.facebook.com/seeyakhautakhe.

**Spiritual Activities**

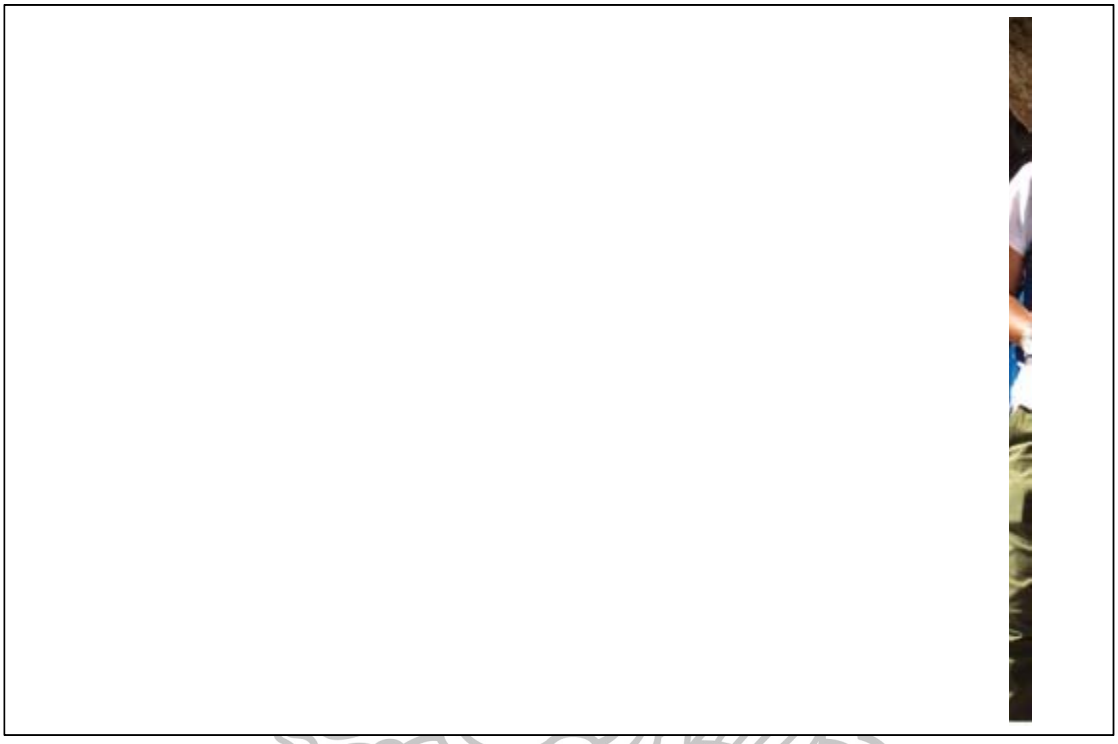


Figure 80 Feeding the fish, Khlong Bang Ramad

Source: Dolruthai Jiarakul, 2015

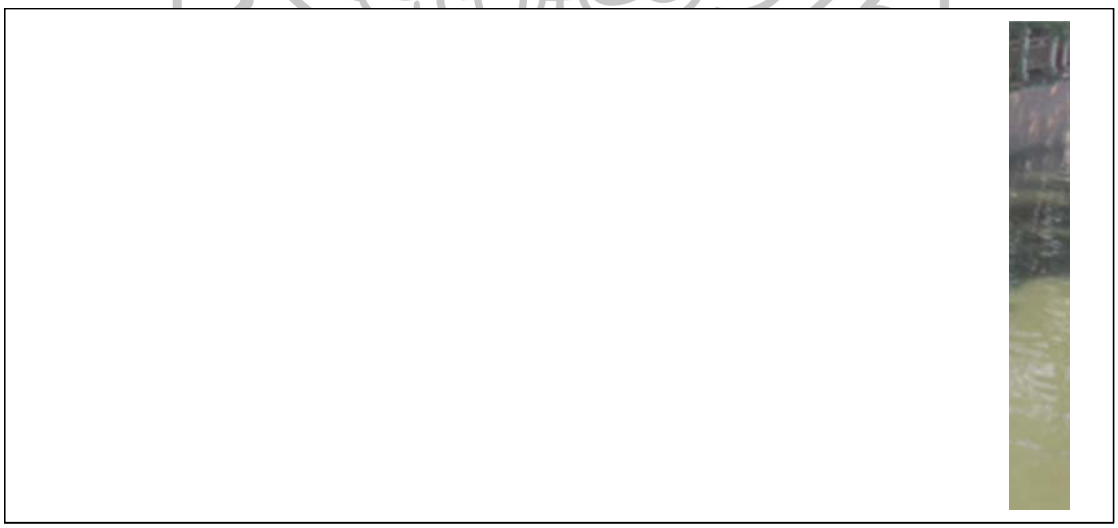


Figure 81 Free the fish, Khlong Bang Lampu

Source: Dolruthai Jiarakul, 2015

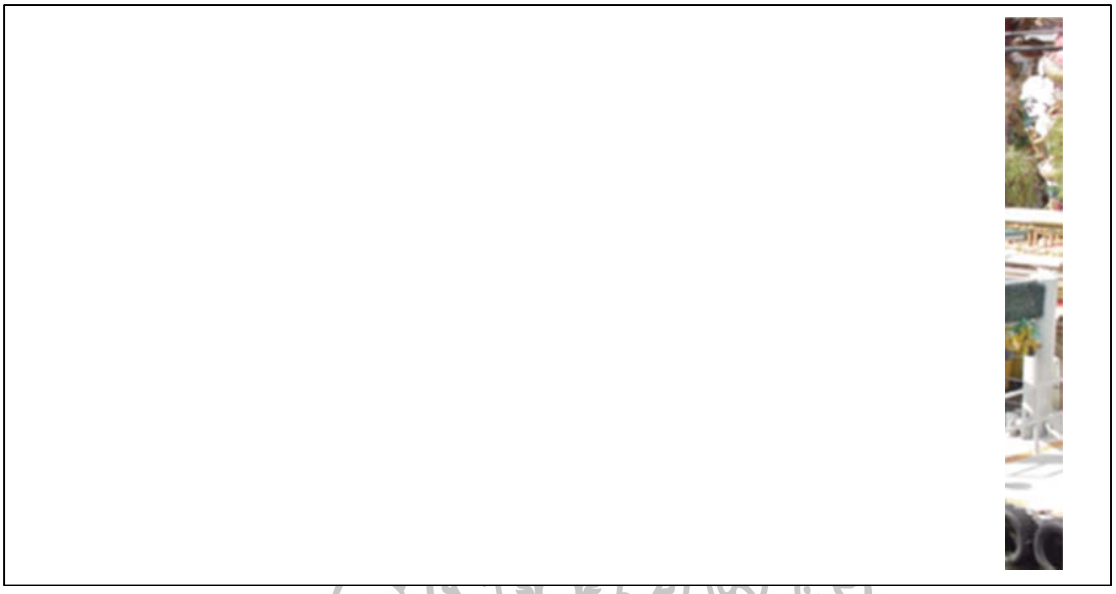


Figure 82 Feed the fish, Wat Nimma Noradi, Khlong Pasi Chareon
Source: Dolruthai Jiarakul, 2015

**Link to Other Cultural Resources Such as Architectures and Communities**

*Khlong* often are where the settlements were in the past; therefore the communities can be found along the *khlong.* It is where the old temples, monuments, and other structures or civic spaces are too. These are important elements in understanding the values of *khlong* to the city and community. Institutions include mosques, churches, museums, universities, and others important associated elements are also part of *khlong.* These include the hydraulic technology such as water gates and locks, bridges, and pathways. The bridge, pathways, bicycle lane, piers, and embankments all contribute to connecting the *khlong* to their uses.

A good sample is Khlong Saen Saeb. Used primarily for transportation, this *khlong* features 29 piers. Five out of these service temples and mosques, which are Wat Makkason, Wat Mai Chong Lom, Wat Klang, Wat Sri Boonreaung, and Baan Don Mosque. One also services a university.


Figure 83 Sapan Chang Rongsi, Khlong Khu Meaung Derm

Source: Accessed January 2, 2016, Available from http://www.manager.co.th/ Travel/ ViewNews.aspx?NewsID=9520000138995.


Figure 84 Architecture along the Khlong Khu Meaung Derm - Sapan Chareonrach 31 near Pak Khlong Talad

Source: Accessed January 2, 2016, Available from http://www.manager.co.th/ Travel/ ViewNews.aspx?NewsID=9520000138995.

Figure 85 Architecture along the Khlong Khu Meaung Derm – Sapan Hok
Source: Accessed January 2, 2016, Available from http://www.manager.co.th/ Travel/ ViewNews.aspx?NewsID=9520000138995.

Figure 86 Wat Mon Dhop, Khlong Bang Ramad
Source: Dolruthai Jiarakul, 2015

Figure 87 Baan Don Mosque, Khlong Saen Saeb
Source: Accessed January 6, 2016, Available from https://www.facebook.com/ Surao Baandon.

Figure 88 Wat Makkasan, Khlong Saen Saeb

Source: Accessed January 6, 2016, Available from www.วัด.ไทย/วัดดิสหงษาราม-มักกะสัน.

### 7.6 Tourism and Recreation

#### Tourism

*Khlong* for tourism is an alternative use of *khlong* in Bangkok. There are several cultural routes available for visitors. These include too a possible eco-tourism route. Foreigners mostly seek to use *khlong* to provide a sense of the authentic in the city, to link to other attractions, and to understand the way of life along the *khlong*. *Khlong* are a valuable asset to tourism. They have a special character, such as a friendly atmosphere. “For example, you can wave your hands to people along the *khlong* while acting the same way on roads will look awkward,” explained Rapeepat Katekosol, Tourism Development Specialist (interview February 5, 2016).

#### *Khlong* tourism route

The tourist pocket guide waterways series created by the Tourism Division, Couture, Sports and Tourism Department, BMA suggests six routes for

waterways tourism in Bangkok (Tourism Division, Culture, Sports and Tourism Department, n.d.). These are as follows:

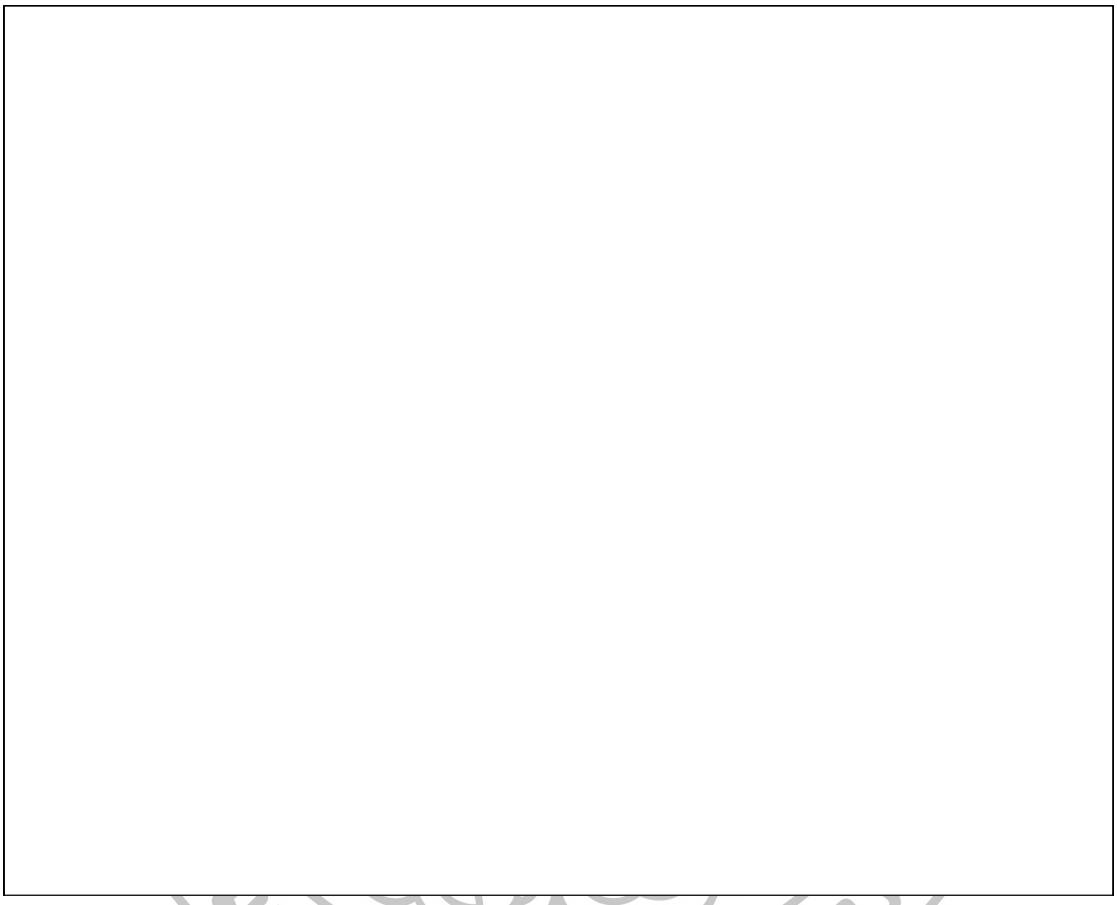


Figure 89 Tourist pocket guide: Waterways Series
Source: Water Series, Tourism Division, Couture, Sports and Tourism Department

1. Chao Phraya River

Chao Phraya River is the origin of *khlong* in Bangkok. The river represents Bangkok as a capital city through the main artery of Thailand. The route includes many important places of varied age and style.

2. Khlong Bangkok Noi

The route includes the Royal Barge Museum, Wat Sri Sudaram, Wat Suwannaram, Baan Bu, and Talad Nam Taling Chun. It also includes the route to "inner Bangkok fruit orchard" at Khlong Bang Ramad.

3. Khlong Bangkok Yai

This route focuses on the trade and residences of the nobility and rich people of Bangkok. People also call Khlong Bangkok Yai “Khlong Bang Lhuang.” This route links to Khlong Daan and to the sea on the south. The route was not only an old trading route but also an old military route. The *khlong* has been densely residential from the time of Ayutthaya. As a result, there are many important *wat*, such as Wat Moleelokyaram, Wat Hong Rattanaram, and Wat Chee Chotikaram. The *khlong* also features other important places, such as Ton Son Mosque, Wat Intaram, Wat Pak Nam, Wat Nuan Noradis, Baan Sinlapin, and Talad Nam Khlong Pasi Chareon at Wat Nimmanoradi. The route can be lengthened to Bangkok Sea at Bang Khun Thein too.

4. Khlong Lad Dao Kanong

Khlong Dao Kanong is a natural watercourse. It is the east branch of Chao Phraya River. The *khlong* forms the route to Talad Nam Wat Sai and the Snake Garden at Thonburi. It has many *wat*, many containing beautiful artwork. The *khlong* is one of the busiest transportation routes, because it links to Khlong Lat Pha Ched Nha and Khlong Sanam Chai and to Khlong Bang Khun Thein, which was an important route for the salt trading during the reign of King Rama VI. The route further features the Snake Garden at Thonburi, Wat Nhung, Wat Nangnong, Wat Raja O Rasaram, Khlong Daan (Khlong Sanam Chai), and Wat Sai.

5. Khlong Prawet Burirom

Khlong Prawet Burirom was excavated during the reign of King Rama V to link the Bang Pakong River and the Chao Phraya River. The route starts from Khlong Phra Kanong to Khlong Prawet Burirom. The beginning of the route is confusing, as Khlong Phra Kanong is a natural *khlong*, so it is not as straight as Khlong Prawet Burirom, which is man-made *khlong*. This route includes the Muslim communities that were brought from Pattanee during the reign of King Rama III. Muslims are also the majority race on this route. The route ends at Wat Kratum Sue Pa. The route includes Talad Phra Kanong, Wat Tai, Wat Maha Bus, Wat Yang, Wat Pak Bo, Wat Kajon Siri, Yami Allibdeh Mosque, Wat Kratum Sue Pa, Talad Hua Takae, Wat Sutthapot, and Talad Luang Paeng.

