MORPHOLOGICAL STUDY OF AN ORCHARD SYSTEM IN THE LOWER BASIN OF CHAO PHRAYA DELTA :
A Case Study of Amphawa Neighborhood

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ABSTRACT

An orchard system, in the lower basin of the Chao Phraya Delta, could be regarded as a sustainable land reclamation process that contributed its indispensable role in providing space compatibly suitable for settlement, for five hundred years ago. This study led to a result of the land formation process through the orchard system in the Amphawa neighborhood, by clarifying the correlation between the waterways and the orchard unit. From an apparent hierarchy of waterways, and for reason of the geographical advantage which had much influence on the capacity of irrigation and accessibility to water, the first settlement was possibly located along the main waterways. And according to the development pattern of the unit of land-parcels and grouping of land-parcels, there was a systematic land formation process performed to accomplish the linkage and fabric of an orchard neighborhood.

Keywords : *morphology / orchard system / Amphawa*

1. INTRODUCTION

1.1 Background

It is believed that land reclamation for agriculture was introduced into the lower basin of the Chao Phraya Delta to enable and heighten an opportunity for settlement in this lowland marsh area. Besides the reclamation of rice fields, which was done in the upper basin, the reclamation for orchards was relatively outstanding in the lower basin, especially in the western part of the Delta[1].

The reclamation for an orchard neighborhood had not just served the needs of the people who emigrated from the upper Delta, but it had also developed into a complete orchard system that provided a rich ecological system supporting people's life, and maintaining balance between humans and nature. Unlike the modern idea, which mostly insists on overcoming any inconvenient and unpleasant condition for modern life by enforced resistance, the orchard system could be regarded as a compromised way contributing to the half-artificial dwelling space which produced the most compatible and sustainable living environment[2]. Unfortunately, there are only a few studies on this orchard system, especially in terms of architectural design and planning. The knowledge of the orchard system in the Delta can not only be useful in understanding the morphology of the settlement in the whole lower basin but also provides some hints for regional and neighborhood planning, and design for sustainable settlement.

1.2 Objectives and Methods

This study has an aim to analyse the orchard system from basic structure to the whole correlative formation by clarifying the land development process of an orchard system. The author uses the analysis of its basic elements and the whole spatial structure, through a field survey, including the collecting of fundamental data from Feb-Mar2003, Dec 2003, and Jun 2004. The Amphawa municipality and surrounding area, as seen in Fig.1, was chosen[3] as the research area to explain the morphology of the orchard neighborhood in the western part of the Chao Phraya lower basin. The author explains the correlation between the orchard unit and the waterway network. Therefore the land parcel and waterway formation pattern were researched using the following method;

1) Analysis of the pattern of land parcels through the distribution map of orchard unit correlated to land-ownership. From the following process:

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[1] *Compare to the western part of the Delta, the eastern part, which also used to be just a vast lowland area, was rapidly reclaimed for rice fields after the introduction of the free trade market during the end of the nineteenth century.*

[2] *Ref.1.*

[3] *Amphawa municipality and its surrounding area has been chosen as a study area, due to its significant role as the main waterfront market of the neighborhood, which consisted of a waterfront market and floating market, and its background settlement of the royal family and other aristocrats that proved its status as the center of expansive settlement of the orchard neighborhood.*

a) Mapping of more than 800 units of land parcels by overlaying the 1975 and the 1994 aerial photographs which provided the exact features of orchard units; and 1922 lands property maps[4], which provided the precise territory line of each land parcel.

b) More than half of land parcels mentioned above were selected to clarify the exact land ownership and their profile in detail.

2) Analysis of the correlation between the land-parcel and waterway network by observation of daily change of the flow and tide in each waterway, together with the use of the distribution map of the orchard unit[5].

