

Formation and Transformation of Canal Network in the City Plan of Chiang Mai

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Abstract: The formation and transformation of the canal networks in the city of Chiang Mai, due to the expansion of community that disconnect of the canal network. Then evanescent in people perception and on behalf of the city element. So that, concern with the city planning. In the past, people use a wisdom to manage the canal network and cooperate with the city planning. The canal network is lost naturally even the transformation of the city irrespective of the traditional in a canal network. That event concern with the city planning. However, people use modern technology to solve a tentative problem of the canal network. Moreover, consisting of the extension in a messily tradition community. The reasons above have an effect on some canal network change to be a drainage of wastewater in the city planning. More than that public utility system. Then, rise to a flood problem form the canal network was block.

This thesis according to research in the point of formation and transformation in the city of Chiang Mai, in the sense of the canal network and city planning. The researcher concedes to the reason that influence with the transformation and the canal network in the city of Chiang Mai change. For the purpose of providing the simple method to manage the canal network in the city of Chiang Mai, and accord with the environment of the city. Along with the land use and appearance of the city is the present. The results revealed that a category relation of the canal network has a transformation from a factor of politics, administration, change. Moreover, perform with a land tenure of a government sector, ordinary people and private sector. That the canal network was managed by the government and private sector. So that makes the canal network still fullness. For the canal network with non-government to take care of, that produces the damage of the canal network and be faint from the city planning.

Keywords: The city plan of Chiang Mai, Transformation, Formation, Canal network, Urban structure

I. INTRODUCTION

Human society has been developed by adjusting the settlement and lifestyle according to the surrounding environment of the location. The abundance of strategic location is important. Natural resources reflect local wisdom and culture which public utilities are the main supporting factors, including basic components that is tightly connected to suburb areas, which are the areas that supplied products and resources to the city, including mitigating disasters and being a buffer zone during wars (Nawit, 2016). The settlement of the communities are set according to the geography. The abundance of the city helped support its prosperity and became a capital city afterwards. Obviously, most developed cities mainly located along the riverbanks and basin plains (Suebsak, 2009). According to the archaeological evidences of the water networks of the city plan dating since the prehistoric period, moats tended to be built around the city rather than walls. There were constructions of the embankment to slow down the water and a large reservoir for the use of the city. This kind of pattern has been later developed in important cities in the Thai history such as Ayutthaya, Sukhothai, Chiang Mai (Srisak, 2002).

Cities in the northern region of Thailand with their characteristics of water networks and water management are unique and interestingly different from other regions. Especially in Chiang Mai that has a smart city plan with a strategic location design and selection in terms of security, abundance of agriculture, land and water trades, loosely inter cities connections within the Lanna kingdom, cohabitations of people in the communities, escaping routes in case of war with mountains as

a defensive line for safety, major river courses for trading, and slope areas for rice plantation with abundant surrounding rivers (Sawitree, 2015). Designing the city, there is a sacred part of the city including a natural heritage. Doi Suthep is located on the west with Huai Kaew falls flows through the area and the Ping River in on the east. In the northeast, it is almost near the Mae Kha River. In addition, Chiang Mai city was planned based on seven auspicious beliefs, resulting in the only square-shaped city surrounded by moats in the Lanna region, which was influenced by the urban layout and water management system from Sukhothai, which is a walled city surrounded by moats. There is a reservoir built on the western slopes, depending on the canal system to pass water into the moat for consumption, including preventing the enemies from attacking the city, making both cities in the past never experience water shortages crisis or severe flooding problems. Chiang Mai is therefore a city with an urban layout and water management system related, which affects the structure, the land utilization, and the sustainability of the settlement of the people in the city. Chiang Mai that used to be related to the structure of the city plan, the structure of the city began to be divided into parts. Dams, reservoirs, ditch lines, water diversion canals, weirs, moats, and canals naturally began to be divided into parts and started to disappear from people's perceptions as an element of the city which is connected to the structure of the city and serves to control the water system for consumption, preventing floods until effectively protecting the city from enemy invasions formerly. Viewing the water management system in the past, which is the use of water that flows naturally into the system is also the basic settlement, patterns, and environments for living within urban areas. The disappearance of the natural water management systems according to the development and expansion of the city, regardless of the structure of the old system in the past and using modern technology to help solve water management related problems in the urban areas instead, therefore allowed the expansion patterns of settlement and habitation occurred independently and causing following problems as currently encountered.

This study aims to explain the origin and development of the water network that is related to the city plan of Chiang Mai in which these networks determine the structure of the city, the pattern of area utilization in Chiang Mai from the beginning, which has been developed and changed according to the urban development process that affects the area utilization along the water network, architecture, and way of life that has changed. This study also aims to inform of the current situation, factors that caused the changing process of the water network and the city plan physically in order to understand the basic information of the water network in relation to the city in the past, including the functionalities of the water network that remains intact and changes its roles according to the urban context. Also to have basic physical understanding and the changing factors affecting the city in the form of a water network that has naturally changed from its original function and transfer to join with modern technology. The study will help us to be able to properly preserve and develop the city in connection with the water network in the past under the remaining conditions at present with the needs of the people and the current city plan of Chiang Mai.