6. Khlong Maha Sawat

Khlong Maha Sawat was excavated in the reign of King Rama VI to link Nakon Chai Si River and the Chao Phraya River. It is an eco-tourism route that starts at Wat Suwannaram. It provides a sense of welcome to visitors. The route includes Wat Chai Pruek Mala Raja Wihan, Sai Tai Train Station, Wat Puranawas, Utthayan Road (Aksa Road), Buddha Mondhon, Mahidol University Salaya Branch, Orchid Garden, Fruit Garden, Women Farm Group of Maha Sawat, and Na Bua (lotus farm).

The six routes promoted in this booklet can show only a few possible tourism routes. For example, foreigners also like travelling along Khlong Saen Saeb. Therefore, many other routes can be used for tourism.

Figure 90 Thai tourists on a *khlong* tour
Source: Dolruthai Jiarakul, 2015

***Talad Nam***

Another tourism activity for *khlong* is *talad nam* or floating market. The famous *talad nam* is Talad Nam Damnoen Saduak, which is in Ratchaburi province. But there are also many other unique and lively *talad nam* in Bangkok. These include Talad Nam Taling Chun, Talad Nam Khlong Lat Mayom, Talad Nam Wat Sapan, Talad Nam Song Khlong Wat Taling Chun, Talad Nam Wat Gampaeng, and Talad Nam Bang Nampeung.

Figure 91 Talad Nam Taling Chun
Source: Dolruthai Jiarakul, 2015

***Talad Rim Nam***

An integral of *Talad Nam*, *khlong* are also a part of *Talad Rim Nam* (markets along the water). *Khlong* give these markets a unique atmosphere. Since older communities were settled by the water, the old way of life, as expressed through vernacular architecture and skills for making goods and food, passes from generation to generation up to present. Examples of Talad Rim Nam are Talad Nang Leung, Talad Wat Thong, Talad Wat Nimmanoradi, Talad Hua Takae, and Talad Luang Paeng.

***Khlong* as monuments**

There are many *khlong* involved in tourism but that are not used as a tourism route because there are no more transportation uses in the *khlong*. But these *khlong* have been kept in good condition and still form an important part of Rattanakosin history.

Tourists often visit the three city moats, Khlong Khu Meaung Derm, Khlong Rob Krung, and Khlong Padung Krung Kasem, as part of an old city of Rattanakosin Tour. Generally no activities are held at these *khlong.*

**Recreation**

Recreational activities can rarely be seen in most *khlong* today. This is due largely to the poor quality of the water and the safety of use. As many *khlong* are

polluted, recreation seems impossible. This also includes the use of sideways along the *khlong*, many of which are isolated.

The limitations of *khlong* used today have resulted in a lack of awareness about *khlong* and add to the negative impacts on the condition of *khlong*.

Figure 92 Bicycle path along Khlong Saen Saeb (east) bank
Source: Accessed December 29, 2015, Available from http://www.jakayanrides.com/gallery/125angkok/20150103-cycling-klong-saen-saeb.

Figure 93 *Khlong* and the bicycle lane on its banks from Big C Lad Prao to Asoke
Source: Accessed December 29, 2015, Available from http://www.jakayanrides.com/rides-and-exploration/125angkok/big-c-ladphrao-to-asok.

Figure 94 Activity at Khlong Saen Thor, Bang Khun Thein
Source: Accessed January 18, 2016, Avialable from https://www.facebook.com/LocalAlike/photos/a.690335564397935.1073741853.321685411262954/690337627731062/?type=3&theater.

### 7.7 Consumption

Outside the city, there still are people using water for consumption in their daily life. They get water from *khlong* to clean themselves, bathing, washing clothes, and even brushing their teeth. They use water from *khlong* to cook food as well (interview Nawin Meebunjong).

Other than water, people also fish for daily consumption, as well as use some vegetation found growing in *khlong.*

Figure 95 People using water from *khlong* to brush his tooth, Khlong Pasi Chareon
Source: Nawin Meebunjung, 2016

**7.8 Other Uses**

Other than the above uses of *khlong* in Bangkok, *khlong* are also used in other ways. They often serve as boundaries between districts. They also form a part of the image of the city. In many books, especially tourist books, *khlong* representing the traditional way of life of Bangkok.

Figure 96 Khlong Rangsit (Khlong Sip-si) as a territory of Bang Nam Preaw, Chacheungsao and Nhong Jok District, Bangkok
Source: Accessed March 8, 2016, Available from https://www.facebook.com/thaitourismsociety.

**Location and Information**

Signs can be found along the *khlong*, typically on the banks. Mostly these signs identify *khlong* names and sometimes provide information about the *khlong*, and other kinds of information.

Figure 97 Interpretation near Khlong Khu Meaung Thonburi about Krung Thonburi and its fort, *khlong*, and city wall

Source: Dolruthai Jiarakul, 2015

Figure 98 Sign identifies Khlong Padung Krung Kasem

Source: Dolruthai Jiarakul, 2015


Figure 99 Information of Khlong Khu Meaung Derm and Phan Phiphop Lila Bridge

Source: Dolruthai Jiarakul, 2015


Figure 100 Information given about Khlong Lot Wat Theptida and map of Rattanakosin attraction sites

Source: Dolruthai Jiarakul, 2015

**8. Conclusion**

There are still numbers of *khlong* in Bangkok. But there are also many important issues related to *khlong.* The issues will be discussed in the next chapter.

# Chapter 5
# Discussion

From the study of the history and current condition of Bangkok *khlong*, it has been shown that *khlong* used to be a very important part of Bangkok. Their decline is due to many factors. The three most important factors are urbanization, the direction of city development, and government policy. These three main factors have resulted in the deterioration of Bangkok's *khlong*, in which many other ways, such as flood, land erosion, pollution, quality of life, etc., remain important. These factors and problems will be described in this chapter.

## 1. Cause of *Khlong* Declining

### 1.1 Buildings and Structures Built from Urbanization

Urbanization is in large part responsible for the current condition of *khlong* in Bangkok. As Bangkok became an important port city after the excavation of Khlong Lat Bangkok, it attracted more people and became more urban. Bangkok developed from a small fishing and orchard village to a capital and also is now an urbanized primate city. This is because the development and opportunity in Bangkok attract people. Orchards have turned into real estate housing. Buildings and infrastructures were built to support the increasing population of Bangkok. These structures change the natural movement of water as well as uses of *khlong*.

The majority of houses in Bangkok discharge water directly in to *khlong*. As a result, the water in most *khlong* is polluted. Biochemical Oxygen Demand (BOD) in inner Bangkok, where there is a dense population is very high.

Also, urbanization has taken place without local wisdom. Each area is different. These separate places have a deep understanding of the geological aspect of the area as well as the cultural aspect of the people, which included beliefs and the way of life to manage *khlong* well. Globalization takes away from the uniqueness of places and leaves communities with no roots or attachment.

**1.2 Direction of City Development**

Over a nearly two hundred years period Bangkok has shifted from a water-based city to a land-based city. This started with the influence of westerners after the Bowring Treaty. There were more big trading ships in the river. As a result it was not convenient for people to live on rafts. Another development was the construction of more roads and bridges. Early on, the development of *khlong* and roads was not exclusive. However, during the reign of King Rama VI, no more *khlong* were excavated. Another factor was for shallow and dirty *khlong* to fill up. People eventually wanted roads more than dirty *khlong.* The land price also got higher. This is the beginning of *khlong* declining.

As this process of shifting continues there is less concern with *khlong.* People also changed their house to face roads instead of *khlong.* The filling of *khlong* has changed the relationship of *khlong* to the city. *Khlong* used to be everywhere and were part of a linked network. Now, this system is broken. As an example, some bridges are made so low that boats cannot pass during the water season.

**1.3 Government Policy**

In 1961, the first National Economic and Social Development Plan was established and applied. The first toward third plans (1961 – 1976) focused on the infrastructure of Bangkok (Pakkasem, 1988). The decision was to make clean water accessible from pipes not from *khlong.* Government policies meant that *khlong* did not have to be taken care of. They could be left as sewage pipes. In the fourth toward sixth plans (1977 – 1991) Bangkok became a location for factories for the export of products. Factories were encouraged and more wastewater was released into the *khlong.*

The use of *khlong* is now mostly for flood prevention. Watergates are built to control the flow of the water. Without a serious concern on other factors, Watergates are an unnatural part of *khlong.* Humans have controlling the difficulty flow of water. Communities gradually lose their collective knowledge and skills related to the use of water. It also requires more manpower to maintain an effective system. The water has become more still. Still water gets dirty easily.

All of these factors, including the zoning and housing policy, are related to one other. The policies that encouraged the development of Bangkok made

it become more urbanized but neglected an understanding of the city's geography. More people means need for the more resources as well as creating more problems. The land-based city has reduced the use of *khlong.* Neglected and dirty, *khlong* are now less used.

**2. Related Issues**

**2.1 Flooding**

Bangkok is a fertile delta formed from the sediment from water. The land is highly suitable for agriculture. The life of living with water, in floods, is acceptable from time to time. In the past flooding did not affect the people of Bangkok very much. Thai ancestors have long use collective wisdom in understanding nature and living in harmony with it. Riverine society houses were located next to the water and were elevated. People moved around using *khlong.* Also, the making of *khlong*, *lamrang*, and *lamkradoong* in the city planning, involved water. Agriculture activities were planned to be suitable for each season.

Shifting from a water-based to a land-based city left Bangkok people with less sense of water. Concrete surfaces are increasing for roads, housing, and factories. There is less soil for water to drain after the rain in the water season. Together with the fact of the location of Bangkok and that there are fewer *khlong* and the existing *khlong* are mostly in a bad condition, Bangkok definitely floods.

**2.2 The New Comers**

From the time of Rattanakosin, many people moved and settled in Bangkok. In the old days most settlements were along *khlong.* And as mentioned earlier, Bangkok is a primate city; it attracts increasingly more people to Bangkok to seek a better life.

Many people that have moved near *khlong* do not have a particular set of knowledge in living in harmonize with *khlong*. Therefore, the relationship to *khlong* is not as strong among people with this set of knowledge. Some new settlements, such as modern housing projects, do not take advantage of being next to *khlong.* Some put high thick wall to prevent theft and prepare for floods. However, they miss out on the values associated with *khlong* e.g. the open space, relaxation from the water, recreation opportunities, and the possibilities of raising food and

creating occupations. Occupants of new houses also prefer open roads more than *khlong.* When houses turn their back on *khlong,* especially with wall or hard concrete embankments, the relationship between man and water is reduced too.

**2.3 Water Quality**

*Khlong* in Bangkok are polluted. According to the Pollution Control Department the main cause of polluted water quality in Bangkok is untreated municipal wastewater being discharged directly into the water. This includes residential sewerage and industrial discharge. As Bangkok population grows more wastewater is discharged into the water. The water cannot cope with the amount of wastewater.

Water pollution was the first factor mentioned among the problems facing Bangkok *khlong.* The use of *khlong* for transportation and recreation cannot be well applied. For example, using *khlong* for transportation, the passengers must face the odors that come from the polluted water. Also, during the trip, water might splash into the face and body. There are many cons for the use of water transportation. Recreation and water sports are not appropriate consideration water pollution as well.

**2.4 Image of *Khlong***

In the past, people looked upon *khlong* as a channel of water resources. They were the life of the people and the city. People lived along *khlong.* Making and maintaining the number and quality of *khlong* was part of city management. Bangkok was referred to as "The Venice of the East" from many foreigners point of view. In the present day, *khlong* are being looked at as a channel for water disposal. Water for daily consumption is available through the water supply channel, while disposal of wastewater is directly to *khlong. Khlong* can hardly seen as link to the majority of people in Bangkok.

In contrast to reality, *talad nam* are still presented as an image of Bangkok on tourist websites and tourism books. The most popular *talad nam* promoted for tourism is Talad Nam Damneon Saduak, which is not in Bangkok. Other *talad nam* is not as popular.

Figure 101 Cover of tourist guidebooks with *talad nam* or *khlong* presented
Source: Accessed March 16, 2016, Available from www.google.com.

### 2.5 Bangkok, Future Drowned City

Scientist and scholars are concerned that many coastal cities including Bangkok, are to be under water in the near future. Climate change outcomes, such as global warming, causes a rise in sea level. Although the sea level has stayed nearly stable since the end of the last de-glaciation, about 3,000 years ago, the tide gauge measurements which are available since the late nineteenth century show that the sea level has risen on average of 1.7 ± 0.3 mm/year since 1950 (Canzenave, 2010). The rise of water results in flooding of the coastal land, as well as saltwater intrusion into the surface water. It makes many coastal cities around the world, including Bangkok, risk being drowned. Therefore, there are many attempts undertaken by these cities to prevent this.

In the Netherlands, the government has devoted about 1 percent of the annual budget to a system of dikes, dunes, and sea walls. The focus in the twentieth century was on such defensive barriers. But a more recent focus has been embracing the philosophy of "living with water." Hence waterways are being connected to absorb the sudden influxes of water. There are zones of flood designated. Houseboats and other floatable houses are the passion of the people (Ritter, 2013).

For Bangkok, the risk is not only from the rise of the sea level but also the sinking of land as well as the subsidence of land. Drainage of ground water is another cause of Bangkok's being drowned. Urbanization has replaced natural vegetation with impermeable structures. These structures reduce evapotranspiration

and infiltration rates. They cause a fall into groundwater level and an increase in surface runoff (Walling, 1987). Also, the excessive use of ground water for municipal and industrial use and the reduced sediment from existing of dams also impact the subsidence of the land. The evidence of this effect is shown in the boundary pole of Bangkok standing away from the shoreline, more than a kilometer in Bang Khun Thien District.

Infrastructure development in Bangkok, such as the sky train, the underground train, roads, and highways will not be able to facilitate Bangkok and its people if the city is under the sea. However, the ancient way water-based development may point to some solutions.

In contrast, the government concentrates on the development of flood prevention projects. Also, many politicians propose projects to prevent the flooding of Bangkok. These include the ideas of shifting the capital of Thailand to a higher city, such as Nakon Rachasima.

Figure 102 Boundary pole of Bangkok standing away from the shoreline for more than a kilometer

Source: Dolruthai Jiarakul, 2014

**2.6 Water Management**

Water does not flow naturally in Bangkok today. While *khlong* management involves many agencies, the flow of water is mainly controlled by the

Department of Drainage and Sewerage, BMA. There are three missions for the departments (Department of Drainage and Sewerage, n.d.). First, is to develop the public utilities infrastructure, drainage, and flood protection to support the growth of the city as a livable safe city. Second, is to improve the environmental aspects of water quality management to sustainable. And third, is to improve the performance of the personnel of the Bureau.

A priority of the department is to drain and prevent Bangkok from floods. The water is always treated as an enemy. The idea that water is an enemy is obviously seen in the time of flooding. Not only does the department concentrate on flood prevention but also the whole city tries to keep water away. During other times, water levels are kept low to make sure the city drains well in the event of rain or flood, not for other uses.

This “keep the water away relationship” has complicated Bangkok ‘s management. The process began with the shift from a water-based city to a land-based one. Houses that used to be elevated with boats kept below were replaced by house on a reclaimed land dependent on cars. Trying to control the water and to cut off water from the *khlong* were not understanding and not living harmoniously with the water. In the past, people who lived along the *khlong* could use *khlong* efficiently. Foreigners often mention these remarkable skills, such as traveling in small boats. By keeping the water level low in the *khlong* and keeping the city dry, people do not have the chance to practice these skills. Eventually these skills are lost.

As the connection to water decreased, activities in *khlong* decreased too. Public awareness and involvement also decreased. In an interview at Talad Hua Takae, Khlong Prawet Burirom, people opined strongly that taking care of *khlong* was the government’s responsibility. That is to use law enforcement to protect *khlong* and also for a government agency to maintenance of *khlong*, including overseeing their cleanness, water quality, embankments, awareness signs, and dredging (Sattumsakul, 2016; Yamgasorn, 2016).