2. THE FEATURES AND FORMATION PROCESS OF AN ORCHARD

2.1 Condition to form an orchard

(1) Classification of waterways

From a study of the settlement in the Delta by Tachakitkachorn[6] and Yantrasast[7], to conduct an analysis of the settlement in the Delta, which is formed by a complicated waterway network, we have to present this network partially into an order pattern of linear elements. As seen in Fig.2, consider this criteria; (1) its physical feature, the width and depth of a waterway, connecting or dead-end (2) its function used by people in or out of the area including daily or periodic use as the line of transportation and irrigation, (3) changes of physical features and function during high-tide and low-tide. We can separate and classify the hierarchy of waterways into five classes as follows;

(a) Main river (R): Natural river = *Mae Klong River*

(b) Primary *canal or Khlong* (M) : Main structural line channeled directly from the River = *Khlong Amphawa*

(c) Secondary *Khlong* (K): main structural line channeled from the primary Khlong, or the River, with a smaller dimension = *Khlong* Ladtachote

(d) Tertiary *Khlong* (k): Branch waterway channeled from above the primary and secondary Khlong.

(e) Lampradong: Dead-end irrigation waterway or ditch.

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[4] *Land ownership in the Amphawa neighborhood was first officially started in 1922. Though there would be any informal contracts or engagements, involving land property, done by people before that time.*

[5] *There were a lot of restrictions that made this research hard to be conducted, especially the limitation in obtaining information about land-ownerships; unclear information from a decrepit land property map, which was issued in 1922, and enormous records of land issued which were frequently changed. Moreover, the physical change of waterways, from 1922, also affected the process of water-way hierarchy.*

[6] *Tachakitkachorn Terdsak (1998), A study on waterside settlement in the Lower Chao Phraya Basin: Case study of Bangkuviang waterfront market and surrounding area. Master thesis. Kobe University*

[7] *Yantrasast Kulapat. (1995), A Study of the Phenomenon of Water and Urban Transformation: Bangkok's Water Logic. Doctoral Dissertation, University of Tokyo*

Classes of waterways shift or evolve due to changes. We could identify some waterways being abandoned and left without any maintenance that finally would be declined to lower classes, as seen in urbanized areas. On the other hand, they could be inclined to upper classes with being frequently used or being enlarged due to specific reasons, as seen in the development of the Chao Phraya River after the excavation projects for more convenient in transportation[8].

(2) Water system

As seen in the whole Delta, the water system in the lower basin has specific characteristics. The water level in this area is dependent on both water from the sea tide and from the upper watershed flow, as both of them are changed by daily, monthly and yearly cycles. The daily water tide could be stable in some periods, but it could also be varied in some periods.

Generally, it is well known that the water system in a young delta has received influence from (1) the flow of fresh-water from upper watershed areas and (2) the tide of sea-water from lower coastline areas. It is dependent on these two factors at the same time. However, changes caused by these two factors were controlled by their differential balance due to seasonal change. And this change could be explained by consideration of the differential balance of flow from the upper area and the tide from the lower area and is in correlation with the seasonal change as follows:

(a) Dry season (December – April): The influence from the sea tide is more than from the upper water flow. The change of water level has the flow from low area to high area in high tide, and from the high areas to the low areas during low tide.

(b) Rainy season (May – November): On the other hand, this water level change could be sometimes in reverse movement during the rainy season. Because of an influence from the water flow from an upper watershed area has much more influence than from the sea tide after the rain in the watershed area. The water flow, as mentioned, would move from the upper part to the lower part in a pattern of waves with long intervals. When this wave arrives to the neighborhood, the water level rises from the upper-stream area to the lower-stream area, and it is falling from the low-stream area to up-stream area.

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[8] *From historical records about the waterway excavation process, waterway excavations were conducted to provide a short-cut or irrigation waterway, using human-power and animals. This would be done in the dry season, and with the force of water flow and tide in the rainy season. Finally waterways would be widened. The introduction of the western modern technology in civil engineering, especially from the Netherlands, brought about a big change to the waterway excavation process during King Rama IV and V era. In spite of the practical use of modern technology by aristocrats, it was considered that this process could not be suddenly introduced into a remote local area, but mostly used in the state projects. Besides the development of an irrigation network, the waterway excavation generally would also be conducted for short-cut waterways. There are two typical kinds of shortcut waterways; (a) Shortcut waterway to reduce the distance from a winding waterway, or to connect waterways in a different network or basin; (b) Shortcut waterway as an alternative route to avoid passing through a rapid stream of the main waterway. While the first type is mostly channeled and connected to each waterway at a right angle, the latter type is mostly parallel with the main waterways. These shortcut waterways would also have a function as a boundary line of land-parcel, neighborhood and sub-region.*