II. MAJOR FORMAT GUIDELINES

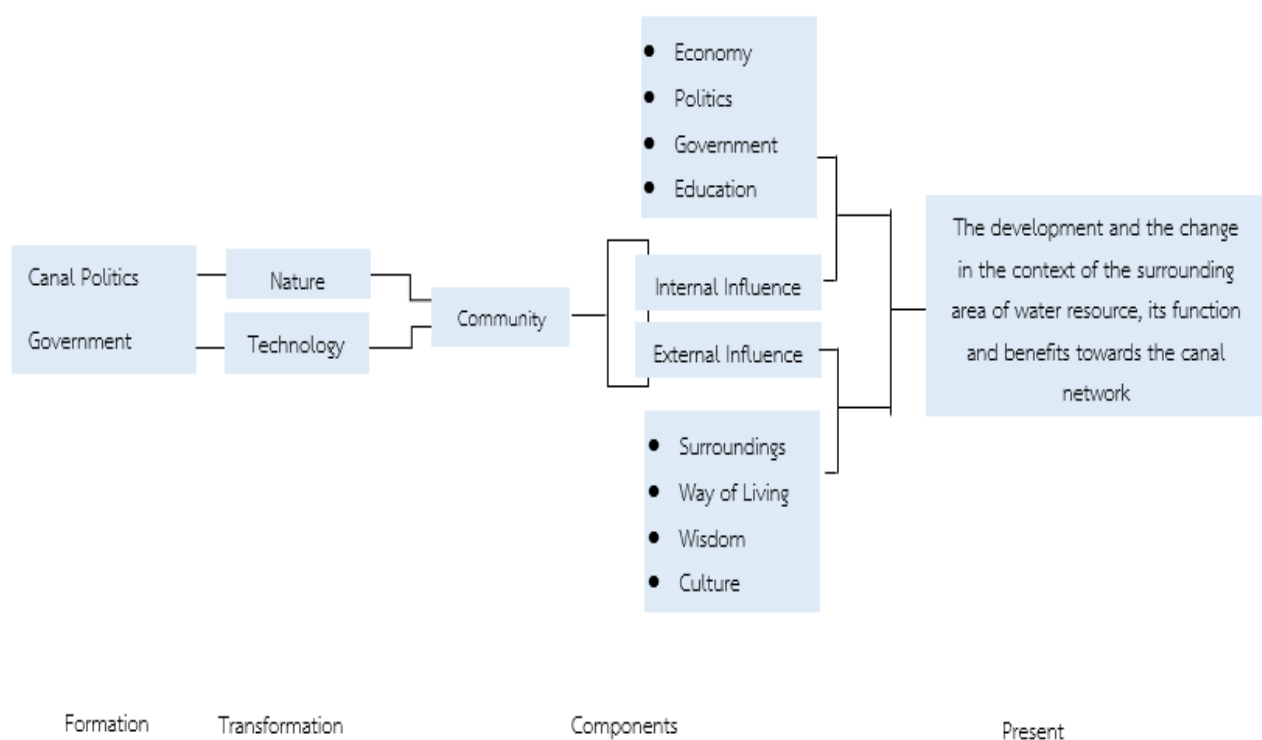
The method of study is based on the analysis and consideration of data according to the objectives of the study. The study of the origin and development of Chiang Mai city in terms of water management systems in relation to urban planning by considering the factors affecting the development and changes of the water network of Chiang Mai city and the effect of the said change. In response to the objectives of each of the above issues, this research has therefore created a research methodology by collecting relevant documents which is a survey of all relevant documents including research, publications, journals, articles, photographs, aerial images, internet maps, by focusing on historical, economics, and social sciences data of urban changes that affect water system management. This research studies since the beginning of the settlement of Chiang Mai city, city development during the year 1997¹ and the expansion of Chiang Mai city that began to build high-rise buildings and housing compounds. During Chiang Mai flooding in 2005 (period from 1296-2007) as well as the urban architecture level, especially the housing that has caused the water network in the past to disappear. This research also conducted a preliminary analysis of documents, research papers, related articles, various publications from the past until present by collecting and screening content that is necessary and consistent with the research and classifying. Setting a clear guideline for field survey and data collection by creating maps to illustrate the origin and development of the city's canal network by using historical map data and literature review, analyzing the physical characteristics of the city and its components that affect the physical characteristics of the city and the architectural

¹ Urban development during 1997, economic development methods after the financial crisis, including the constitution, causing people to be involved in urban development and had a widely participation with the government, resulting in the changes in various patterns of the physical environment of Chiang Mai.

elements that are man-made to consider together with the architectural elements, economy-society, and culture let us know which period urban architecture has changed and disappeared.

The collection of field data and data related to the research area are based on the traffic routes and measured from various routes within a distance of 500 meters to 1.5 kilometers with areas related to various water sources networks in order to study the physical components of the community and the architectural features that occurred during the current change, including the way of life by using image collection with a camera, drawing and taking notes as a database. A field survey is a collection of data within communities that are connected to history, origin and development of canal networks in the city planning, system analysis and data validation.

To summarize and discuss the findings of the urban planning structure that is influenced by changes especially relevant areas within the city, which are affecting each other and affecting the development and changes of the water network in relation to the urban architecture of Chiang Mai city nowadays.



Picture 1: The study process of the research methodology

Previous studies: Influence of settlements and city canal network

According to the study, it was found that culture of settlement, urban planning, and city building of Chiang Mai derived from the culture that has been passed since 19th century Buddhist era. Thai people had successfully seized Sukhothai, the city once belonged to Cambodia, in which Cambodia made an assumption about its characteristic that matches with the ruined walls and rectangular moats. The archaeological site is especially important because the direction and the layout of the temple's area are related to the Sukhothai city structure (Sumet, 1996). Chiang Mai city's characteristics have been determined by an ecological system for the most use of the area by choosing the location of Doi Suthep to be in the west of the city with Huai Kaew falls flowing through and the Ping river located in the east. In the northeast, it is almost near the Mae Kha River (thanachan, 2007). Other factors to be determined are the choosing of a vantage location and sufficient resources for consumption and agriculture for the people in the city and natural boundaries that are the basic components of the city, such as mountains, rivers, highlands, forests, and swamps.