Blocking the natural flow of water to *khlong* by making dams and watergates creates other problems. Watergates need to be managed and maintained. They need a budget for that. People also sense a loss of nature from this artificial control.

As mentioned in chapter 4, there are still agricultural activities in Bangkok. In the time of dry season, the BMA will keep a good amount of water to facilitate this activity. But in the event of unseasonal rain, water does not drain well to *khlong* and other drainage systems. Conflicts arise as a result.

### 2.7 Other Factors

The filling of *khlong* and making more roads to deal with the increasing number of cars are especially problematic. Too many cars not only made a bad traffic but also generate a polluted air.

If such as skills and local knowledge do not pass from generation to generation, the community will lose its identity and lose the sense of belonging to the community. This results in less awareness and less protection of local resources.

*Khlong* are decline; they are more neglected and are gradually losing their importance. The existing of *khlong* in some community are often unnoticed. Some communities prefer to remove polluted *khlong* because they seem to have no value. Monitoring and law enforcement have not been effectively applied. As a result, existing problems of *khlong*, such as pollution and encroachment, have increased.

## 3. Why Revive Bangkok *Khlong*?

The successful revitalization of *khlong* in Bangkok can benefits in many ways. These include improvements to the environment, improvements to the appearance of Bangkok, the conservation of historic sites, value added to local skills, an increase in revenue, more jobs opportunities, and the acceleration of new investments, as many other cities have experienced.

### 3.1 The Importance of *Khlong*

*Khlong* are what makes Bangkok. The area of Bangkok originally was a swamp. The use of *khlong* is well suited well with the geography. Until the making of Khlong Lat Bangkok in 1522, during the period of Ayutthaya, Bangkok was barely settled. The area became an important route for trading. It once then became Meaung Thonburi Sri Maha Samutr and the site of the official custom's house (Canen Bangkok). Later, Bangkok was selected as the location of Siam's capital, Thonburi, after the fall of Ayutthaya.

*Khlong* are one of the oldest heritages from our Thai ancestors in Bangkok. The wisdom of how to live harmony to the water has passed from generations to generations and is gathered in *khlong* today. It includes: how to apply *khlong* to the city; how to use water in everyday life; how to survive in the time of flood or drought; how to make use of water; how to enjoy the living with water; and much more.

The importance of *khlong* is also shown in many ways. For example, *khlong* were behind the selection of Bangkok for a capital, replicating Ayutthaya. The names of roads and places, traditions such as Royal Barges, Loy Krathong, and Tak Batr Phra Roi, the belief of Naga, the understanding of Mount Meru, the singing of Sagawa, the floating market, and many more all derive from Ayutthaya. In Bangkok today, *khlong* are still a vital element in the flood prevention and drainage systems.

*Khlong* are the existing evidence of many historic events such as wars, epidemic disease, trading, etc. They witnessed the growth and change of the city. They were sometimes involved in those events, were the result of those events, or were the outcome of those events. A study of the history of *khlong* will also lead to more understanding of the political transition and economic growth of Bangkok.

*Khlong* in Bangkok have gained the reputation for uniqueness among foreigners. Even though the name "Venice of the East" was used earlier in referring to Ayutthaya (from Fernao Mendez Pinto in the letter to the Society of Jesus in Lisdon in 1554). The appellation later referred to Bangkok, (notable by Salvatore Besso, an Italian nobleman, in 1911). The image of *khlong* in foreigners' eyes is still seen today in many magazines and tourist books.

Each *khlong* consists a special heritage according to the settlement and the geography surrounding it. A *khlong* can be pride of the community. It can be a valuable asset in cultural, environmental, and economic ways.

**3.2 Vision of Bangkok 2020**

"The Vision of Bangkok 2020" in a BMA plan document noted that Bangkok had potential for its economy, trading, and as a service center at the national and regional level. It further offered that the city should be developed under the principle of a "Sustainable Metropolis." The plan also gives three guidelines for development; gateway, green, and good life. Its authors suggested that by following

these guidelines Bangkok could be developed into a balance metropolis and could provide a context for economic competition. *Khlong* can be an important part of this sustainable metropolis.

Bangkok's population, over 10 million, creates about 2.4 million cubic meter of wastewater per day, much of it not processed through wastewater treatments plants. The BMA has estimated the capacity of current wastewater treatment plants as only 42 percent of the overall wastewater. The rest is flittered (Department of Environment, BMA, 2012). The low level of water is monitored in most main *khlong* for flood prevention purposes. But for many other *khlong*, especially those embedded in communities, they lack water.

Apart from flooding and other water issues, Bangkok's development has increased other kinds of problems. These include population density, loss of communities and cultures, high volumes of traffic, pollution, a lack of green open spaces, and a diminution of the overall quality of life. Seeking more development projects and using more resources do not seem to solve Bangkok's chaos.

### 3.3 The Existing *Khlong*

There are numbers of *khlong* already embedded in Bangkok. They are there for use, in education, in the economic, in the environment, among others. They are there to connect to meanings of the city. They are there to explore other kinds of heritage. They can turn into a valuable asset to the city if they are properly planned and managed. On the other hand, ignoring *khlong* will not make *khlong* disappear. The neglect, encroach, and misuse of *khlong* will lead simply to to a dry, dirty, and hopeless remnants. This will only make *khlong* another problem for the city. Therefore revitalizing *khlong* in a sustainable way may un-tap a valuable asset, which will enhance the city's environment, economy, and culture.

The fact of *khlong* inherited from our ancestors to today is never going to be a threat. They actually present an opportunity for the city. *Khlong* can be a valuable asset in the economic, environment, and social character of the city.

### 3.4 Movement Supporting the Revitalization of *Khlong*

In Bangkok today there are several movements that can help support the revival of *khlong*. There is growing awareness about the environmental, including issues such as global warming, pollution, and especially flood prevention. There is

also a movement for urban renewal and historic preservation. Tourism trends, such as nostalgia and eco-tourism, also play an important role. The quest for a better quality of life, such as more open green space, recreation areas, healthy food, and the search for a meaningful city, all contribute to the possibility of *khlong* revival.

**4. *Khlong* Revitalization Movement in Bangkok**

Before the big flood of 2011, *khlong* were widely neglected. The use of *khlong* is limited to the suburbs of Bangkok, for sewerage and some transportation. The situation changed after the big flood, *khlong* have mentioned in the news and people savant to learn more about the *khlong* that existed in Bangkok. At the time of flooding, the concern was about the flow of the water, the capacity, and their drainage route. But after the flood, many questions arose, such as: What if we have *khlong* in better condition? Can they protect the city? Can they reduce the losses from flooding? And later questions: What can we do to make use of *khlong*? How can we maintain the condition of *khlong?* Can *khlong* still function more than as a drainage system? And can *khlong* be connected to the city as they used to be in the past? Are they suitable for the city? Indeed, many techniques and attempts have been applied to *khlong* at many scales and in many locations.

There have been attempts at dredging. Dredging may lead to a better water drainage system and more water capacity in flood prevention. Larger *khlong* usually are dredged to 3 meters in depth and *khlong* branches are excavated to 2.5 meters depth. Also, there has been a project focusing on removing encroaching buildings and homes as well as the making of concrete banks. The BMA plans three stages to address encroachment of buildings and homes over the next ten years. The first stage is at nine main *khlong* with urgent need*;* Khlong Pream Prachakorn, Khlong Bang Khen, Khlong Lad Prao, Khlong Song, Khlong Sam Wa, Khlong Lad Bua Khao, Khlong Phraya Montri, Khlong Bang Sue, Khlong Prawet Burirom, and Khlong Phra Kanong. The second stage includes less severe areas including 34 *khlong.* The third stage includes 1,118 *khlong*, which is not seen as urgent since the *khlong* are small and suffer less encroachment (Daily News, 2014).

**4.1 Khlong Lad Prao**

Dealing with the invasion of buildings and homes is not easy. Conflicts arise in the process. One point to mention is that the project was done without a public hearing. Therefore, the solution may not suit each project well.

At Khlong Lad Prao, some families have to leave the community. The rest have to live differently. The communities have to adapt to a new approach that will affect their lives. There are attempts to find community uniqueness and local wisdom with the hope that this can bring tourism. Tourism can generate money and create better awareness of *khlong* and their contribution to the quality of life. The main concern is that communities seek to live harmoniously with *khlong* in a sustainable way.

**4.2 Khlong Ong Ang**

The story of Sapan Lhek Market at Khlong Ong Ang, part of Khlong Rob Krung, is also interesting. Sapan Lhek has been the market for more than 30 years. The market gradually encroached and covered Khlong Ong Ang, which is registered as a historic site in Bangkok. The market further obstructed the drainage of Khlong Ong Ang and also it was claimed by the government contributed to a high rate of crime and illegal in migrants. The market itself has become an old market. It has stories and links to the residents.

The government's intervention has been successful, and Khlong Ong Ang has been revealed to public after a very long time. The first festival was held at Khlong Ong Ang after the new work was Loy Krathong, held in 2015.

The next step for the Khlong Ong Ang revitalization is still in the planning process.

Figure 103 Khlong Ong Ang in the past

Source: Accessed March 13, 2016, Available from http://haab.catholic.or.th/silom/silom/silom.html.

Figure 104 Khlong Ong Ang, when water transportation was widely used
Source: Accessed January 20, 2016 Available from http://kanchanapisek.or.th/kp6/ sub/ book/ book.php?book=33&chap=3&page=t33-3-infodetail03.htmlandhttp://www.t-pageant.com/ 2011/index.php?/topic/ 146639

Figure 105 Picture of Sapan Lhek Market encroaching Khlong Ong Ang and the picture of Khlong Ong Ang after the demolishing of Sapan Lhek Market.
Source: Accessed January 20, 2016, Available from https://soclaimon. wordpress. com/ 2015/10/23/กู๊ดบายสะพานเหล็ก-ส่อง-10/ and http://travel.kapook.com/view135203.html

Figure 106 Khlong Ong Ang on the Loy Krathong Festivals 2015, after the demolition of Sapan Lhek Market and landscape adjustment

Source: Accessed January 20, 2016, Available from http://www.posttoday.com/ analysis/ report/401898

**4.3 Khlong Bang Lampu**

Khlong Bang Lumpu, another part of Khlong Rob Krung has also been subject to revival attempts. The project was more concerned with the water quality of *khlong* than encroachment. Actually, the movement of Khlong Bang Lampu revival started in 2010, before the big flood in 2011.

Department of City Planning, with the BMA, recognizes Khlong Bang Lampu as a prototype for *khlong* development. The process includes dredging, use of EM, water treatment bike, landscape adjustments, and cultural activities. The Bang Lampu Community is at the center of activities, working with other agencies. The result is that Khlong Bang Lampu is clean and beautiful. The water quality has improved that the aquatic life is thriving.

Although the project has been successful in many ways there are still issues. For example, the use of a water treatment bikes cannot be fully applied due to the limitation of parking space and lack of management personal etc.

Figure 107 The use of water treatment bike at Khlong Bang Lampu. The bike idea was obtain from King Bhumibol Chiapattana Low Speed Surface Aerator Model which aim to give oxygen to the water, attract tourists, and enhance heath of the community

Source: Accessed April 18, 2016, Available from http://search.bangkok post.com/ search/image_detail?imageId=51505.

**4.5 Khlong Bang Bua**

Khlong Bang Bua is another example of *khlong* repair occurring before the big flood. It is called the Baan Mun Kong Rim Khlong Bang Bua Project. The project is to remove homes along the whole community, with more than 9 rai of 264 homes with 80 homes encroaching *khlong,* affected. The aim is 264 new homes for

the community. Each person gets 5x10 meters land. New homes can be one of several choices, a singe one-story house, a single double-story house, a double-story twin house, or a row house. The community will rent the land from the Treasury Department for 30 years at the rate of 1.50 baht per square wah per month. At first the community fought the project, but the government compromised with the community and organize many meeting to clarify the project. The project began with a community forum to create a working group and housing group in 2004. The first phase was in 2006, with nine homes, and followed with many more phases later. The community Organizations Development Institute supported the project with 10.3 million baht for the infrastructure and 24 million baht for the house loans. The community also founded housing cooperatives to manage the project (Kom Chad Luek, 2015).

Home building has also brought the community together as an indirect result. Community members help each other in moving and planning (Kom Chad Luek, 2015).

Figure 108 Khlong Bang Bua before the landscape adjustment

Source: Accessed April 18, 2016, Available from http://www.komchadluek.net/detail/20150823/212048.html.

Figure 109 Khlong Bang Bua after the landscape adjustment
Source: Accessed April 18, 2016, Available from http://www.komchadluek.net/detail/20150823/212048.html.

**4.6 Khlong Padung Krung Kasem**

Another interesting project is the revival of floating market at Khlong Padung Krung Kasem. Before the flood Khlong Padung Krung Kasem presented itself almost as a dead monument; there were no activities in or along the *khlong*. The only sign of interpretation was a story. It was only use as part of the drainage system in Bangkok. The water level was kept low most of the time to be able to receive more water in the water season.

In 2015, the Khlong Padung Krung Kasem Project was initiated in response to the Government's policy to promote tourism and develop new tourism sites. There were three agencies joining this project: the Secretariat of the Prime Minister, the Bangkok Metropolitan Administration, and the Tourism Authority of Thailand (The Government Public Relations Department, 2015).

The Prime Minister Prayut Chan-o-cha initiated Khlong Padung Krung Kasem Floating Market project. He mentioned that Khlong Padung Krung Kasem was an important waterway in Thai history. It has several significant temples

along its side. The development of Khlong Padung Krung Kasem as a tourism attraction would provide, he suggested an opportunity for visitors to learn more about Thai culture and history (The Government Public Relations Department, 2015).

The project indeed does give live to the *khlong.* It was used for a floating market, transportation, marketing, and tourism. It also promotes the communities and other available markets and water markets in and around Bangkok. Although the creation of Khlong Padung Krung Kasem as a floating market was initiated by Prime Minister Prayut Chan-o-cha, the theme was developed later. The theme of the market was presented as "5 *talad bok, 6 talad nam,"* which means 5 land markets and 6 floating markets. The five land markets are Talad Nang Leung, Talad Wat Thong, Talad Wat Nimmanoradi, Talad Hua Takae, and Talad Luang Paeng. The six floating markets are Talad Nam Taling Chun, Talad Nam Khlong Lat Mayom, Talad Nam Wat Sapan, Talad Nam Song Khlong Wat Taling Chun, Talad Nam Wat Gampaeng, and Talad Nam Bang Nampeung. The markets are located in and around Bangkok. Interpretation and marketing technique are effectively used and were successful in utilizing the *khlong* and promoting tourism.

Figure 110 Khlong Padung Krung Kasem in the reign of King Rama VI. It is *khlong khu meaung* without city wall like in the earlier khlong khu meaung

Source: Accessed April 18, 2016, Available from http://www.sujitwongthes.com/2015/02/siam12022558.

Figure 111 Talad Nam Khlong Padung Krung Kasem Revival
Source: Accessed April 18, 2016, Available from http://www.siamrath.co.th/web/?q=category/channel/scoopthai-politics.

**4.7 Khlong Pream Prachakorn**

In 2012, there was the Khlong Pream Prachakorn project, contributed by Matichon Public Company Limited. After the launching of the project, there was a good response from many agencies, as well as from the community. Schools and monasteries were involved. They formed a club and network in doing so. The principle of the project was to promote “knowledge mobilization, religion upholding, and development all water resources and the rivers.” Activities included cleaning campaigns that have been organized continually to the whole length of Khlong Pream Prachakorn. This project is an undertaking of the private sector, which created awareness about the *khlong* and contributed it to the community (Matichon Public Co.,Ltd, 2012).

Figure 112 Khlong Pream Prachakorn restoration
Source: Accessed April 18, 2016, Available from http://info.matichon.co.th/report/2555/pdf/socialsevice.pdf.