Thus, instead of the flow from a low area to a high area, for the orchard people, it is more commonly explained in terms of the following system; from or to the inner area of orchard units – Lampradong – the tertiary or secondary Khlong – the primary Khlong – the Mae Klong River – Sea, as seen in Fig.3.

(3) Structural figure of orchard[9]

From case studies of individual and groups of orchard units, as seen in Fig.4, we could separate the main elements that formed the orchard-unit into 3 parts, as follows;

(a) Structural line

There is no specific name for this part because of its indefinite functional range that would cross from one boundary to others as public or semi-public elements. This includes the structural line of the watercourse and the structural line of pathways that can be explained in detail as;

- *Khlong-Suan* or Lampradong: irrigation waterway
- *Tanon* or *Kwang*: pathway and cross-dike

These structural lines could be developed from a small linear element, as the private space of an individual orchard-unit, into a bigger linear element, as a semi-private or semi-public space of the whole orchard. This would be done for the improvement of water circulation, and for enabling land development into the back marsh area. Both of them also function as the boundary of an orchard unit, land parcel, and neighborhood.

(b) Fruit planting compound (*Khanad-Suan* = KS unit)

This part is generally named *Khanad-Suan*. It is the most complete and minimum typical unit for planting vegetation. It is formed by a part of raised-beds, which is called *Rong-Suan*, and a part of trenches, which is called *Thong-Rong*. While a part of raised-beds would be piled up with soil from trenches excavation for heightening the ground level of the planting area, a part of trenches would be dug in the ground for deepening water-bed level. The dimension of the older raised-bed, *Rong-Suan*, could be 2 meters in width, and about 1.2 meters in depth with 0.3 meter for the shoulder part at high water level. And its trench, *Thong-Rong*, could be 2 meters in width. This dimension would be reflected for the convenience of working in orchard watering and other maintenance. The dimension of recent raised bed doubled that of the former one with 4 meters and a trench of 2 meters in width. This dimension was the result of merging two rows of raised-beds. And with the application of sprinklers, the most recent dimensions of the raised-bed also doubles from 4 meters to 6-8 meters.

We found *Thong-Rong* at the edge of Khanad-Suan, which developed from a private fruit planting area into a semi-private *Kwang* or semi-public pathway automatically. This

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[9] *With their different ways for making the connection between the structural line and the fruit planting unit, we could describe the traditional orchard system as follows; (a) Open-orchard system: This fruit planting unit is generally opened up and connected to the above mentioned skeleton line of a watercourse. It could be closed by piling up a small temporary earthen-dike if the block needed water; (b) Close-orchard system: This fruit planting unit is completely enclosed by Thanon or Kwang. The water control could be done by a palm-trunk pipe buried underground at one point nearest to the main waterway. Most of the old orchard settlements located in the Mae Klong Basin, including the Amphawa Neighborhood, are the open-orchard units. But most of the old orchard settlements located in the Chao Phraya Basin, include the Bangkoknoi Neighborhood and the Bangkok Yai Neighborhood, are the closed-orchard units.*

development is the same as the structural line that is dependent on the *Khanad-Suan* situation. If it has been used by people in the entire neighborhood for a long time, it could be developed into a sub-public space and recognized as such by the owners.

There is no specific dimension and specific numbers for *Thong-Rong*. However, people in an orchard area would never mention the size of their KS unit in term of dimension, but they would mention their possessed KS units in the number of *Rong-Suan*, or line of raised-bed set. And its dimension also varied from a KS unit formed by 3 rows of *Thong-Rong* set, to KS units formed by more than a dozen of the *Thong-Rong* set.