Chiang Mai's city planning is similar to the city of Sukhothai with a location that has mountains as a fortress for the city and adhering to the geography of the river basin, the city plan resembles a similar square shape surrounded by city walls

with dredging and levees. A new city often created in its natural form (Thaweesak, 2011). These could be reflected in two issues which are the close connection between the two city builders with scientific advancement and construction knowledge which makes it possible to build a city with two sides of the walls are equal in length and parallel. This is considered as an unusual thing because in the past there was no any levels or angle gauges to equalize the degrees or measure the distance like in the present time. Normally, moats will be dug two to three level when building the city (Somchot, 2006). The city's water network allows the city to utilize water throughout the whole year, water replenishment, digging up wells and canals to distribute water sources according to the town and community planning system. Therefore, water has been an important component of urban planning since past until present.

Changes from infrastructure development to the water network of Chiang Mai city

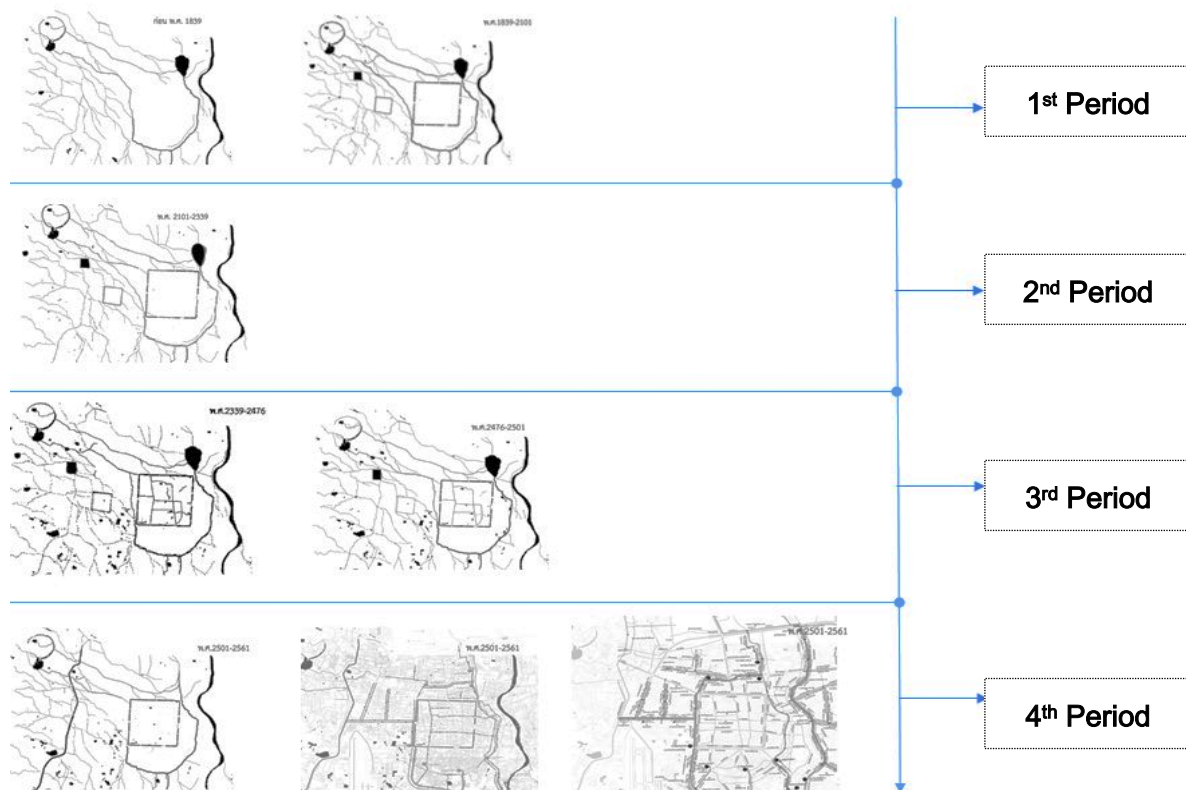
The infrastructure of people in the past known to be derived from basic wisdoms combined with a deep understanding of the area which truly and permanently benefits the community (saratsawadī, 2000). A good water network management is consistent with various component relationships of urban planning in the city, both policies for maintenance of water sources, administrative hierarchy, community and water sources responsibility (Surapon, 1996), including the prevention and storage of water resources during dry season in order not to have any conflict with the agricultural economic products.

The reason that Chiang Mai was built as the capital of the Lanna kingdom was because of the location that can control the transportation route and the ability to do business with other cities. The city of Chiang Mai is actually a city with an urban layout and water network systems related to each other providing sustainability of the settlement of people and communities in the city, either outside or inside the city wall. As early as the founding of Chiang Mai city in the past (sārakhadī, 2000: 44) until present, the city has been developed and become number two city of Thailand. The water management in each period has constantly changed in order to comply with the development pattern, which has a rapid change and the non-systematic growth of the city. The structure and elements of the city are therefore affected. The water network, in terms of the city's composition, began to be cut off from the utilization of water systems naturally and technologically, being supplied to the city became less importance, especially, the change of Chiang Mai city since 1933. The changes from social and political development were modified and created the government policy that helps promote and develop Chiang Mai to become the capital city of the north second to Bangkok. Chiang Mai at that time grew rapidly in all directions, the west side of Chiang Mai was the center of education, establishing Chiang Mai University on a flat area at the foothill (Doi Suthep side) which is to expand the area into a wide area. Structure and natural water network within the area such as reservoirs or ditches have been managed to maintain their original conditions and to remain the benefit of land using, once used to be a reservoir and drain water through the canal system of the city from the Wiang Suan Dok through Wiang Chiang Mai, and later on began to be modified for more uses in other areas.