**4.8 Khlong Pasi Chareon**

In addition to the above efforts, there is also movement to revive *khlong* for use in transportation. The Khlong Saen Saeb Ferry is known as the transportation of choice from the city to the east of Bangkok. The current attempt is to create a link to the west of Bangkok. That is the Khlong Pasi Chareon Ferry. But there is not only the revival of transportation at Khlong Pasi Chareon but also cleaning, dredging, and other cultural activities. *Khlong* awareness, awareness of the architecture along the *khlong*, and awareness on life along the *khlong* were concerns of the ferry service. Therefore, there is a speed limitation for the ferry. There is also use of social media to promote the use of the ferry and to communicate with the community at https://www.facebook.com/Pasrijaroenboat/. There are attempts in making now for new ferry service. The new ferry is made in a different design from older boats with window glass and GPS tracking system. Unfortunately, many found the new design to be hot, as air did not flow very well. Details of transportation route are already mentioned in Chapter 4.

Figure 113 The new ferry which is introduced in a trial phase in April 2016
Source: Accessed April 18, 2016, Available from https://www.facebook.com/Pasrijaroen boat.

**4.8 Khlong Bang Prathun**

After the big flood of 2011, local residents spent more time at their home and realized that *khlong* was a part of their home. They also saw they were very beautiful and realized that their homes were now being threat by urbanization. The use of *khlong* was also decreasing. There used to be school ferries much like a school bus full with students in the morning, but now this experience is rare. There is only one monk using a boat asking for alms. Post is still delivered via boat but only by one postman. The agricultural way of life is decreasing and is not passed to the up coming generation. The contrast between locals and new comers is increasing. Wat Kaew Paitoon, a site that used to be the center of the community, also had a decreasing role in community life.

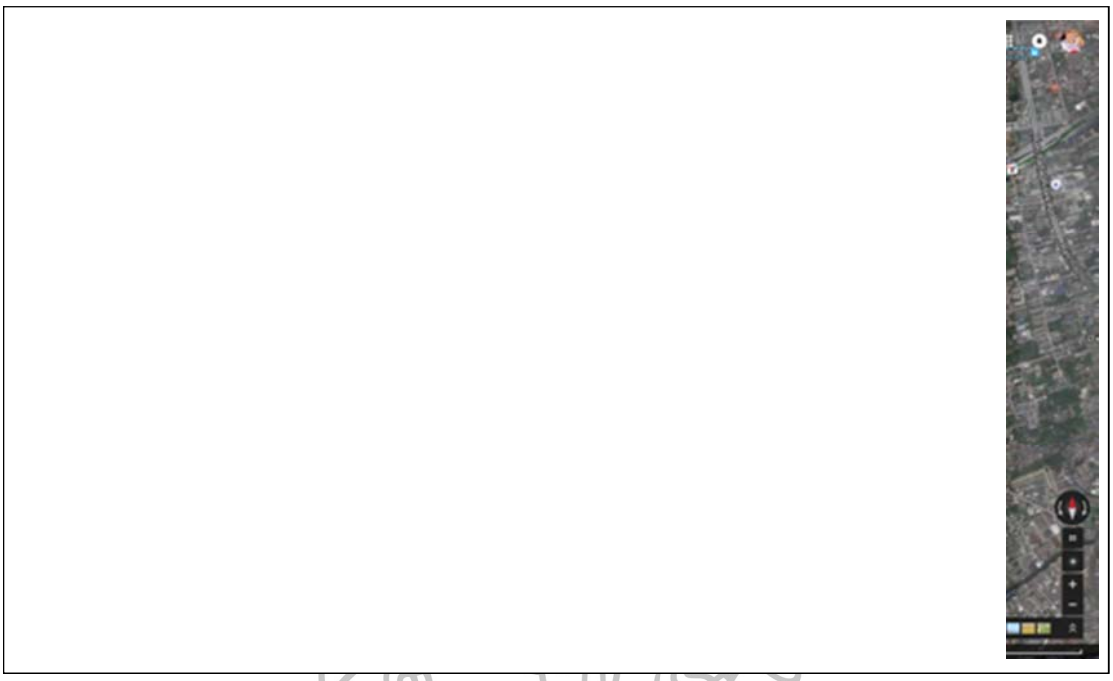


Figure 114 Map of Khlong Bang Prathun shows the encroaching of urbanization to the green area of Khlong Bang Prathun

Source: Accessed February18, 2016, Available from https://www.google map.

At the beginning, the objective of the project was to slow down change and prepare the community for the future. The activities were to document local lives and stories of Khlong Bang Prathun then make an exhibition. The exhibition process had helped bring awareness to the community. People now love and cherish their way of living. The community became stronger. Activities later expanded to the cleaning of *khlong* and making of other activities. Children are involved in the activities of Khlong Bang Prathun too. One significant activity is that the community negotiated with a big mall that was coming to the Khlong Bang Prathun area. The community success involved the water treatment plan of the mall, the fence, and the pier entrance. They also used social media to communicate within the community and with the social. Their Facebook page is https://www.facebook.com/KlongBangPrathun. The result was successful and the community became stronger. They are proud of their community more than before. Agriculture activities were also revived. Stories and skills are now passed on to the next generation. Their objective continues to be expanding awareness of the way of life as people along the *khlong*.

Figure 115 Khlong Bang Prathun with shade from trees
Source: Accessed February 24, 2016, Available from https://www.facebook. com/photo.php?fbid=11474798452632 56&set=a.1147478281930079.1073742006.100000037545554&type=3&theater.

**5. Directions in Bangkok *Khlong* Revival Movement**

*Khlong* revival projects in Bangkok are scattered. It can be seen that there is no overall plan for the revival of *khlong*. As *khlong* are linked like a network, water flows from one *khlong* to another *khlong.* Taking care and making one clean *khlong* will not fully benefit the whole. But a pilot project is better than leaving *khlong* to deteriorate to a worse condition. Also, there is no specific center or organization that specializes in the revival of *khlong.*

Partnerships are important for the revival of *khlong*. The involvement of government agencies, scholars, the private sector, social media, and the community will increase the possibility of a successful project.

The revival plan is mostly concerned with water quality and the landscape. Therefore, it neglects the value of heritage and other functions of *khlong.* Even though

the quality of water and landscape play an important role in revitalization, the function and heritage of *khlong* are very important to the successful revival project too. Function can benefit the community easily and heritage can make *khlong* unique and special.

On the other hand, reviving the function of *khlong* linking *khlong* back to everyday life as well as activities in *khlong.* The community and society will have more connection to water. The awareness of *khlong* may also be enhanced.

Improving the quality of water is mostly done through the cleaning projects. Those are mostly about getting rid of solid waste, dredging, and improving the water flow and the look of the water. But the source of dirty water, from daily consumption, is still not efficiently dealt with.

After a project is initiated many do not have a management team and management plan. Therefore, revival or development cannot continue. Some projects started with a supporting budget but without an effective plan after the project; no budget or manpower is available afterward as well.

Tourism is sometimes used as a tool for the revitalization of *khlong*. It gives *khlong* their livelihood. Tourism generates income. It gives pride back to the community. However, the question of income distribution, effects on the environment, effects on the culture, effects on uniqueness, and effects on normal life have to be considered as well. Tourism can bring staged and generalized experience to the tourist, which in long term will not benefit the tourism activity.

Interpretation can be useful in revitalization. For the example of Khlong Padung Krung Kasem and Khlong Bang Prathun interpretation was being put forward. Khlong Padung Krung Kasem presented a problem because the day-to-day sewage created a dead monument. And yet, it is an important *khlong.* This *khlong* comprises an important historic value for the city of Bangkok. Khlong Padung Krung Kasem was not used for any water activities up until the recent initiation of the new project in 2015. Talad Nam Khlong Padung Krung Kasem use are meant to interpret all floating markets and markets along the *khlong* in and around Bangkok. Even though the floating market is staged it can be a compromise because of the quality of ideas representing other markets. On the other hand, Khlong Bang Prathun uses interpretation as a tool for the community to realize the beauty and the value of their

neglected *khlong*. Both have had good results. In some *khlong* such as Khlong Saen Saeb, which is very rich in history and culture, interpretation has not been effectively applied. It is an unfortunate loss of possible benefits.

*Khlong* can be used as a means of transportation. There is a plan to develop water transport to be linked with rail transportation. This might be beneficial to Bangkok as traffic is very bad. But the question of the effect from the use of transportation has to be considered. In Khlong Saen Saeb water transportation is used. There are complaint of noise and the strong tide from the ferry. This lowers the quality of life for people in the area too. At Talad Nam Wat Sai where people came to trade fruits and other products, increased tourism resulted in bigger boats being used. Bigger boats affect the local boats. It results in a decreasing number of local residents that come to trade. When there is no trade in the water, the *Talad Nam* did not attract tourists anymore. Therefore, Talad Nam Wat Sai lost both local activity and tourist activity.

**6. Conclusion**

Bangkok's geography is suitable for a water-based city. Development of Bangkok in the past has changed from water-based to land-based and many problems have arisen. The revitalization of Bangkok *khlong* can improve the city. But this process requires more work. Examples from the movement of revival projects in Bangkok have shown some issues around *khlong* revitalization, such as the community involvement, important of community hearings, the use of tourism, interpretation as a tool, and many more.

The idea of revitalization in the worldwide content will be discussed in the next chapter.

# Chapter 6
# Waterway Revitalizations

> "Cities seek a waterfront that is a place of public enjoyment. They want a waterfront where there is ample visual and physical public access – all day, all year – to both the water and land. Cities also want a waterfront that serves more than one purpose: they want it to be a place to work and to live, as well as a place to play. In other words, they want a place that contributes to the quality of life in all of its aspects – economic, social, and cultural".
>
> (Seattle Department of Planning and Design, 2012)

The decline of waterways (river and canals) was not an uncommon issue. Many cities in the world have faced a rapid industrialization and growth in which they were not able to sustain their waterways that run through their unban areas. Recently, many cities have started to realize the importance of their waterways. Therefore, there has been a movement to revive or restore the waterways to promote public space, tourism, and the well being of the people.

In the United Kingdom, Canada, and the United States, the waterways have been restored focusing on the improving of navigability, while in Australia the focus includes the improvement of water quality (Princeton University, 2013). The movement for the revitalization of waterways has been developed over a few decades.

## 1. Definitions

Revitalization (definition by the Cambridge Dictionaries Online) is "the process of making something grow, develop, or become successful again" (Cambridge University Press, 2016). The definition of revitalization by the Oxford Dictionary is "the action of imbuing something with new life and vitality" (Oxford University Press, 2016).

There are also words often used such as “Waterway Restoration,” which according to the Princeton University Website is “the activity of restoring a canal or river, including special features such as warehouse buildings, locks, boat lifts, and boats.”

Words such as waterways renewal, waterways redevelopment, waterways reconstruction are also used in these types of projects. In this research, revitalization of Bangkok *khlong* is the process of making *khlong* grow, develop, strong, active, and be successful for Bangkok and its people again.

**2. Movement of “Inland Waterways” or “Canal” Revitalization**

The global trends of tourism including community-based tourism, eco-tourism, and sustainable tourism have an influence on the transforming tourism activity in Bangkok. Planning and the revitalization of the urban waterfront has been a focus in the US since the early 1960s. Revitalization has had an impact on many European cities, especially the revitalization of the urban waterfront, in the 1970s and 1980s and Asian cities since the late 1980s and 1990s. Waterfronts have become an area of interest for urban management and urban developers. Many waterfront projects have been initiated and have expanded the development strategies of waterfront areas to broader issues that can contribute to urban redevelopment as well.

The environmental awareness also plays an important role in the restoration and revitalization of waterways.

**3. Benefits of Waterway Revitalization**

The benefits of waterways revitalization or waterways restoration have been studied and scrutinized in many documents. Some are shown here.

> “The restoration to navigation of canals and rivers has revitalized key parts of the country’s transport and industrial heritage, generated jobs and development and increased opportunities for leisure, recreation and tourism.”
>
> Waterways for Tomorrow, 2000

> "Canals make a significant contribute to the Scottish economy. They provide a valuable local amenity and resource for education, recreation, and tourism as well as acting as a catalyst for change and creating the opportunity for renaissance for many communities."
>
> Scotland's Canals - An Asset for the Future, 2002

> "Urban waterways have the potential to support healthy environments, growing business and educational and recreational activities. By bringing together the experience and expertise of multiple federal partners, we have a chance to reconnect local residents, young people and community groups with the environmental resources all around them."
>
> Lisa P. Jackson, EPA Administrator

> "Restoration is the catalyst for redevelopment and regeneration in the canal corridor, we've seen an investment of over £85 million across two Local Authorities, creating over 300 jobs and the restored canal had been the catalyst for two major district center developments"
>
> Graham Birch, Chair, Huddersfield Canal Society (Canal & River Trust, The Inland Waterways Association, n.d.)

The document *Water Adds Value* by the Canal & River Trust and The Inland Waterways Association has carried out a research project to explore the economic, social and environmental impacts of restoration projects in the last two decades in Great Britain. The research sums up the benefits of waterways restoration in three parts: economic benefits, social benefits, and environmental and heritage benefits (Canal & River Trust, The Inland Waterways Association, n.d.).

In economics, waterways revitalization includes the short-term impacts, such as a construction jobs, and more long-term impacts, such as increased in leisure and tourism and the re-development of disused land and buildings. Revitalization has rescued the future of many historic buildings and canal side can also be developed. Revitalization also contributes to an increase in the number of visitors - and visitors spending - as well as

stimulating regeneration and development activities (Canal & River Trust, The Inland Waterways Association, n.d.).

Social benefits are the social outcome from increased employment, economic activities, and regeneration impacts. Benefits include a sense of community, through campaigning and volunteering for local projects, as well as benefits to health, through increased opportunities for walking and cycling (Canal & River Trust, The Inland Waterways Association, n.d.).

In terms of environmental and heritage benefits, benefits include a significant positive impact on many aspects of environment, such as the benefits of biodiversity in flora and fauna and increased in green space. There are also benefits to traffic (more people use towpath for commuting), drainage, and reduced carbon dioxide emissions. The data shows that local people were seen as the engine behind regeneration and played a fundamental role in maintaining the heritage of waterways (Canal & River Trust, The Inland Waterways Association, n.d.).

From these studies it can be concluded that successful waterways revitalization projects can benefit the city in many different areas. Revitalization can lead to a better city.

**4. Examples**

**4.1 Amsterdam, Netherlands**

Amsterdam is a famous water city. The canals and harbors fill a quarter surface of Amsterdam (Amsterdam Info, 2003). The earliest canals are the city defensive structure. As the city expanded further than the old canals, they lost their function as a defensive structure. But eventually, the canals were then used for transportation and this new function made the city wealthy.

Later, as with many other cities, to make more roads and more space Amsterdam filled in many of its canals. Some canals were filled for sanitation purposes. Some new roads are still called *"gracht"* (canal) because they were once canals (Gray, n.d.). The largest project to redefine the relationship of the city to its canals was the construction of the Central Station in 1885. The station connected rail and roads as well and left canals behind. The canals, as a result, were in a bad

condition. After WWII, the number of houseboats increased, because of the lack of housing, and most houseboats are illegal (Maarten Claasen, 2013).

Beginning in the 1950s, a new function for canals was introduced in Amsterdam. This was recreation. There were canal tour operations. Amsterdam has the advantage of using its canals as there are more access to canals there comparison to other water cities, such as Barcelona, Copenhagen, and Stockholm, which utilize canals for markets, promenades, and other public uses (Maarten Claasen, 2013).