(c) Residential compound

Generally, a residential compound is developed from an earth filled areas along the natural levee of waterway or the newly excavated waterway, and from a part of the land area for a fruit planting unit. Considering the water level during high tide, the land level of this residential compound would be specifically piled up a little bit higher than fruit planting compounds. There would be the process of compound grading by land pressing and covering by manure of cows or buffaloes[10]. The development from a fruit planting compound could be conducted by enlargement or the merging of *Thong-Rong* or *Kwang* along the irrigation waterway. This could be fulfilled by the grading of two *Thong-Rong* into one *Thong-Ron*g and up more by soil from piling Rong-Suan. The dwelling-units would be settled in a group on this compound. They would be expanded into the inner KS unit, after the compound is densely occupied.

This area would be firstly occupied by the single detached dwelling-unit. But eventually it would be developed into a compact group of detached dwellings, and rowhouses or shophouses, as seen in the waterfront market of the Amphawa Neighborhood. In addition, the size of this area would be proportionate to the class of waterway. The primary waterway would have a bigger residential compound than secondary and tertiary waterways. We found most of the first KS unit of fruit planting compound along the primary waterway developed into the residential compound.

2.2 Pattern of orchard land-parcel

Mostly, the boundary of each land-parcel for orchards would be decided by the center line of Lampradong or semi-public pathways (*Thanon* or *Kwang*). As seen in Fig.5, we can separate the pattern of land-parcel in the study area into 3 types:

(a) Land-parcel formed by multiple KS units (A):

This includes the single-strip pattern (A-1), the multi-strip pattern (A-2), and free-form pattern (A-3). This kind of land-parcel mostly belonged to aristocrats, including former Royal Family's members, former government bureaucrats, Chinese merchants, and the temples. We found this type of land-parcel at an area along the *Mae Klong* river and primary Khlong and an area nearby the temples[11].

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[10] *Takaya Yoshikazu. (1987), Agricultural Development of a Tropical Delta: A study of the Chaophraya Delta, University of Hawaii Press*

[11] *Most of the land that belonged to temples was donated by aristocrats or landlords of that time. It could be considered that these lands would be a part of a land parcel possesed by those people, who lived in nearby neighborhoods.*

(b) Land-parcel formed by single KS unit (B):

This kind of land-parcel belonged to the relatives of those first settlers mentioned in (a), and also belonged to orchard farmers. It is scattered in the whole area of the orchard neighborhood, but regularly seen at the area nearby the temples[12]. Different from the typical KS unit (B-1), the KS unit along the main waterways would be developed into the residential compounds. There is also the combination of this residential compound with a single KS-unit behind. This specific unit (B-2) is mostly seen in the waterfront market area.

(c) Land-parcel divided from single or multiple KS units with an incomplete unit feature, or land-parcel of split KS unit (C):

There are various types of subdivision patterns; including the follow-ridge subdivided pattern (C-2 and C-5), the cross-ridge subdivided pattern (C-1), specific divided pattern (C-3 and C-4), and land-parcel of split single KS unit, and land-parcel of split multiple KS-units. This kind of land-parcel was obviously seen in the inner area far from the Maeklong River and the primary Khlong.

And in Fig.6, which shows the distribution of land-parcels formed by various patterns of KS unit, we can identify that even the land-parcel of the same type was also formed with various sizes. For instance, we could identify a B-type land-parcel with larger size than an A-type land-parcel. Moreover, we could identify that most of A-type and B-type land-parcels were located mostly along the Mae Klong River and Amphawa canal , while most of C-type land-parcels were located along the inner waterways.

2.3 Pattern of Grouping of land parcels

Besides the individual land-parcel, which is formed by KS units, there is a specific characteristic that can be identified from tracing and grouping these land-parcels. And this grouping of land-parcels can be described by the following criteria;

(1) Lay out and direction of KS units, correlated to the waterway:

Superficially, the lay out of the whole KS units seems to be varied and set at random. However, if we examine separately each waterway level, we can identify the specific pattern from the correlation between each group of KS units and their structural waterways. There is a common rule that the individual KS unit would be vertically lined side by side, at right angles from their attributed Khlong. And under this rule, a grouping of land-parcel can be identified.