Later in 1969, a super highway road was built. (In front of Ched Yot temple) causing the expansion of the community along the road, extensively. This also caused the water network, which has a ditch and canal-liked pattern in the north of Chiang Mai once used to be designed to relatively provide benefits to the area in the past, have been modified and invaded until they are all shallow and lack of natural water flowing into the system like before, this has affected the whole water network of the city of Chiang Mai at a later time. The water network of Chiang Mai that used to be related to the structure of the city plan. The structure of the city started to be cut into parts, dams, ditch lines, weirs, moats, and canals naturally began to be cut into parts. The water network in the past was the use of water that flows into the city naturally according to the environment and geographic area. Changes of area patterns created a barrier of the water route network. The surrounding physical components tend to change according to the environment.

Results: The Chiang Mai city water network and the development of the city

Water network in Chiang Mai city planning system was created by the need of the city builder. The former Lanna Kingdom was an agricultural society, an important component inside the city being considered for the city building location is a perfect water network in order to supply the community and to transfer water to the rural areas. When changing power and politics, the city governance had affected the city planning system and the whole urban context as well. According to the study, it is found that these changes have effects to the development and the change of the water network in Chiang Mai city which can be divided into 4 periods as follows.

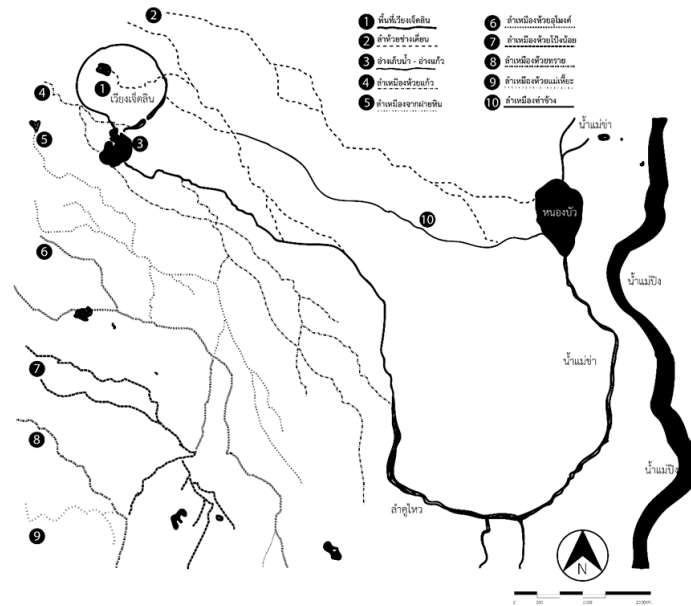


Picture 2: The period of development and changes of the water network that are related to all Chiang Mai city plans

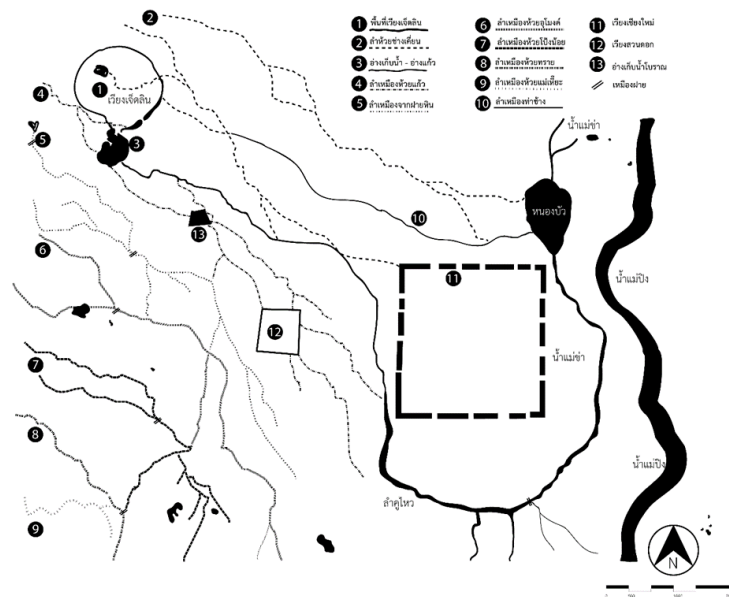
Generation 1: The Building of Chiang Mai City and Water Network (1296-1358)

According to the geographic environment, city formation of Chiang Mai during 1296-1358 was a prosperity period of the Lanna Kingdom with clearly development. In the middle period of the Mangrai Dynasty, during this time, moats were dug around the city. A pond behind the city wall was dug for soil to build a city wall. Water from Huay Kaew waterfall partly flows into Angkaew reservoir which located in the area of Chiang Mai University nowadays. Another part of water runs through Huai Chang Khian. Water is partially stored and flows together to the north of Chiang Mai combining and becoming the Mae Tha Chang canal. The water management system was allocated, some parts will be arranged into the Huarin corner for circulation and draining water into the moat. Regarding the Angkaew, some part of water flow around the southwest to Wiang Suan Dok passing the existing branch canal into the Suan Prung Gate and joining together at Huai Lam Khu Wai forming into the Mae Kha canal and going south of the city, passing Wiang Kum Kam, and meeting each other at the Ping River again (saratsawadi, 1994). The Ping and the Wang river basins are considered great strategic areas for doing business and having routes for travelling to every city. The water network in Chiang Mai is quite perfect from almost natural systems.