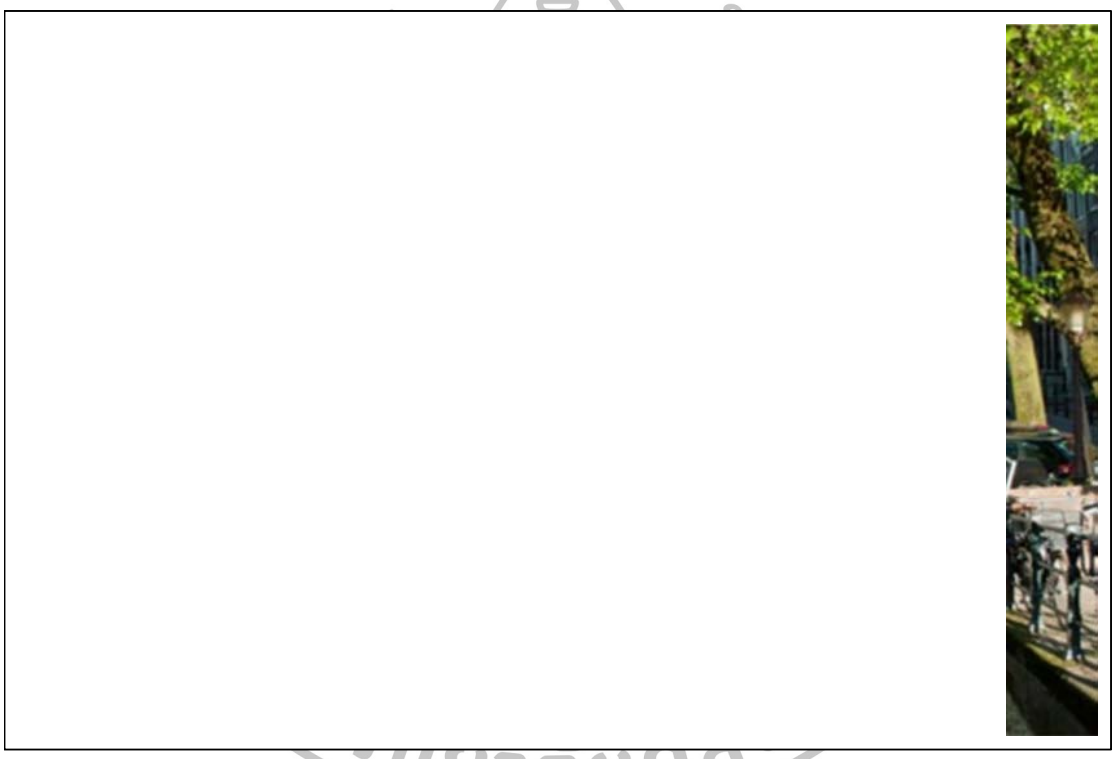


Figure 116 Canals in Amsterdam

Source: Accessed March 9, 2016, Available from http://thetravelbunny.com/ 2013/07/03/ amsterdam-canals.

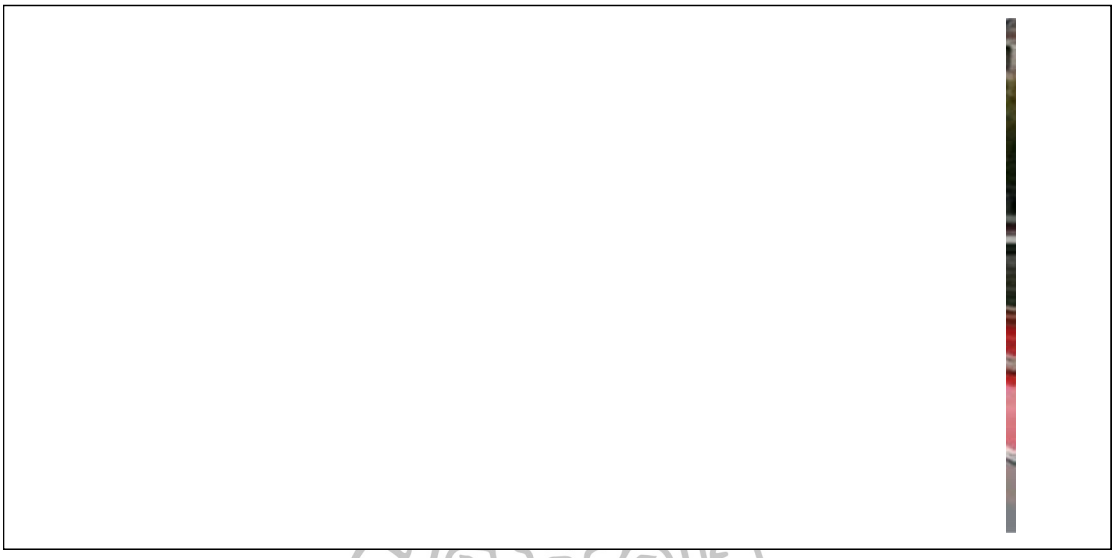


Figure 117 Canal Cruise in Amsterdam
Source: Plan Amsterdam Document, p.3

Currently, there are 165 canals in Amsterdam with the total length of about 100 kilometers (Amsterdammer, 2015). Amsterdam canals carry some three million passengers every year. Canals tours are considered to be one of the most popular attractions of Amsterdam. There are many busy events successfully take place on and around the canals. (Maarten Claasen, 2013).

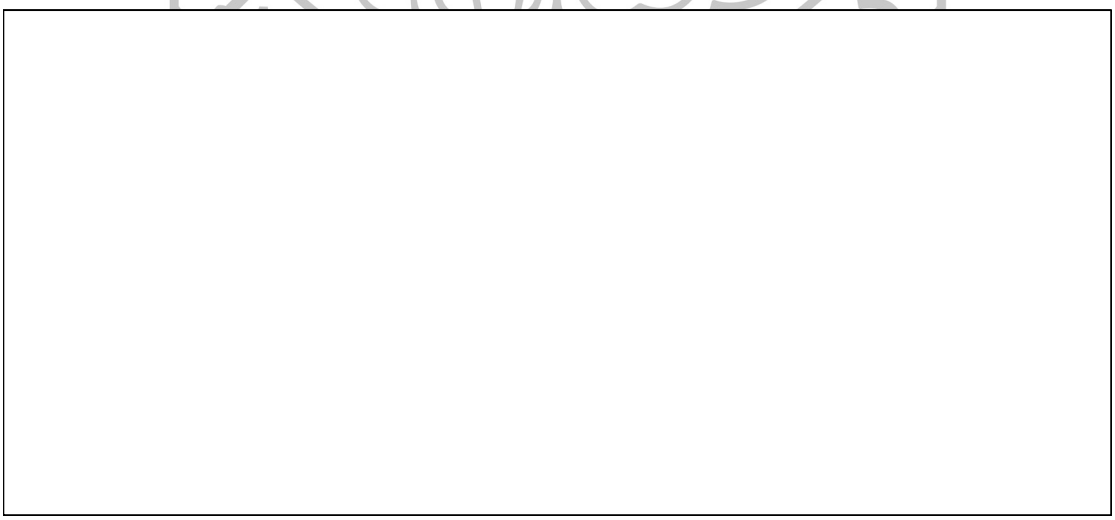


Figure 118 Canal Parade Gay Pride 2015, Amsterdam
Source: Accessed March 11, 2016, Available from http://www.gettyimages.com/ galleries/ photographers/frank_wijn.

Today, canals in Amsterdam are used for navigation, tourism activities, recreational activities, such as boating and skating, special events, restaurant boats, and many other things. Canals are also home for many people who live in houseboats (A View on Cities, n.d.).

Amsterdam provides a good example of the projects that involve waterways to the city into everyday life of the people.

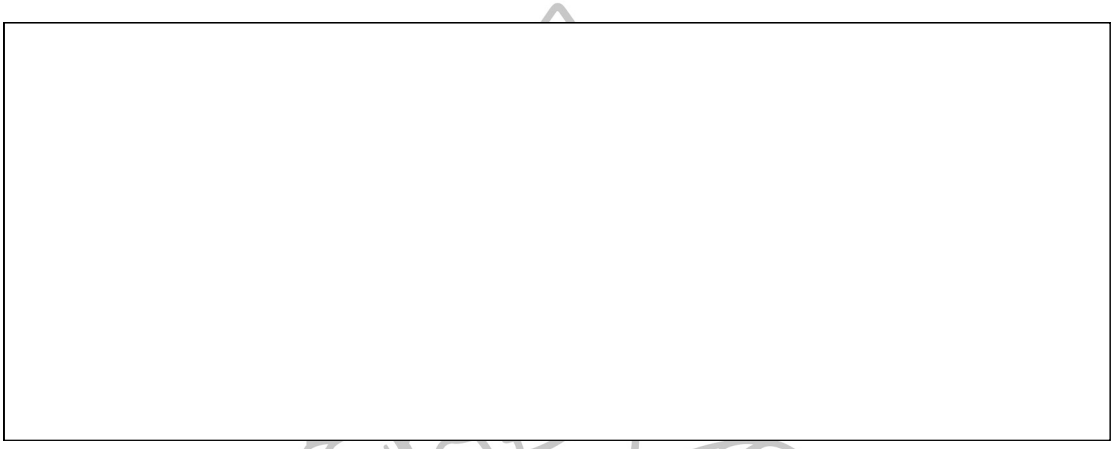


Figure 119 Houseboats in Amsterdam Canals

Source: Accessed March 9, 2016, Available from http://www.aviewoncities.com/amsterdam/canals.htm.

Amsterdam also comprises a group of canals that is listed in 2011 in the UNESCO World Heritage list. It is the Canal Belt. The Canal Belt is a concentric belt around the old city of Amsterdam. It is made of three canals ringing the old core of the city.

Figure 120 Canals Belt

Source: Accessed March 9, 2016, Available from http://www.dutchamsterdam. nl/canals.

### 4.2 Cheonggyecheon Restoration Project, Seoul, South Korea

Cheonggyecheon is a stream that flows through downtown Seoul. It was originally a seasonally flowing brook that developed into a stream in 1412, with fourteen waterways.

Figure 121 Cheonggyecheon in the past
Source: Accessed February 11, 2016, Available from http://worldcongress2006. iclei. org/uploads/media/K_LEEInKeun_Seoul_-_River_Project.pdf.

In the1900s, the South Korean government began to cover the stream for military, sanitary, and flood control purposes.

In the mid 1970s, an elevated highway was built over Cheonggyecheon. There were approximately 168,000 vehicles a day on this highway.

In 2002, Lee Myung-bak, Seoul's new mayor, proposed a restoration project for Cheonggyecheon. He believed that the projects would benefit the city, including providing an opportunity for development, revitalizing the downtown economy, and nurturing a breathing place for the city.

Because of the history of Cheonggyecheon, the project was processed as a symbolic task and the entire country of South Korea was eager to revive this historical and natural heritage (Lah, 2012).

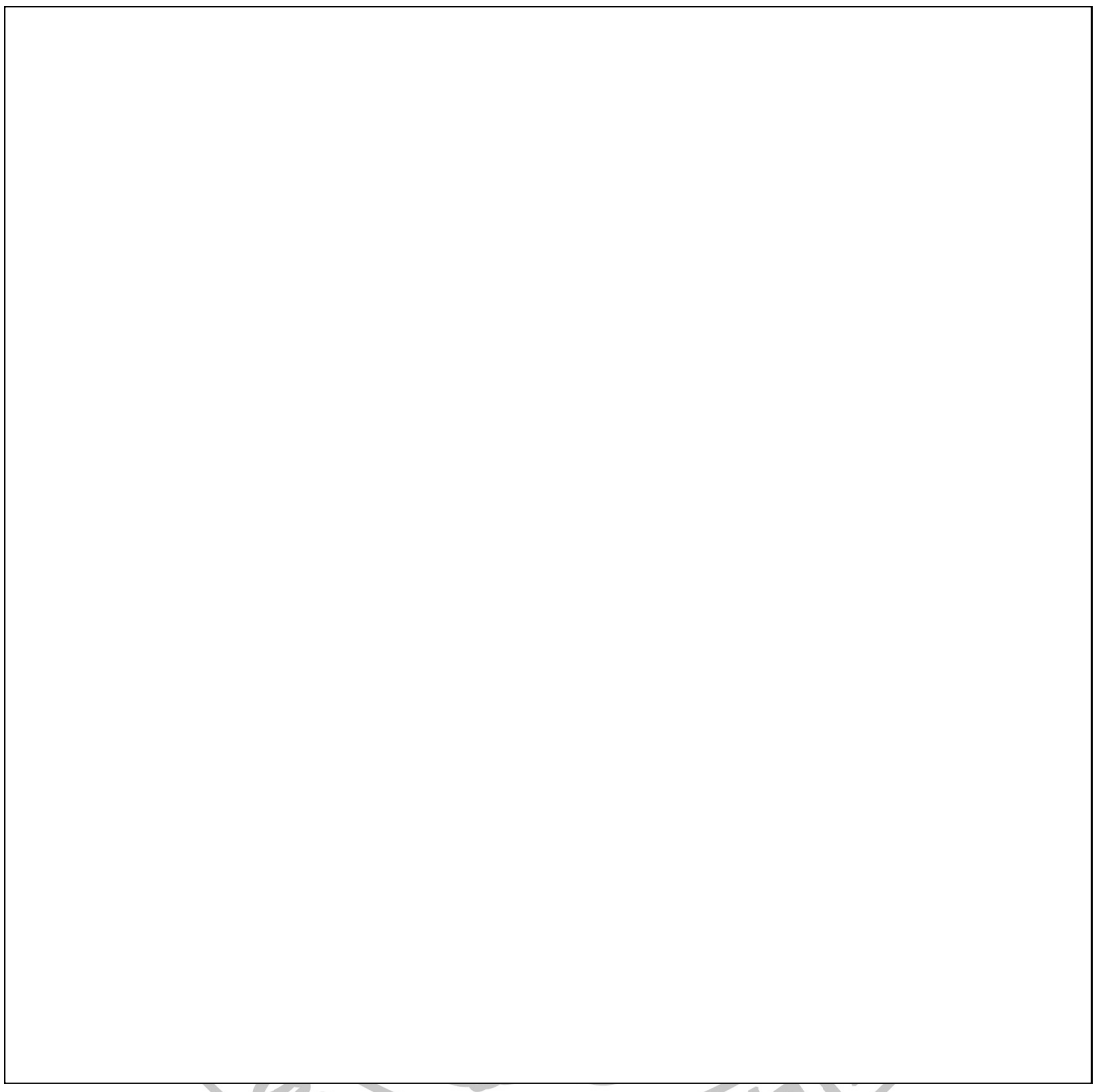


Figure 122 Cheonggyecheon Highway in 1990s
Source: Accessed February 11, 2016, Available from http://worldcongress2006.iclei.org/uploads/media/K_LEEInKeun_Seoul_-_River_Project.pdf.

The project was to create a 5.8 kilometers landscape of green pathways along the revitalized the old stream of Cheonggyecheon. It was about restoring nature in an urban setting. The project starts from the Taepyeong-ro district - the very center of Seoul - and runs to the east and exits the old fortified Hanyang near the East Gate. At the east end of the stream, it is joined by another stream called Junglang-cheon, flowing from the north of Seoul.

Figure 123 Cheonggyecheon
Source: Accessed February 11, 2016, Available from https://carolineguillet.files.wordpress.com/2014/03/cheonggyecheon-restoration-project.pdf.

Since its opening in 2005, Cheonggyecheon has been popular among residents and visitors. The stream has become a tourist attraction, drawing about 18.1 visitors by the end of 2008 (Commission for Architecture and the Built Environment, 2011).

The results of the Cheonggyecheon project are environmental benefits, social benefits, and economic benefits (Landscape Architecture Foundation, n.d.).

Environmental benefits include providing flood prevention, increased biodiversity, reduction of the urban temperature, and reduced small particle air pollution. The project further increased the biodiversity by 639% from 2003 to 2008. Plants species increased from 38 to 62, fish species increased from 4 to 25, bird species increased from 6 to 36, aquatic invertebrate species from 5 to 53, insect species increased from 15 to 192, mammals species increased from 2 to 4, and amphibians from 4 to 8 (Revkin, 2009; Lee, 2006). The temperature along the stream is 3.3° to 5.9° C cooler than that around the parallel road, which is about 4 to 7 blocks

away (Lee, 2006). The small particle air pollution is reduced by 35% from 74 to 48 micrograms per cubic meter (Revkin, 2009).

Figure 124 Cheonggyecheon stream stretches in the city of Soul shows the nature harmonizing in the city

Source: Accessed April 19, 2016, Available from http://auracles.blogspot.com/2013/04/seoulful-trip-day-3-4th-destination.html.