(2) Distribution pattern of land-parcels, correlated to the character of land ownership:

This criteria itself could not completely indicate the obvious tendency seen in a grouping of land-parcels, but it could emphasize a pattern of grouping of land-parcels after the first criteria. The grouping of land-parcels from the first criteria shares the same common point that the land-parcel with multiple-KS units would be the main structure of grouping, while the land-

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[12] *According to the former regulation under the slavery system; there had to be some laymen, contributed by aristocrats, sent to temples to give service for monks. These people would set up dwellings on land near those temples.*

parcel with single-KS unit, in the same alignment, would also be clustered near each other. And each grouping of land-parcels apparently formed in a different alignment to those surrounding ones. Besides the pattern of land-parcel, there are also a few cases that show some tendencies in grouping of land-parcels, such as land ownership belonging to the same relatives in the same grouping of land-parcels.

From the above mentioned criteria, through the waterway network as seen in Fig.2, we can indicate the grouping of land-parcels in the study area as seen in Fig.7, and can identify their characteristics as follows;

(a) Grouping of land-parcels along the Mae Klong River (M1-5):
All Lampradong in this part was directly channeled from the Mae Klong River. Some of the tertiary and secondary Khlong would probably be developed from Lampradong, such as K-3, K-9, K-10, k-3, k-4, and k-5. As seen in M-1, M-2, and M-3 this part was mostly occupied by the land-parcel with multiple KS units, except areas along those Sub-Khlong and temples, which was occupied by the land-parcel with a single KS unit. While, most of the grouping of land-parcels along the Mae Klong River occupied most of the area along the whole natural levee of the river, an area of natural levee at the M-5 area was mostly occupied by land-parcels in the group A-2 area.

(b) Grouping of land-parcels along the main part of Khlong Amphawa (A1-5):
All Lampradong in this part was directly channeled from Khlong Amphawa. Some of the tertiary Khlong would probably be developed from Lampradong, such as k-1, and k-2. Except A-2, A-4, and an area along those Sub-Khlong and temples, which is occupied by the land-parcels with single KS units; A-1, A-3, and A-5 were mostly occupied by the land-parcels with multiple KS units[13]. Moreover, the KS unit in this area, especially in A-3, was comparatively bigger than in other parts.

(c) Grouping of land-parcels along the extended part of Khlong Amphawa (A6-8):
This part could be counted as the extended part of Khlong Amphawa, due to its re-unification with Khlong Amphawa at the junction with Khlong Philok (K-2), and its end at the Mae Klong River. All Lampradong in this part was directly channeled from Khlong Amphawa. However, the scale of the groupings are comparatively smaller than those along the main part of Khlong Amphawa. There is no Lampradong developed to be a Khlong in this part. This part is mostly occupied by the land-parcels with single KS unit, and land-parcels with a split KS unit, except A-7, which is occupied by the land-parcels with multiple-KS units.

(d) Grouping of land-parcels along Khlong Ladtachote (L1-7):
All Lampradong in this part is directly channeled from K.Ladtachoke. Except L-1, which is occupied by the land-parcels with multiple KS units. This part is mostly occupied by the land-parels with single KS units and the land-parcels with split KS units. Moreover, the KS unit in this part is comparatively small compared to the others.

(e) Grouping of land-parcels along Khlong Prayayart (P1-2):
Different from P-1 area, which has Lampradong channeled from both Khlong Ladtachote and K.Daodeung. All of Lampradong supporting P-2 area is channeled from Khlong WatPrayayart. This part is mostly occupied by the land-parcels with single KS unit and the land-parcels with split KS unit. Moreover, the KS unit in this part is comparatively small, like in K.Ladtachote part.

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[13] *Land-parcels in this part mostly belonged to the Royal Family and relatives of the Bangchang family, including His Majesty the King Rama VI, GlomLuangNakornsawan, and PrayaMonTriSurivong*

(f) Grouping of land-parcels along K.Daodeung (D1-2):

All Lampradong in this part is directly channeled from K.Daodeung. While D-1 area is occupied by the land-parcels with multiple KS units, D-2 is mostly occupied by the land-parcels with a single KS unit and the land-parcels with a split KS unit.