The transformation of the canal network (picture 3) is from human and their wisdom from learning the nature of places. From the study of Phaya Mengrai, it is said that when he founded Chiang Mai city and dig a ditch around the city wall, it shows Mangrai Customary Law. The irrigation system from Mangrai Customary Law is one of the water management systems that uses local wisdom. Irrigation ditch is divided into two parts. The first part is the dam, this part is used to store and level up water. The second part is the ditch. It is the part that is dug to create a canal to supply water to places at the end of the ditch. There are doors at the dam area to open and close at specific time. Water management of Chiang Mai city gives importance to supplying water as consumer goods, flood prevention, and using in agriculture in the inner city area. It was seen that some areas of the city also has swamps for consumers in the city to use water as well. It was presumed that in the dry season, people in the community withdraw groundwater and store to use in their daily life. Chiang Mai people at that time did rice farming, grew crops, and did animal farming. They used irrigation system, dike, and reservoir for their water management. These elements are factors that create technology for various canal networks.



Picture 2: The analysis of the canal network characteristics that relates to Chiang Mai city plan before 1296

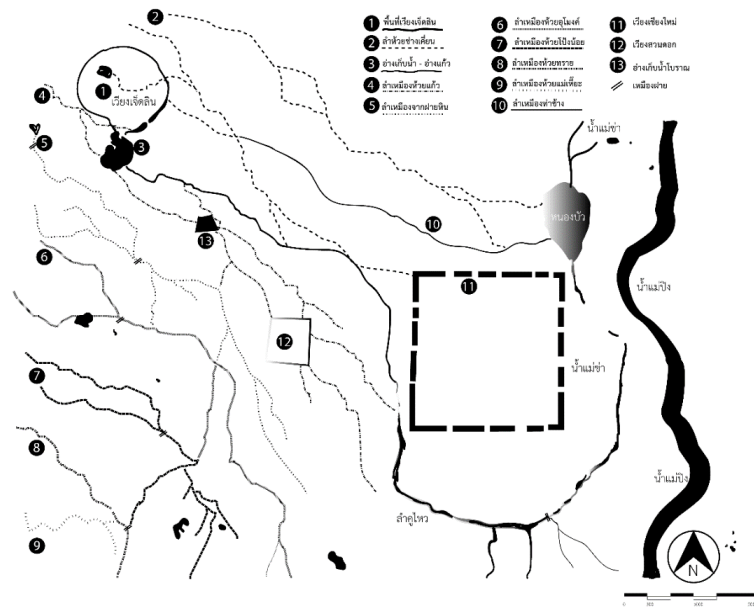


Picture 3: The development of the canal network and Chiang Mai city plan during 1296 – 1558

Generation 2: The Regression of Canal Network and Chiang Mai City Plan (1558 - 1796)

Changing to the Burma’s form of regime 216 years affected the water network during that time, which made it the regression age of Lanna under the rule of Burma alternate with the rule of Krungsri Ayutthaya. Apart from that, in some period, Chiang Mai was considered a free state since there was times when Burma needed to encounter their internal politics problems. However, after they solved their problems, they marched their army to conquer Lanna. This made the Burma authority in Lanna unstable. Because of the long period of time Burma ruled Lanna, the period is called Burma rule in Lanna. Lanna was under the rule if Burma since Bayinnaung reign. In this era, there were very few historic evidence of Lanna, so it is chosen to analyze and compare the historical event from social, politics and government, which is divided into two characteristics.

During Burma rule in Lanna, the change of regime forms are unstable, the city was under a war in seizing the power. In the beginning, Burma took care of people in Chiang Mai by letting the King continue ruling the city and only making Lanna pay regular payment and send people to Burma to fight with Siam. The watercourse of the west side of Chiang Mai at the foothill of Suthep Mountain was still the same; the brook and the ditch still had their efficiency and richness.

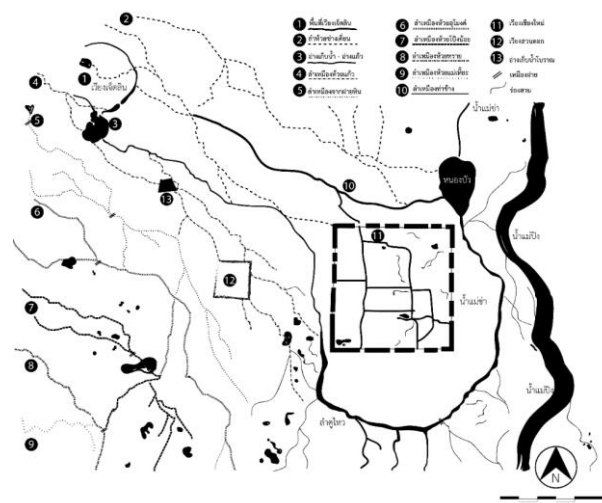


Picture 4: The development of the canal network during Chiang Mai is under the rule of Burma (1st stage) during 1558 – 1776

Generation 3: the improvement of a perfect water system and the restoration of Chiang Mai city after being an abandoned city