The social benefits are an increase in bus ridership by 15.1% and subway ridership by 3.3% from 2003 to 2008 (Lee, 2006). The site also attracts about 64,000 visitors per day (Lee, 2006).

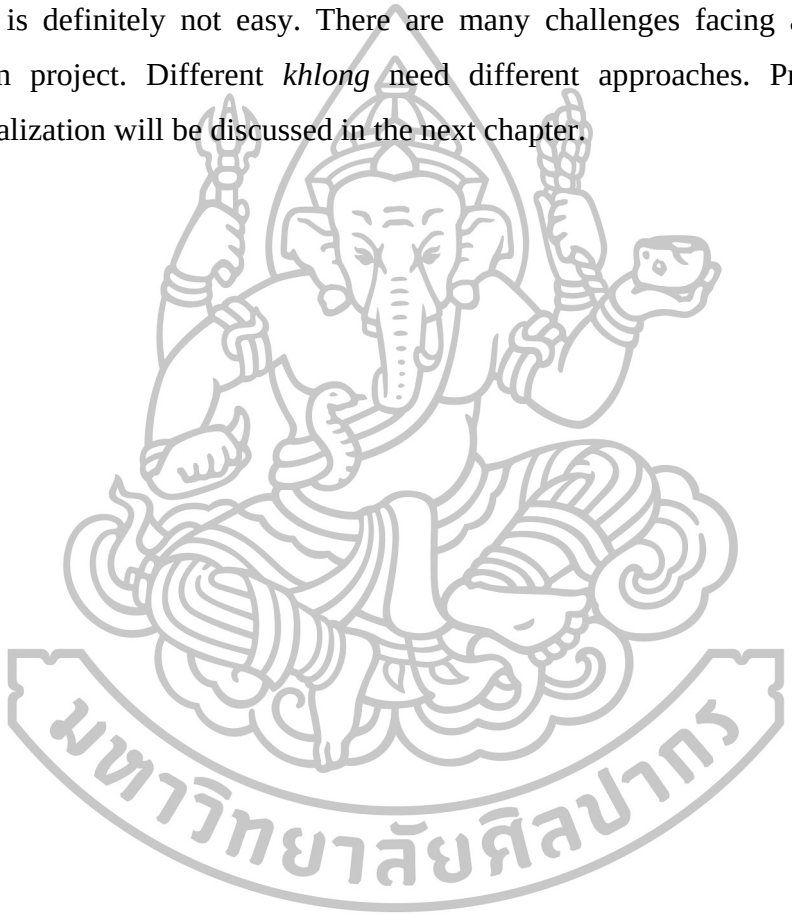
In economic terms, the project has increased the property value within 50 meters from the restoration by 30-50%. Business numbers have increased by 3.5% in the Cheonggyecheon stream restoration area (Lee, 2006).

The case of Cheonggyecheon is a good example of where canal revitalization, with the initiation from authority and community hearing process, has contributed to the environmental, economic, social, and public identity of Seoul. The project demonstrates revitalization creativity and the possibilities interested in mega projects.

**5. Conclusion**

It can be concluded that revitalizing urban waterways can benefit cities in many ways. Many cities with declining waterways have already started the movement and have demonstrated success. Each waterways revitalization project is unique, according to the context and aim of their projects.

These examples make the revitalization *khlong* in Bangkok appealing but the process is definitely not easy. There are many challenges facing a successful revitalization project. Different *khlong* need different approaches. Proposals for *khlong* revitalization will be discussed in the next chapter.



# Chapter 7
# Proposal

> "Sustainable development is a development that meets the need of the present without compromising the ability of future generations to meet their own need." (Brundtland, 1987)

This study has shown that *khlong* are valuable assets for Bangkok. They are part of the history of Bangkok from the origin. *Khlong* are suitable for the way of living in the plain delta. In the past, the development of the city and the people has led to *khlong* extending in different directions. Overtime, *khlong* decreased in use and importance. Many were subsequently filled and neglected. Recently, the importance of *khlong* has been raised to the public, one big contribution coming from the big flood in 2011, especially as part in the drainage system of Bangkok. But some people have also realized that *khlong* are more valuable to the city than just for drainage. Therefore, attempts to revive *khlong* have been initiated. Some revitalization projects have been successful and some not. This chapter presents a proposal for *khlong* revitalization in Bangkok as a whole.

To accomplish the revitalization of *khlong*, it is important to establish effective management collaborations, partnership agencies that authorize the holistic management of *khlong.* This type of management will transform *khlong* into economically beneficial assets, while preserving the heritage of the city. The recreational use of *khlong* will also be part of authentic *khlong* and authentic *khlong* proposal.

Revitalization should aim to provide a green city and improve the quality of life of the people.

**1. Trait of *Khlong* Revitalization**

1. *Khlong* revitalization needs to consider the connection of geography to the city. This understanding will lead to an appropriate land use scheme that respects living with nature.

2. *Khlong* revitalization is a merging of conservation, restoration, and development.

3. *Khlong* revitalization is not a start and finish process. It has to be continuing as part of the city.

4. *Khlong* are connected as part of a network. Water flow in different contexts. In other words, each *khlong* maybe revived differently, but all *khlong* are connected.

5. *Khlong* revitalization success may not be indicated directly by increases in income but by other benefits, such as environmental and social improvements. There are also indirect benefits from *khlong* revitalization too.

6. *Khlong* revitalization requires multi-disciplinary skills and knowledge.

7. There is no prototype for *khlong* revitalization. Each *khlong* is unique and should be dealt with differently.

**2. Directions**

The direction of revitalizing *khlong* must be to follow the idea of sustainable development. *Khlong* should utilize the idea of a water-based city, as water-based cities are suitable way of living in the area of plain delta like Bangkok.

**2.1 Sustainability**

Sustainable development will strive to create a balance between social, economic, and environmental factors. With the balance of these three factors, *khlong* have high potential to successfully connect Bangkok and its people. The revitalization will be sustainable, successful, and beneficial if it meet the needs of community, enhance the economy, and does not negatively affect the environment.

To be sustainable, *khlong* revitalization should be beneficial to the community. And it should be self-sufficient. The management should find ways to distribute income or other benefits to the community, as well as find ways to manage future change.

**2.2 Develop toward a Water-Based City**

As Bangkok has geography suitable for a water-based city, development of the city in a different direction will need greater effort and can create problems such as floods. The development of the city back to a water-based city will contribute much to any *khlong* revitalization projects in Bangkok. It does not mean moving back and living as in old times, but to move on and make Bangkok a modern, water-based city.

One tool to connect water to the city is to improve the physical condition of *khlong* and put in more functions. Improvement of a physical condition of *khlong* will enhance the friendliness of the city and make it usable and accessible. Embankments and pathways should be built and maintained in a useable way. Historical ceremonies and traditions should also be revived. Recreational activities in the water and *khlong* banks and new events also must be encouraged. Accessible open space should also be considered. Innovations in living with water should be encouraged. For example, developers should consider elevating houses, fast boats with less noise, water treatment products, and other considerations.

It is also important that efforts be made to connect *khlong* to other important features, such as to the core of the city for transportation routes, connections to important architecture, museums, and communities. These connections can enhance tourism activities, including cultural routes as well.

**2.3 Holistic**

The revitalization of *khlong* holistically involves multi disciplinary approaches, involvement of all stakeholders, and bringing all concerns into account. These include community affairs, social interests, and the environment. To address one aspect or solving one problem and ignore others may result in other problems.

To accomplish this, all information should be collected from every stakeholder, including government agencies, communities, scholars, business owners, and other interests. Therefore, a team with should be established accordingly.

The management team will evaluate *khlong* and their surroundings, making decisions and planning. Planning for revitalization consists of a beginning stage and extends to the ongoing process of implementing, evaluating, adaptation, and again implementing.

**2.4 Resource Management**

*Khlong* need water to function but water is a limited resource. A primate city such as Bangkok has difficulty in providing enough resources as well as taking care of waste, including wastewater. Therefore, development of the country needs to decrease the population density of Bangkok. This approach needs to be applied to other provinces as well.

Awareness of sufficient use of water as well as the littering control should be raised, not only for reviving *khlong* but also for the whole city.

**2.5 Revitalization Organization**

A non-profit, non-governmental organization is probably a first step in taking care of *khlong* as a whole in Bangkok and in other provinces, and country at large in revitalization projects.

The revitalization organization would aim to be the center of *khlong* revitalization efforts. The task would involve giving all kinds of support to the revitalization projects, including fund-raising, community communication, market needs, and other knowledge.

The organization would be comprised of many stakeholders from many *khlong*. They could use the organization to share their knowledge, seek common help, enlist professions, and learn from others, while at the same time promoting their ideas.

**2.6 Keep Identity**

The identity of individual *khlong* includes the attribute that makes one particular *khlong* different from other *khlong*. It can be a sense of place, natural character, built character, or culture.

Enhance the positive identity of *khlong* not only helps the meaning of a place, but also is a valuable asset for tourism. Therefore, finding the true culture of individual *khlong*, and their relationship to geography and early settlement is an important first step.

The study of identity of place is important to the revitalization of *khlong*. Different *khlong* are unique and should be dealt with accordingly. This identity will be a solid foundation for *khlong* revitalization.

### 2.7 Compromise to Change

While keeping identity is important and is also an advantage for revitalization but changes are necessary. The current condition of *khlong* might have already been changed from the original condition. Therefore, changes are needed to facilitate future uses of community. Changing and maintaining identity should be well compromised.

## 3. Stakeholders and Partnership

Every stakeholder should be involved and support *khlong* revitalization project to become a broader partnership. By involving all stakeholders, more aspects will be taken into account in the revitalization process. Notably authority, experiences, skills, knowledge, budget, and manpower all need to be applied.

### 3.1 Government

The government plays an important role in the development of the city and its structure. The government should play active part in the revitalization process.

The government should invest in water treatment facilities for Bangkok. *Khlong* should drain rain and water from the north as well as seawater, while wastewater should be distributed elsewhere and treated before redistributing into the *khlong*.

The government, in particular the BMA, should encourage public, private, and voluntary sectors to be involved in the revitalize process. The government can assist in the process by providing a revitalization guideline, outlining information about skills, knowledge, and challenges; for example, clear guidelines to evaluate *khlong* or guidelines to get funding and create partnerships for a project. Tax incentive could also attract more revitalization projects.

Law enforcement has to be dealt with accordingly. The encroachment of *khlong* by homes should be dealt with at an early stage, as many cases have shown to have difficulty after a long period of time.

### 3.2 Local Communities

Local communities should have a clear vision of what they want to achieve or to become. Involving local people in the revitalization process as well as other activities will give a positive effect toward sustainable *khlong* revitalization.

Local participation can include access to *khlong* from their own homes. That is the first thing an individual can do. When there is access there are possible uses. When there are uses there is awareness. Littering the *khlong* can become less common with the eyes of neighbors monitoring their *khlong*.

Local community members should see the benefit of *khlong* revitalization. Therefore, they will see the importance of keeping *khlong* useable and function.

**3.3 Schools and Universities**

Schools can contribute to *khlong* revitalization by involving young people in the revitalization process. This can enhance the awareness of *khlong* and the importance of *khlong* to their community. School children can pass on to their parents or other adults the values they learn. As well as their awareness and attachment can continue into adulthood.

**3.4 Business Owners**

Business owners are important in providing jobs and in generating new investments that bring more money to the community.

**3.5 Scholars**

Scholars support the revitalization process by providing their expertise and skills in the revitalization process.

**4. Tools**

Many tools can be applied in *khlong* revitalization. Three suggested tools are given below.

**4.1 Interpretation**

Interpretation is a tool that gives meaning and understanding to *khlong.* Interpretation gives *khlong* importance and attention for revitalization. The process of identifying and interpreting places can be of use at the community level to increase awareness and help connect of people to *khlong* or for tourism. Interpreting *khlong* well will enhance not only touristic appreciation; tourists will be encouraged through interpretation to spend more time participate more, and have more curiosity about *khlong*. Interpretation needs to be effectively connected to the landscape of *khlong,* that is the area around them, as well as history, architecture, and culture.

### 4.2 Tourism and Recreation

Tourism and recreational activities can be important tools for *khlong* revitalization. Revitalization should also bring a fun livelihood of *khlong* back to the city. In preparing for tourism and recreational activities, infrastructure has to be prepared to underwrite activities such as access and transportation. Tourism can also generate money for *khlong* revitalization. On the other hand, a community may become proud of its *khlong* because others appreciate it. *Talad Nam* is one way to promote tourism for *khlong.* Reviving historical traditions also can contribute to *khlong* tourism. New festivals can also be tools for revitalizing *khlong.*

### 4.3 Transportation Use

Transportation is a way to bring *khlong* back to everyday use. As the physical aspect of *khlong* is linear and link to many areas in the city. Transportation use will also open more access for community. Larger number of people will be using *khlong* and relate to their normal life. Trade and other form of business can also advantage from the water-transportation. Innovation for water transportation maybe created with less noise and pollution to suit better in Bangkok's *khlong* context.

## 5. Conclusion

Bangkok *khlong* revitalization can be successful if stakeholders work together and plan towards sustainable development. *Khlong* can be revived as individual units but the process will be more effective as a whole. Tools such as interpretation and tourism and recreation activities can be utilized. This chapter suggests an overall direction for *khlong* revitalization project. To apply these ideas, the context of each project should be studied.

# Chapter 8
# Conclusions and Recommendations

The researcher aims to untapped another heritage of Bangkok. It can be concluded that even though *khlong* has decreased in numbers and importance there are still available potential.

## Conclusions

History of *khlong* is deeply related to the history of Bangkok. It has significant values in being the origin of Bangkok. Moreover *khlong* is a heritage that has been passed from generation to generation, at least from Ayutthaya period.

Looking broader to the world perspective, waterways or canals were widely used from the origin of civilization as it brought the essence of life, water, to the land and its people. They played an important role for many countries during the industrial revolution. But in most countries, waterways had been replacing by the development of railways. Only some countries continue to develop waterways along with other infrastructure of the city, Amsterdam, for example.

The neglected waterways being untapped by the revitalization movement in which environmental awareness is an important influence. In some countries, revitalization is mainly purposed to restore ecology of the waterways, while other places make use of it to bring all aspect of waterways back to the city. This includes the heritage aspect as reflect in the ICOMOS attempt to list heritage canals. Many studies have shown that success canals revitalization could benefits environment, society, and also economy. Therefore, it is worth looking back into current condition of *khlong* in Bangkok if it can be valuable asset to the city.

At the beginning of this research in 2010, the situation of khlong was much ignored, however, the big flood in 2011 has changed the way people look at khlong, at least some. Many maintenances and revitalization attempts have been made by various sectors including the government, the BMA, private sector, NGOs, scholars, and communities. The research therefore has developed into a different direction. This study then includes the study of revitalization attempts and its result, the needs of the city, and potential of *khlong*.

Meanwhile, other problems of Bangkok have been shown. The study shows that *khlong* involve or can be related to some of the problems such as flood, land erosion, pollution, quality of life, traffic, etc. Therefore, reviving *khlong* may help in decreasing problems for the city.

It was large amount of information and suggestions, also in many directions about *khlong*. The researcher has put revitalization movement mainly into two directions. The first direction is avoiding water, which is by using water management and water preventive structures, such as concrete banks Watergates. As a result, *khlong* will be revived to be separate from the society. The second direction is living with water by utilizing and planning uses of water to the city, which will result in stronger connection of society to water. This second revitalization direction focuses on the life of people and on heritage aspects to enhance people awareness for *khlong.*

The researcher suggests revitalization to be directed to the second direction, which is toward a water-based city, as it is suitable for geological of Bangkok. It also keeps cultural root of Bangkok, and Thailand. The researcher also proposes suggestions on direction of revitalization projects of Bangkok. They are to holistically and sustainably develop *khlong* and the city towards a water-based city with the involvement of all stakeholders particularly the community and keep its identity. In contrast, reviving *khlong* by separating *khlong* away from people and the city will lead to less understanding in living with water. Living without this understanding is difficult for Bangkok people, for city's lowland condition. This may result in dramatic loss in the event of flood, such as the one occurred in 2011.