2.4 Micro-land use of Agriculture-based kinship settlement

As seen in Fig.8, case studies of the Cheivijit's family, and Fig.9, case studies of Muangseng's family, both of land-parcels are formed by multiple KS units with a group of dwelling-units on the residential compound and some single detached dwelling-units in the backyard KS units. It is clear in both case studies that the residential compounds were developed for the first settlement along the main waterway, Khlong Amphawa. This first step residential compound would form separately from a KS unit. Due to an increase of dwelling-units after family expansion, this first step residential compound would gradually be enlarged by merging the KS unit in a backyard. The hierarchy of dwelling-units makes clear that the first dwelling-unit for oldest members, being the most respected, was settled nearest to the main waterway, Khlong Amphawa. Then the later descendants formed their dwelling-units lined orderly behind the first one. These later dwelling-units had a water supply from an irrigation waterway channeled from Khlong Amphawa.

From both case studies, we can classify their dwelling-unit lay-outs on the main residential compound: an area for the first generation, an area for the second generation and an area for the third generation. These areas are now succeeded by their descendants respectively. In case of no more dwelling space in each dwelling-unit or the residential compound for the expanded family, the later members have to form their dwelling-units on the other inner KS units.

Generally, the hierarchy of the KS unit possessed by family members is parallel with the division of dwelling-units in residential compounds. The first generation member had the right on the KS unit next to the residential compound, and the later generation member would occupied on the inner KS unit respectively. Therefore, the formation of the fourth generation dwelling-units on those inner KS units would be conducted together with the succession of the right on those KS units. This automatically forced dwellers in the inner area to develop and maintain an irrigation waterway for a constant water supply.

3. SUMMARY

3.1 Formation of orchard unit

From details of the structural figure of orchard unit and the correlation between orchard unit figure and land-parcel, we can summarize some characteristics of the orchard units as follows;

(1) Size of multiple KS units can be determined by

- Size of the family: The bigger the number of the number of the family to be formed is means more labor for land reclamation and orchard management, including production and maintenance.

- Class of irrigational waterway: This limits the capacity of the water supply for orchard management.
- Expansion or evolution of waterway

(2) A land-parcel formed by multiple KS units was not reclaimed completely at one time, but would be accomplished by the orderly addition of single KS unit by unit, from generation to generation. This could be conducted together with the development of an irrigation channel for water supply. It means that the first unit would be reclaimed at the same time as the irrigation channel (Lampradong), and the later units would be added after the expansion of that irrigation channel.

(3) Single KS units would result from the subdivision of the land parcel through the process of distribution of the estate by generations, after the whole area was occupied and left no place for any more reclamation, except lands in remote areas.

3.2 Formation of Land through an orchard system in a micro scale

As seen in Fig.10, along with the formation of an orchard unit, we could summarize the micro scale development of an orchard land-parcel 3 processes, as follows;

(1) First land-parcel formation along the river and main Khlong

Land reclamation and development for orchard settlement with a raised-bed orchard system was initiated into the Delta at least five hundred years ago[14]. And from the interviews of the elderly, there was no one who ever observed or participated in the reclamation process of traditional orchard units. However, from the correlative features of land-parcels and KS units, we could assume that the construction of traditional orchard units would be conducted through the formation of KS units one by one, starting from the land along the main waterway. The scale of this process would be dependent on (a) the ability of irrigation supplied from a nearby waterway for fruit planting units, and (b) the ability for the managing and maintaining of fruit planting units after reclamation. Under these criteria, the size of a KS unit would be limited mostly by human-labor taking part in the orchard management, while the beginning of construction could be accomplished by calling for intensive human-labor.

(2) Expansion of land-parcels and the development of land-parcel grouping

The expanding KS units would be continued along with the development of irrigation channels, after all dwelling-units were settled. These KS units, which developed by the same groups of family or same masters, could finally be unified into land-parcels and the orderly grouping of land-parcels. In addition, the longer and deeper the irrigation channel was developed, the more units of orchard land-parcel would be reclaimed. Starting from dead-end irrigation channels, when they were expanded into deeper areas and met with other irrigation channels, all the irrigation channels would be connected into a network. With this cycle under progress, the connective waterway network would be naturally developed and enabled more opportunities for orchard unit development into the vast back marsh area.