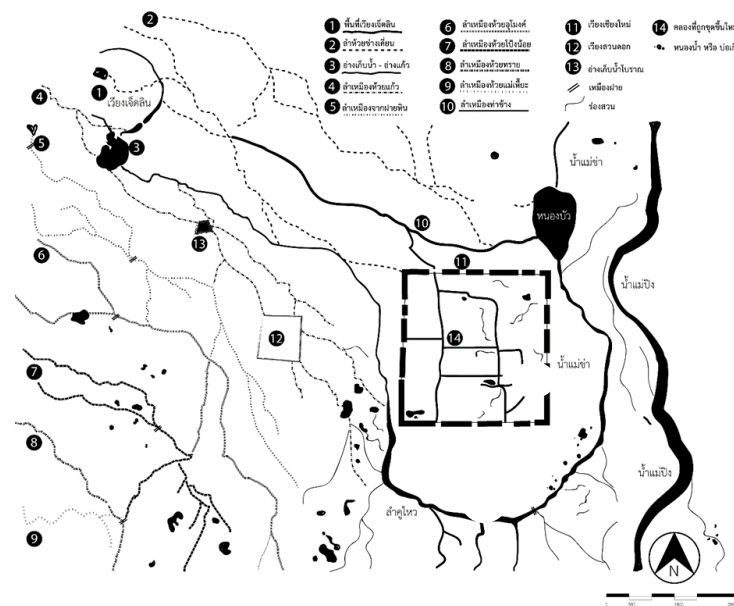
The restoration of Chiang Mai city began in 1796, the city founding year, until 1804 when the Burmese were driven out from Lanna. It was the period of gathering people to the city, it was also called the era of “collecting vegetables to the basket, collecting slaves to the city.” Chiang Mai city in King Kawila reign was not any more an abandoned city. There was a restoration in the city as well as in the canal network of Chiang Mai. The troops were gathered to dredge Mae Kha Canal at the east side of Mae Ping River, in order to make it fully supplied.

During the government of Phraya Tham Langka in 1818, a ditch was made from Hua Lin Corner along the four roads around the moat and four roads in the inner city wall including 1) Sripoom Road to Moon Muang Road, 2) from Singharat Road, passing Wat Dab Pai, and along Samlan Road, 3) along Arak Road and Bamrungburi Road, and 4) from Singharat Road soi 4 to the city area and along Ratchapakhinai Road at Chiang Yeun Gate before meet together at Katham corner as presented in the history of Chiang Mai. These ditches are used for plantation in the inner wall area of Chiang Mai.



Picture 5: The analysis of the characteristics of canal network that is related to Chiang Mai city plan during 1796 - 1933

The change and transformation of Chiang Mai city during that time was a major change. It was also a change of many provinces, having Siam as a capital city. Chiang Mai was the center city of the northern part. The change of regime form at that time highly affected the inner government when the north royalty family was taken down the power and the government employee occupied more areas in the inner wall. The canal network was made more to support the living of people in the city. Moreover, the city plan in the innercity wall was changed rapidly and the community in the outer city wall was starting to be built. The royalty family expanded their power to the outer city wall area and developed the canal network by building a water gate, dam, and embankment in order to collect levy from the people. The city plan was influenced by the plan from western cities but the canal network in different forms were developed from the old system. They developed by analyzing the demand on public utility, lifestyle, and way of living. The network was improved and changed from the original system and the city expansion by following the same laws and regulation. People gave importance to trading and economic growth, which made Chiang Mai become more interesting and prosperous. In consequence, Chiang Mai served as the economic centre for the northern region of Thailand. Western influences played important role in developing Chiang Mai as well. People had higher demand on machinery and on filling the areas to develop the education system, governmental institution, or even to build real estate.



Picture 6: The analysis of the water canal that related to Chiang Mai city plan during 1933 - 1958

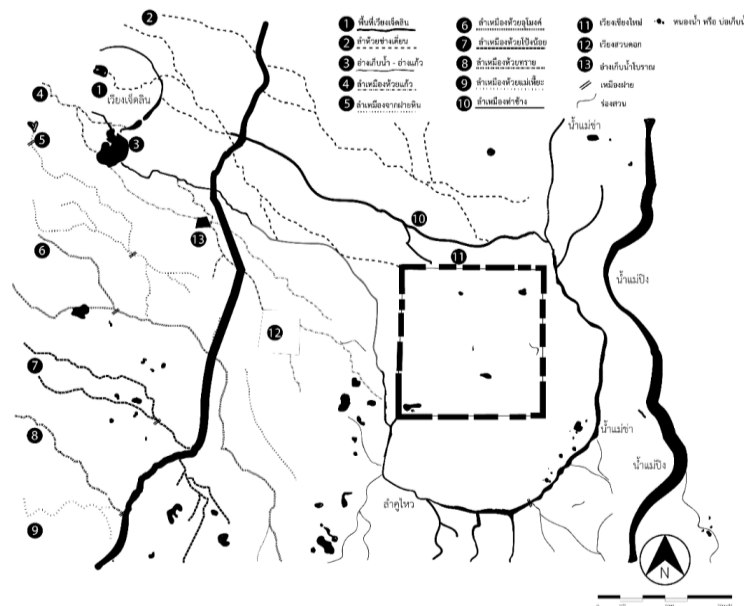
Generation 4: The development of canal network and basic technology in city plan system

According to National Economic and Social Development Plan from 1933 until 2018, the city plan system in 1935, there was a City Plan division in the Department of Public and Municipal Works. This division focused on designing the city hall and governmental offices as well as the adjustment plan of the fire area, and the temple area plan that needed to be in order. They still did not focus on the development of the city's physical suitability and universal sustainability. Therefore, in 1952, the government proposed to use the Town and Rural Planning Act, which it is said in article 7 that the city plan following this act focused on the universal planning by identifying local areas that would be in the project and the map showing the border in order to write a new city plan. It could also be used for building a city or a part of a city to replace the part that was destroyed by the fire, earthquake, or other disaster. Moreover, it could be used to restore the city land that has identified border or to renovate the area to be better and more comfortable, in order to support the economy of the city. Also, to keep the existing building or other valuable objects in terms of architecture, history, art, or landscape.