**Difficulty of this research**

There is loads of information while difficulty of the revitalization is from the water quality and water management policy.

Bangkok *khlong* are so rich in heritage in various ways. Each *khlong* is unique. Without a deep study or research, community may not realize the real potential of *khlong*. But with the study, stories related to the people will flows.

*Khlong* in Bangkok are varied in many ways. For example the different nature between natural khlong and man-made *khlong* gives different possible potential in transportation and making of embankments. Also the different background of each *khlong*, gave each *khlong* special characteristics that might be unique and very valuable.

Also *khlong* relate to community in many layers. They involve the development of the city in policy level from the government, as well as also deeply involve to the local community.

**Recommendations for future research**

In chapter 7, the researcher proposed general directions for *khlong* revitalization. The researcher would like to note that the proposal need to be develop in a partnership atmosphere individually along with deep research on particular site prior to utilization. Challenges such as the question of authenticity, level of acceptable changes have to be taken to account. Community must be involved with the revitalization projects. Different projects may response differently. Staged heritage may be effective in interpretation for some cases but keep identity will be the foundation.

To develop *khlong* for tourism, the local community should find their strength such as their identity as a based of their development. The capacity, fair income distribution to all stakeholders and the maintenance of *khlong* should also be taken to account. Tourism can affect local community in both positive and negative ways, therefore, the community must decide whether they welcome tourism activities or not. Or, how can tourism be apply with less impact to their daily lives.

## References

A View on Cities. (n.d., n.d. n.d.). *Amsterdam's Canals*. Retrieved March 9, 2016, from A View on Cities: http://www.aviewoncities.com/amsterdam/canals.htm

A Brief History of Suez Canal. (2014, August 7). Retrieved October 28, 2015, from State Information Service: Your Gateway to Egypt: http://www.sis.gov.eg/En/Templates/Articles/tmpArticles.aspx?CatID=2872#.VjCN764rJTY

Anusasananan, J. (2012). *Changes from the Expansion and Management of Lad Mayom Floating Market.* Bangkok: Silpakorn University.

Andrews, E. (2014, November 17). *9 Fascination Facts About the Suez Canal*. Retrieved October 28, 2015, from History.com: http://www.history.com/news/9-fascinating-facts-about-the-suez-canal

Andriotis, K. (2005). Perceptions of and Preferences for tourism development: Evidence from Crete. *Journal of Hospitality & Tourism Research , 29* (1), 67 - 90.

Amsterdam Info. (2003, n.d. n.d.). *Canals*. Retrieved March 9, 2016, from Amsterdam Info: http://www.amsterdam.info/canals/

Amsterdammer. (2015, June 18). *Amsterdam FAQ*. Retrieved March 9, 2016, from Amsterdam FAQ: http://amsterdamfaq.com/1/amsterdam

Aon Benfield. (2012). *2011 Thailand Floods Event Recap Report: Impact Forecasting-March 2012.* Retrieved 2015 йил 11-July from Aon Benfield: http://thoughtleadership.aonbenfield.com/Documents/20120314_impact_forecasting_thailand_flood_event_recap.pdf

Bangkok Agricultural Extension Office. (n.d., n.d. n.d.). *Basic Information of Bangkok.* Retrieved January 28, 2016, from Bankok Agricultural Extension Office: http://www.bangkok.doae.go.th/ag/dataagri56.pdf

Bangkokbiznews. (2014, April 24). *First day of Phasi Chareon Ferry is quiet.* Retrieved January 20, 2016, from Bangkokbiznews: http://www.bangkokbiznews.com/news/detail/577518

Barrow, R. (2015, February 10). *Phadung Krung Kasem Canal and Floating Market*. Retrieved February 11, 2016, from Richard Barrow in Thailand: http://www.richardbarrow.com/2015/02/phadung-krung-kasem-canal-and-floating-market/

Bella S. Galil, D. M. (2006). Chapter 4: Snakes and Ladders: Navigable Waterways as Invasion Corridors. In J. L. John Davenport, *The Ecology of Transportation: Managing Mobility for the Environment* (pp. 71-76). Dordrecht: Springer.

BMA. (n.d., n.d. n.d.). *Bangkok Flood Protection System.* Retrieved January 6, 2016, from Asian - Pacific City Summit: http://apcs.city.fukuoka.lg.jp/download/mayor/pdf/13_bangkok_10me.pdf

BMA. (n.d.). Khlong Saen Saeb. Bangkok: BMA.

Bruce Douglas, M. T. (2001). *Sea level Rise: History and Consequence.* Miami, Florida: Academic Press.

Bruce Prideaux, M. C. (2009). *River Tourism.* Oxfordshire: CAB International.

Brundtland, G. (1987). *Our Common Future: The World Commission on Environment and Development* . Oxford.

Brummelhuis, H. T. (2007). *King of the Waters: Homan van der Heide and the origin of the modern irrigation in Siam.* Chiang Mai: Silkworm Books.

British Waterways. (2003, n.d. n.d.). *Waterways & Development plans.* Retrieved April 9, 2016, from http://www.britishwaterways.co.uk/media/documents/publications/Waterways_and_Development_Plans.pdf

Culture, Sports and Tourism Department. (2012). *Old Canals tell City History.* Bangkok: Culture, Sports and Tourism Department.

Culture, Sports and Tourism Department, BMA with reference to the Local Bangkok Museum Project, Chulalongkorn University. (n.d., n.d. n.d.). *Chak Phra Festival, Wat Nang Chee Chotikaram.* Retrieved March 8, 2016, from Living Cultural Sites: http://livingculturalsites.com/chapter22_02_02.html

CABE/Design Council. (n.d., n.d. n.d.). *Cheonggyecheon Restoration Project.* Retrieved February 11, 2016, from European Centre for River Restoration: http://www.ecrr.org/Portals/27/Cheonggyecheon%20case%20study.pdf

Canzenave, R. J. (2010, June 18). Sea-Level Rise and Its Impact on Coastal Zones. *Science* , 1517-1520.

Canal & River Trust, The Inland Waterways Association. (n.d., n.d. n.d.). *Benefits of Waterway Restoration.* Retrieved January 10, 2016, from Waterways Association: https://www.waterways.org.uk/waterways/restoration/restoration_resources/pdfs/water_adds_value_benefits_of_waterways_restoration

Cambridge University Press. (2016, n.d. n.d.). *Meaning of "revitalization" in the English Dictionary*. Retrieved March 19, 2016, from Cambridge Dictionaries Online: http://dictionary.cambridge.org/dictionary/english/revitalization

Cambridge Distionaries Online. (n.d., n.d. n.d.). *Canal*. Retrieved February 2, 2016, from Cambridge Dictionary Online: http://dictionary.cambridge.org/dictionary/english/canal

Chaikong, P. (n.d.). *West Thonburi Khlong Ku Meaung is left just as drainage*. Retrieved October 30, 2015, from Lek - Prapai: http://www.lek-prapai.org/watch.php?id=186

Christopher John Baker, P. P. (2009). *A History of Thailand (2nd Edition).* Cambridge: Cambridge Press.

Columbia University. (1963). *The Columbia Encyclopedia. 3rd edition.* Columbia: Columbia University Press.

*Collapse, why do civilizations fall?: Mesopotamia*. (n.d.). Retrieved October 27, 2015, from Annenberg Learner: http://www.learner.org/interactives/collapse/mesopotamia_sub.html

Commission for Architecture and the Built Environment. (2011, January 1). *Cheonggyecheon Restoration Project*. Retrieved February 11, 2016, from Commission for Architecture and the Built Environment: http://webarchive. nationalarchives.gov.uk/20110118095356/http://www.cabe.org.uk/case-studies/cheonggyecheon-restoration-project/evaluation

Council of Cultural Affairs of Bang Khun Thein. (2006). *Bang Khun Thein Culture Past to Present.* Bangkok: Council of Cultural Affairs of Bang Khun Thein.

Daily News. (2014, July 7). *Start operating 20,000 home invasion, results in 10 years*. Retrieved April 17, 2016, from Daily News: http://www.dailynews.co.th/bangkok/250546

Dailynews. (2014 йил 7-July). *Begin the Operation of removing two thousand homes and buildings encroaching khlong. Result will be seen in 10 years*. Retrieved 2015 йил 11-July from Dailynews: http://www.dailynews.co.th/bangkok/250546

Dallen J. Timothy, S. W. (2015). *Tourism and Trails: Cultural, Ecological and Management Issues.* Ontario: Channel View Publications.

Daoreuk Communications Co., Ltd. (2015, n.d. n.d.). *Water Transportation*. Retrieved January 20, 2016, from Bangkok Car Free: http://www.bangkokcarfree.com/travel4.php

Department of City Planning. (2012, June n.d.). *Agricultural in Bangkok.* Retrieved January 28, 2016, from Department of City Planning: http://cpd.bangkok.go.th:90/web2/strategy/DATA54_55/1AG.pdf

Department of City Planning, BMA. (2009). *225 Years of Rattanakosin.* Bangkok: Amarin Printing and Publishing.

Department of Environment, Bangkok Metropolitan Administration. (2013). *Bangkok State of the Environment 2012 (Revised Edition).* Retrieved December 19, 2015, from Environment: http://www.bangkok.go.th/environment

Department of Environment, BMA. (2012). *Waste and Wastewater Management by Community.* Retrieved 2015 йил 12-July from Environment: http://www.bangkok.go.th/environment/

Department of Drainage and Sewerage. (n.d., n.d. n.d.). *About*. Retrieved March 2016, 18, from Department of Drainage and Sewerage: http://dds.bangkok.go.th/about.php

Department of Drainage and Sewerage. (2010). *Information of Ku Khlong.* Retrieved December 20, 2015, from Department of Drainage and Sewerage: http://203.155.220.231/klong2553/klong02.pdf

Department of Drainage and Sewerage. (2010, n.a. n.a.). *Khlong Ku Lamrang Lamkradong.* Retrieved December 22, 2015, from Information of khlong ku lamrang lamkradong in Bangkok: http://203.155.220.231/klong2553/klong03.pdf

Department of Drainage and Sewerage, BMA. (n.d.). *Legend of Siam Irrigation.* Bangkok: Department of Drainage and Sewerage.

Department of Drainage, BMA. (2015). *Khlong Conservation community.* Bangkok: Department of Drainage.

Division of Policy and Planning, City Planning Department, BMA. (2011, September n.d.). *Report of Registered Historical Site in Bangkok in 2011.* Retrieved February 22, 2016, from City Planning Department: http://cpd.bangkok.go.th:90/web2/strategy/DATA54/AN_BKK54.pdf

Division of Policy and Planning, Department of City Planning. (2011). *Report listed of Historic Site in Bangkok in 2011*. Retrieved December 19, 2015, from Department of City Planning: http://cpd.bangkok.go.th:90/web2/strategy/DATA54/AN_BKK54.pdf

Douglas L. Johnson, L. A. (2007). *Land Degradation. 2nd edition.* Oxford: Rowman & Littlefield Publishers, INC.

Encyclopedia Britannica. (n.d.). *Chao Phraya River*. Retrieved 2015 йил 2015-October from Place: http://global.britannica.com/place/Chao-Phraya-River

Encyclopedia Brittannica. (1974). *Encyclopedia Britannica. 15th edition. Canals and Inland Waterways.* Chicago: Helen Hemingway Benton.

Fine Arts Department. (n.d., n.d. n.d.). *Historical Site*. Retrieved December 23, 2015, from Fine Arts Department GIS System: http://www.gis.finearts.go.th/gisweb/viewer.aspx

Fisher, W. B. (2015). *Suez Canal*. Retrieved October 28, 2015, from Encyclopedia Britannica: http://www.britannica.com/topic/Suez-Canal

Fowler, D. D. (1980). *MX cultural resources studies preliminary research design.* San Francisco: Woodward - Clyde Consultants.

Fredrickson, T. (2015, February 25). *Bangkok's temporary floating market (UPDATED)*. Retrieved February 11, 2016, from Bangkok Post Learning: http://www.bangkokpost.com/learning/learning-from-news/483454/bangkok-temporary-floating-market

Garrett, M. (2014). *Encyclopedia of Transportation: Social Sciene and Policy.* California: SAGE Publications, Inc.

Gray, J. (n.d., n.d. n.d.). *Lonely Planet Publications: Amsterdam.* Retrieved March 9, 2016, from Massachusetts Institute of Technology: http://web.mit.edu/zoz/Public/lp/lp-amsterdam.pdf

*Grand Canal: Canal, China.* (2014, March 3). Retrieved October 28, 2015, from Encyclopedia Britannica: http://global.britannica.com/topic/Grand-Canal-China

Hubbard, R. V. (1977). *Canal Construction in the Chao Phraya River System, Central Thailand.* Michigan: The Department of Geography and The Center for South and Southeast Asian Studies University of Michigan Ann Arbor.

History World. (n.d.). *History of Canals*. Retrieved October 27, 2015, from World History: http://www.historyworld.net/wrldhis/PlainText Histories.asp?historyid=aa19

Homlert, K. (2016, February 5). Khlong and Tourism. (D. Jiarakul, Interviewer)

ICOMOS. (n.d.). *The International Canal Monument List.* Retrieved May 15, 2015, from http://www.icomos.org/studies/canals.pdf

Ingram, J. C. (1971). *Economic Change in Thailand 1850 - 1970.* Stanford, California, United States of America: Stanford University Press.

*Importance & Advantages of Suez Canal*. (2014, August 7). Retrieved October 28, 2015, from State Information Service: Your Gateway to Egypt: http://www.sis.gov.eg/En/Templates/Articles/tmpArticles.aspx?CatID=2874#.VjES7K4rJTY

Jumsai, S. (1997). *Naga: Cultural Origins in Siam and the West Pacific.* Bangkok: Chalermnit Press and DD Books.

Jang, L. T. (2010, July 16). *The Evolution from Transportation to Tourism: The Case of New York Canal System.* Retrieved December 16, 2015, from DOI: 10.1080/14616688.2010.494683

King, R. (2011). *Reading Bangkok.* Singapore: NUS Press.

Khunsong, S. (2010). *The Cultural Development of Ancient Nakhon Pathom Prior to the 14th Century A.D., PhD Theisi.* Bangkok: Silpakorn University.

Kom Chad Luek. (2015, August 23). *'Bang Bua Model' recognized world wide as a prototype to canal side community problem.* Retrieved April 18, 2016, from Kom Chad Luek Online: http://www.komchadluek.net/detail/20150823/212048.html

Lah, T. (2012, September n.d.). *The Dilemma of Cheonggyecheon Restoration in Seoul.* Retrieved February 11, 2016, from Prospernet: http://prospernet.ias.unu.edu/wp-content/uploads/2012/09/SPC-learning-case-2_final.pdf

Landscape Architecture Foundation. (n.d. йил n.d.-n.d.). *Cheonggyecheon Stream Restoration Project*. Retrieved 2015 йил 25-June from Landscape Performance Series: http://landscapeperformance.org/case-study-briefs/cheonggyecheon-stream-restoration

Landscape Architecture Foundation. (n.d. йил n.d.-n.d.). *Landscape Performance Series*. Retrieved 2015 йил 25-June from Landscape Performance: http://landscapeperformance.org/case-study-briefs/cheonggyecheon-stream-restoration

Lee, I.-K. (2006, n.d. n.d.). *Cheong Gye Cheon Restoration Project.* Retrieved April 19, 2016, from world congress: http://worldcongress2006.iclei.org/uploads/media/K_LEEInKeun_Seoul_-_River_Project.pdf

Muang Boran Journal. (2012, October 24). *The restoration of Wat Kaew Paitoon Pavillon*. Retrieved February 22, 2016, from Muang Boran Journal: http://muangboranjournal.com/modules.php?name=News&file=article&sid=3791

Murray, J. (2005). *Erie Canal.* Minnesota: ABDO Publishing Company.