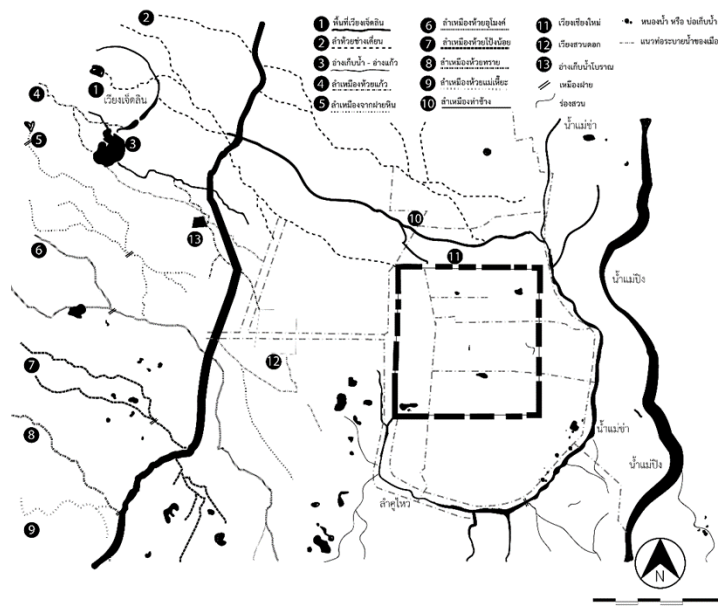
This includes interesting natural landscape that the government developed the basic structure, especially, the irrigation system of the outer districts to respond to the economy at the upper part of the north, which is the main agriculture area of the country. In the first economic development plan, there was tap water system in the city but it was not very commonly used by the villagers since people were used to using well water. However, when time passed, well water was less needed due to the contamination in the water, which made people use more of tap water. This affected the drift in the city that was then depreciated and only used as a drain. The purpose of the change of the government form and economic development plan was to create water management system in the city for people to thoroughly use from the canal

network. The train station was built in 1967 to prepare for the future transportation. Big swamps were reclaimed as lands to open Asdathorn Road and Rattanakosin Road. The canal was dug during Phraya Tham Langka reign. Thoroughfares were also built in the inner city wall. At present, people build economic building in some areas. There was an obvious change in Mae Kha Canal, which is the concrete built on both sides of the canal. Five years later in the year of 1972, there was Night Bazaar Market and the change in the residence. Tribesman moved more to the commercial area to trade. People focused more on being the owner of the house and land near Mae Kha Canal, which made the riverbank become narrower.

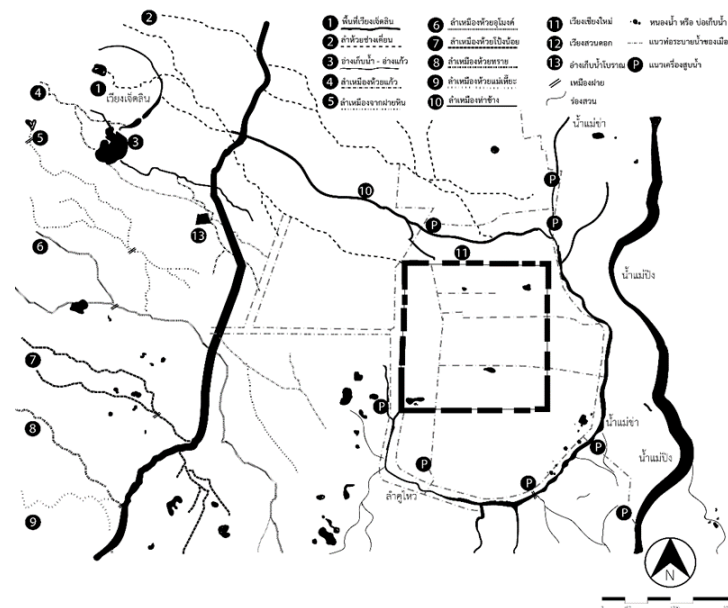
From the exploration on the waterway of Mae Kha River in 1977 and the interview of former people in the area near the river, the river was used for washing and for being the city transportation. Moreover, it was also used as water storage (the Kaem Ling project) before flowing through the city and down to the Ping River at Baan Sob Mae Kha, Hang Dong, Chiang Mai. The growth of Chiang Mai city attracted more people to settle down and make a living in the city. Tap water was more common and cars were used more instead of boats. It was a modern development, but was also a part that makes Mae Kha Canal, the main river, be no longer beneficial. It become useful for being waste storage, which is hard to restore at the present. There are cement wall attaching both sides of the river.



Picture 7: The analysis of the characteristic of canal network that relates to Chiang Mai city plan during 1958 - 2018



Picture 8: The analysis of the characteristic of canal network that relates to Chiang Mai city plan during 1958 - 2018



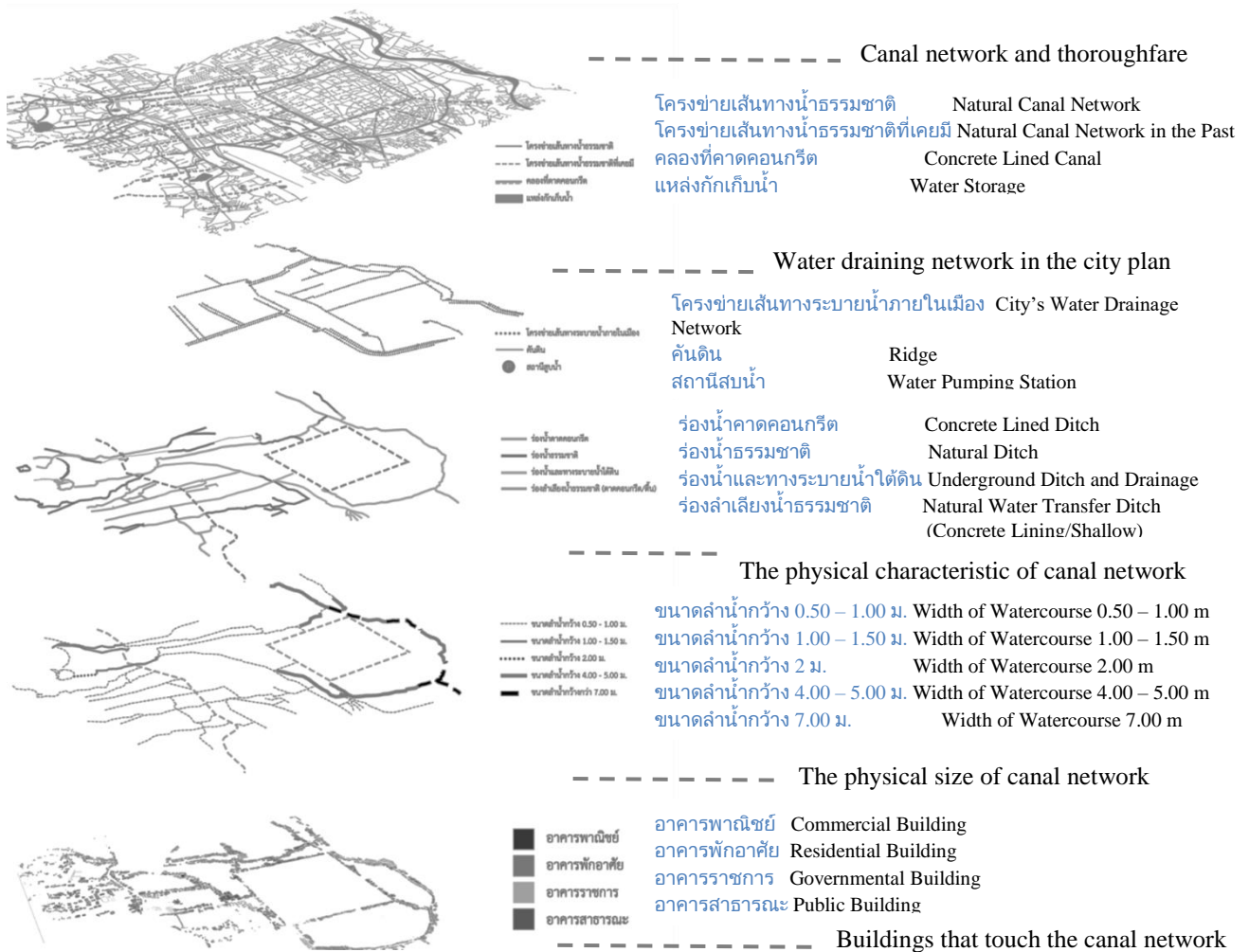
Picture 9: The analysis of the characteristic of canal network that relates to Chiang Mai city plan during 1958 - 2018

III. CONCLUSION

The formation and transformation of canal network in the city plan of Chiang Mai occurred during National Economic and Social Development Plan from 1933 until 2018, the city plan system in 1935, there was a City Plan division in the Department of Public and Municipal Works focusing on city planning to make things be in order. Water storage and irrigation canal were built in 1958 to support agriculture. The city plan had been unconventional changing and expanding. Areas in the inner city wall were disconnected with the canal network because roads were built over it. The canal network then became a drain. Technology was applied in to support the new city plan. There was water gate to control the water and solve the water problems that occur in the inner city wall. This highly affected the natural canal network in many ways. Satellite towns of Chiang Mai like Wieng Suan Dok was depreciated; people did not take care of the ditch and left it dry. The canal network was strongly affected, which made the government starting to draft the city plan of Chiang Mai as well as piping and waste draining system and built a bigger pumping door.

The study concluded that the canal network is related to the city plan. At present, the canal network is still doing its job but not as complete as in the past. There were many changes in the context from the politics and government since in the past and also the expansion of Chiang Mai city to support the National Economic and Social Development Plan in 1958. In consequent, Chiang Mai was able to handle its growth on tourism and education at the same time. When the city rapidly expanded, the original structure system of the city was invaded and could not be fully used. This was especially on the canal network inside and out of the city wall. Water resources in Chaimongkol principle was suddenly depreciated. The elements found in the city plan including people's settlement and the relationship between architecture and canal network was because public and private institutes and villagers owned more land and invaded the canal network. Also, because of the government and the expansion of the agriculture area as well. The exploration in the study areas shows that the canal network was supervised and managed mainly by the government not by the private organizations and villagers. From the sixth exploration point, it was found that the canal network that are still occupied were taken responsibility by the government in two forms as follows:

- 1) The government and private organization possessory area. For this area type, its canal network of the city plan is managed by the government and private organizations. It is seen as a physically abundant canal network. However, its function is not to distribute water to the city as in the past, since it is used to respond to the people's requirement, which is to be a waste drain in the inner city wall area. This is to higher the efficiency of the draining system in the city.
- 2.) The community possessory area that is not involved with the government. The canal network of this type is physically deteriorate because the villagers do not take care of the water resource and the canal network in the area. It is said that the problem is caused from the government; their proposal on coming to help maintain the canal network is unclear.



Picture 10: The canal network that relates to Chiang Mai city plan

The study of the canal network of Chiang Mai city shows that nowadays, the network is a combination of technology system that is created by human and the natural system found in the area's geography. The system from nature will change and develop according to time and surrounding factors. The big canal network that cut through the smaller canal network works as water distributor preventing too much water going to the city. The expansion of the government possessory area, the formation of big government officer residence, and the improvement of large areas caused a lower amount of water from Doi Suthep.

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