Maarten Claasen, C. v. (2013, July n.d.). *Plan Amsterdam*. Retrieved March 9, 2016, from Amsterdam: www.amsterdam.nl/planamsterdam/en.

Maimanee Raksaphromraj, T. P. (2011). *Srisak Valipodon: Cultural Landscape and the water management system in history (2) : Dhavaravati - Rattanakosin*. Retrieved 2015 йил 2-October from Lek-Prapai: http://www.lek-prapai.org/watch.php?id=487

Marine Department. (2013, n.d. n.d.). *Density of Khlong Saen Saeb derry in 2013.* Retrieved January 20, 2016, from Marine Department: http://www.md.go.th/md/index.php/2014-01-19-05-02-28/2014-01-19-05-20-44/-1-1/65--2556-2/file

Marine Department. (2013, n.d. n.d.). *Density Statistic of 2013*. Retrieved January 23, 2016, from Marine Department: http://www.md.go.th/md/index.php/2014-01-19-05-02-28/2014-01-19-05-20-44/-1-1/64--2556-1/file

Martin Morganstein, J. H. (2004). *Image of America: Erie Canal.* San Francisco: Arcadia Publishing.

Matichon Online. (2016, January 9). *Splendid wooden pavillion, the last wok of Arwut Ngenchooklin and Somjai Nimlek, is ready*. Retrieved February 22, 2016, from Matichon Online: http://www.matichon.co.th/news_detail.php?newsid=1452308145

Matichon Public Co.,Ltd. (2012, n.d. n.d.). *Activities for Social Contribution*. Retrieved April 18, 2016, from Matichon Annual Report 2012: http://info.matichon.co.th/report/2555/

McColl, R. W. (2005). *Encyclopedia of World Geography.* New York: Facts On File, Inc.

Meebanjong, N. (2014, April - June n.d.). Bang Prathun: Water of peacefulness. *Lek - Prapai Viriyapant Fpundation Newsletter , 18* (102), pp. 11-14.

*Mesopotamia: Economic and Agriculture*. (n.d.). Retrieved October 27, 2015, from Wikipedia: https://en.wikipedia.org/wiki/Mesopotamia

Merriam - Webster. (n.d., n.d. n.d.). *Canal*. Retrieved Fabruary 2, 2016, from Merriam - Webster Dictionary: http://www.merriam-webster.com/dictionary/canal

Mieroop, M. V. (2011). *A History of Ancient Egypt.* West Sussex: John Wiley & Sons Ltd.

Mollylarge. (2011, May 19). *Irrigation in Ancient Mesopotamia.* Retrieved October 28, 2015, from https://www.youtube.com/watch?v=5RP2KfewiJA

na Ayuthya, T. K. (2004). The Establishment of Bangkok: Construction and Maintenance of Canals and Bridges. In C. P. Department, *Portraits of Bangkok 222 Years* (p. 67). Bangkok: City Planning Department.

Namo. (2002, n.d. n.d.). *Water related events & Festivals of Thailand*. Retrieved March 8, 2016, from Thaiways Magazine: http://thaiwaysmagazine.com/thai_article/2803_water_festival/water_festival.html

National Park Service, U.S. Department of the Interior. (n.d., n.d. n.d.). *Cultural Resources*. Retrieved from National Park Service: http://www.nps.gov/acad/learn/management/rm_culturalresources.htm

New York State Canal Corporation. (n.d.). *Canal History*. Retrieved October 24, 2015, from canal Corporation: http://www.canals.ny.gov/history/history.html

Nonnat, A. (2012). *Dhonburi Sri Maha Samutr: from the root the base of Bangkok*. Retrieved 2015 йил 7-October from Lek Prapai: http://www.lek-prapai.org/watch.php?id=594

Oxford University Press. (2015). *definition*. Retrieved 2015 йил 15-June from Oxford Dictionaries: http://www.oxforddictionaries.com/definition/english/canal

Oxford University Press. (2016, n.d. n.d.). *Definition of revitalization in English:*. Retrieved March 19, 2016, from Oxfrod Dictionaries : http://www.oxforddictionaries.com/definition/english/revitalization

Office of the Royal Society. (2015). *knowledges*. Retrieved 2015 йил 15-June from Office of the Royal Society: www.royin.go.th/?knowledges=คลอง-๑๕-ธันวาคม-๒๕๕๔

O'Neil, M. (2008). *Bangkok: A Cultural History*. Oxford: Oxford University Press.

Puangsomjit, T. (2006). *The Birth of Waterworks Authority in the era of King Rama 5 and the Changes of Thai Way of Life*.

Paengie. (2015, December 18). *Department of Environment collect 18 tons of solid waste and aquaric weed from Chao Phraya*. Retrieved December 19, 2015, from Bangkok Metropolitan Administration: http://www.bangkok.go.th/environment

Pakkasem, P. (1988). *Leading issues in Thailand's development transformation 1960-1990*. Bangkok: National Economic and Social Development Board.

Pamornprawat, C. (2011 йил 4-May). *History of Thai Irrigation*. Retrieved 2015 йил 2-October from Information of Irrigation: http://kromchol.rid.go.th/lproject/2010/index.php/2011-07-16-11-26-03/56-2011-05-04-06-45-54

Perkins, D. (2013). *Encyclopedia of China: History and Culture.* New York: Routledge.

Peter Saundry, M. L. (2013, May 20). *Suez Canal, Egypt*. Retrieved October 28, 2015, from The Encyclopedia of Earth: http://www.eoearth.org/view/article/156309/

Piyanat Boonnak, D. B. (1982). *Khlong in Bangkok.* Bangkok: Chulalongkorn University.

Pisanbut, P. (2001). *Sampao Siam Tumnan Jek Bangkok.* Bangkok: Nanmee Book.

Pitrpreecha, S. V. (2001). *Centennial Memorial of Bangkok.* Bangkok: A.B. Publications.

Plainoi, S. (2002). *Thai life along the Canal (translated by Suttinee Yavaprapas.* Bangkok: Office of the National Culture Commission.

Pollock, S. (2004). *Ancient Mesopotamia. 5th edition.* Cambridge: Cambridge University Press.

Prakraiwan, T. (2012). *Cultural Tourism Route of Thai Way of Life Along Bangkok Canal.* Bangkok: Silpakorn University.

Princeton University. (2013, n.d. n.d.). *Waterway restoration*. Retrieved April 9, 2016, from Waterway restoration: http://www.princeton.edu/~achaney/tmve/wiki100k/docs/Waterway_restoration.html

Provincial Waterworks Authority. (n.a., n.a. n.a.). *Water Supply in Thailand*. Retrieved December 7, 2015, from Provincial Waterworks Authority: http://en.pwa.co.th/contents/about/history

Rak Bang Prathun . (2013, April n.d.). Witi Bang Prathun: Water and peacefulness. Bangkok: Bang Prathun Lover.

Revkin, A. (2009, July 17). *peeling back pavement to expose water havens*. Retrieved April 19, 2016, from New York Times: http://www.nytimes.com/2009/07/17/world/asia/17daylight.html?_r=1

Ritter, K. (2013, June 16). *Waterfrint cities plot ways to protect themselves from devasting floods*. Retrieved March 15, 2016, from SKIFT: https://skift.com/2013/06/16/waterfront-cities-plot-ways-to-protect-themselves-from-devastating-floods/

Rhiraksapitak, Y. (2015, August 11). *Water Transport: Bangkokian Choice*. Retrieved January 23, 2016, from Daily News: http://www.dailynews.co.th/bangkok/258632

Royal Institute. (1982). *Thai geography* (Vol. 1). Bangkok: Royal Institute.

Suwannanon, T. (1975). *Economics and Politics Problems after the Bowring Treaty from 1850 to 1910.* Bangkok: Master Dissertation of Srinakarinxirot University.

Sukhum, P. (2000). *From Yommarat to Sukhumvit: Events in 4 dynasty. 3rd edition.* Bangkok: Chulalongkorn University Press.

Sattumsakul, C. (2016, January 12). Life at Hua Ta Kae. (D. Jiarakul, Interviewer)

Seattle Department of Planning and Design. (2012, n.d. n.d.). *Waterfront Open Spaces and Interfaces of Edge Environments*. Retrieved January 3, 2016, from http://depts.washington.edu/open2100/pdf/2_OpenSpaceTypes/Open_Space_Types/waterfront.pdf

Sithithanyakij, P. (2012). *Chaophraya River Legend.* Bangkok: Siam Knowleace.

Shaw, R. E. (1990). *Canals for a Nation: The Canal Era in the United States 1970 - 1860.* Lexington: University Press of Kentucky.

Strategy and Evaluation Department. (2012). *Policy and Plan.* Retrieved December 23, 2015, from Strategy and Evaluation Department: http://203.155.220.230/bmainfo/docs/plans/1plan%20development%2012%20year%20time%202%20(%202556-2559).pdf

Tanabe, S. (1977). Historical Geography of the Canal System in the Chao Phraya River Delta: from the Ayutthaya period to the fourth reign of the Ratanakosin dynasty. *Journal of the Siam Society , 65 part 2*, 24 - 72.

Tanthai, K. (1977). *Canals and the economic system of Thailand (A.D. 1824 - 1910).* Bangkok: M.A. Thesis, Chulalongkorn University.

TCIJ. (2014, March 10). *Saen Saab Boat, profitable or loss*. Retrieved December 22, 2015, from tcijthai: http://www.tcijthai.com/office-tcij/view.php?ids=3965

TICCIH. (1996, n.d. n.d.). *International Canal Monuments List.* Retrieved February 2, 2016, from ICOMOS: http://www.icomos.org/en/what-we-do/involvement-in-international-conventions/world-heritage/thematic-studies/116-english-categories/resources/publications/235-international-canal-monuments-list

Thai Encyclopedia for Youth. (n.d.). *Man - made canals in Thailand*. Retrieved October 29, 2015, from Thai Encyclopedia for youth: http://kanchanapisek.or.th/kp6/sub/book/book.php?book=33&chap=3&page=t33-3-infodetail03.html

THAICID. (2002). *History of Water Resources Development in Thailand.* Bangkok: THAICID.

The World Bank. (2012). *Thai flood 2011: rapid assessment for resilient recovery and reconsrtution planning: Overview (English).* Retrieved 11 йил 2015-July from The World Bank: http://documents.worldbank.org/curated/en/2012/01/16360869/thai-flood-2011-rapid-assessment-resilient-recovery-reconstruction-planning-vol-1-2-overview

The Government Public Relations Department. (2015, February 15). *Floating Market in the Heart of Bangkok*. Retrieved February 11, 2016, from Inside Thailand: http://thailand.prd.go.th/ewt_news.php? id=67&filename=index

The Royal Institute of Thailand. (1962). The Royal Institute of Thailand Encyclopedia. *Transportation , 5* , 2681. Bangkok: The Royal Institute of Thailand.

Therakomen, S. (n.d., n.d. n.d.). *Water Community Revitalization: An Urban Design Project for Supporting the Use of Waterways in Modern Bangkok.* Retrieved January 6, 2016, from agaligo: http://depts.washington.edu/agaligo/agaligo/naga/pdf/3.pdf

Thiramongkol, N. (1984). Geology of the lower Central Thailand. In J. T. Narong Thiramongkol, *Geomorphology of River and Coastal Plains Proceedings of the Third Meeting of the Working Group on Geomorphology of River and Coastal Plains.* Bangkok: Department of Geology, Chulalongkorn University.

Thosarat, C. H. (1998). *Prehistoric Thailand from early Settlement to Sukhothai.* Bangkok: River Books.

Tourism Division, Culture, Sports and Tourism Department. (n.d., n.d. n.d.). Tourist pocket guide: Waterways series . *Tourist Pocket Guide* . Bangkok: BMA.

Tourism Division, Culture, Sports and Tourism Department, BMA. (n.d., n.d. n.d.). *Bangkok tourist guide: Art and Culture of Thailand* . Bangkok: BMA.

Topengpat, R. (2000). *Floating Market: way of lives of agriculturist in the Central of Thailand.* Bangkok: Fine Arts Department.

Tungchontip, K. (2007, June 29). *Krungtep: Primate City of Thailand.* Retrieved February 10, 2016, from Institute for Population and Social Research, Mahidol University: http://www.ipsr.mahidol.ac.th/IPSR/AnnualConference/ConferenceIII/Articles/Download/Article02.pdf

UNESCO. (1994, n.d. n.d.). *canals94*. Retrieved February 2, 2016, from UNESCO: http://whc.unesco.org/archive/canals94.htm

_____. (1972, November 16). *Convention Concerning the Protection of the World Cultural and Natural Heritage.* Retrieved March 2, 2016, from UNESCO: http://whc.unesco.org/en/conventiontext

UNESCO. (n.d.). *Historic City of Ayutthaya*. Retrieved 2015 йил 19-September from World Heritage List: http://whc.unesco.org/en/list/576

_____ . (n.d.). *Historic Town of Sukhotai and Associated Historic Towns*. Retrieved 2015 йил 19-September from World Heritage List: http://whc.unesco.org/en/list/574

_____ . (2015, n.d. n.d.). *Operational Guidelines for the Implementation of the World Heritage Convention.* Retrieved March 3, 2016, from World Heritage Convention: http://whc.unesco.org/en/guidelines/

_____ . (n.d.). *The Grand Canal*. Retrieved October 29, 2015, from UNESCO world Heritage Centre: http://whc.unesco.org/en/list/1443

Valipodom, S. (2015). Federal Dhawarawadi. *Muang Boran , 41* (4).

_____ . (2012). Krungthep Dhavaravati Sri Ayutthaya. *Muang Boran Journal , 38* (3), 82-92.

Vongvisessomjai, S. (2006). *Chao Phraya Delta: Paddy Field Irrigation Area in Tidal Deposit.* Retrieved 2015 йил 1-October from http://www.rid.go.th/thaicid/: http://www.rid.go.th/thaicid/_5_article/2549/10_1ChaoPhraYaDelta.pdf

Water Encyclopedia . (n.d., n.d. n.d.). *Canals*. Retrieved February 2, 2016, from Water Encyclopedia: http://www.waterencyclopedia.com/Bi-Ca/index.html

_____ . (n.d.). *Irrigation Systems, Ancient*. Retrieved October 27, 2015, from Water Encyclopedia: http://www.waterencyclopedia.com/Hy-La/Irrigation-Systems-Ancient.html

Weiner, M. B. (2010, November 11). *7 Cities Ablot to Sink*. Retrieved February 26, 2016, from U.S. News & World Report Travel: http://travel.usnews.com/features/7_Cities_About_to_Sink/

Wongchongchaiharn, P. (2004). *The Thai Culture in Bangkok from Westerners' Viewpoints.* Bangkok: Silpakorn University.

Wongsanuprapat, C. (1941). New and Old Khlong in Bangkok and Other City. In *History of Ministry of Agriculture.* Bangkok: Soponpipatthanagan.

Wongthes, S. (2005). *Bangkok: The Historical Bankground.* Bangkok: Matichon.

Yamgasorn, O. (2016, January 12). Life at Hua Takae. (D. Jiarakul, Interviewer)

Yothasmutr, S. (2008, June 18-20). *The Analysis of National Economic and Social Development Plan on Co-operative Development Strategy in Thailand : National Plan 1 - 10.* Retrieved February 10, 2016, from Pirun Server: http://pirun.ku.ac.th/~fecospy/ICoSHH08paper.pdf

# Biography

| | |
|---|---|
| Name – Surname | Dolruthai Jiarakul |
| Permanent Address | 193/25 Nonthaburi 9, Nonthaburi |
| | Bangkraso, Meaung, Nonthaburi |
| | Thailand 11000 |
| Education | |
| 2000 | High School Diploma (Science – Math) |
| | Saint Joseph Convent School |
| 2004 | B.S. (Psychology) |
| | Kasetsart University, Bangkok |
| 2009 | MBA (General Management) |
| | Graduate School, Ramkhamhaeng University, Bangkok |
| 2010 - present | Ph.D. Candidate (Architectural Heritage Management and Tourism), International Program |
| | Graduate School, Silpakorn University, Bangkok |