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[14] *Ref.2.*

(3) Subdivision and reunifying of land-parcels

The process for subdivision of land-parcels takes place for the reason of inheritance for the expanding family's members[15]. Usually, after the decline of the slavery system and the vast undeveloped back marsh still remained, those descendants in an expanding family would leave their home settlements looking for empty land on the new frontier. But, after these undeveloped lands were all possessed, the original land-parcels of family were subdivided. On the other hand, the process for the merging of land-parcels would place for the reason of (a) reunifying for the erection of a temple, or (b) reunifying for land redevelopment. The first one is done as the conventional process by anyone who has a devout belief in Buddhism, from aristocrats to commoners[16]. The second one is an advanced process done by administrative or real estate developers. Generally, this was done for the large built-up area with high density dwelling units. We could describe the typology of the merging process physically into 2 patterns as, (a) reunifying of land-parcels following the outline of KS unit, and (b) reunifying of land-parcels out of the outline of KS units. Most land-parcels merging for temples were done by the first process, while most land-parcels merging for new urbanized development or redevelopment projects were done by the second process.

3.3 Development through the orchard system in macro scale

It is clear that the Amphawa neighborhood was developed from the wetland mixed with mangrove jungle area into the orchard settlement by the initiating of the raised-bed orchard system. This raised-bed orchard system provided land surface for building the dwelling-units and for fruit planting, and water surface for and drainage. As seen in Fig.11, we can describe the steps of macro land formation through the development of raised-bed orchard units as follows;

(1) First Period: Start from linear feature

An area along the existing main waterway, including the River and natural tributary waterways, would be chosen as the first choice for settlement. The irrigation channel would be excavated as the first artificial structural alignment for a land-parcel of KS units. The land-parcel size was dependent on the human-labor for the excavation of irrigation channels and also the orchard management after completion.

(2) Second period: Developed into branch-feature

With the increase of human-labor, in parallel with the expansion of the family, the extension of an irrigation channel could be conducted, along with KS units, for more production. However, the ability of water supply for irrigation would be limited by some restrictions, including waterbed depth and width. This problem would be solved by the development of the irrigation

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[15] *Subdivision under the economic conditions can also be considered. From the records in land-issue of the Amphawa Neighborhood, most land purchase contracts had been done during the two or three decades after the first land-issue in 1912. There would be some contracts done before official land-issue. However, it would not be done for money, but for land transfer as the solution for tax payment.*

[16] *From the records of the year of the temple erection in the Amphawa Neighborhood, this process could be traced back to the beginning of the orchard settlement in the Young Delta during the Ayutthaya period and the early Rattanakosin period.*

channel *Lampradong* into *Khlong*. And, an upgraded waterway would be connected to other irrigation channels for enabling extension. This process would be in progress as long as the undeveloped back marsh areas still remained. The development through the first and second periods along the levee of Khlong would into a brach-feature of reclaimed orchards.

(3) Third period: Completion of waterways network and orchard

After the second period, the whole land was covered by a connective waterways network. This eventually led to the evolution of irrigation channels to the tertiary and secondary waterways respectively. Those vast back marsh areas could be well accessible and used for both transportation and irrigation. Finally, the land with a branch-feature would be developed into a complete-feature of a reclaimed orchard area in the waterways network.

3.4 CONCLUSION

As seen in Fig.12, from the above explanation about the land formation process, we could summarize the essence of the orchard system as follows;

(a) Progressive Linkage System:

The reclamation of marsh land was done through the linear elements of *Khlong*. These *Khlong* could be considered the structural alignment of orchard neighborhoods that both performed as; (1) the leading line split from the natural waterways into the back marsh area, and (2) the linkage of short-cut and connective channels for the completion of the whole waterways network. Meanwhile, it could be considered that the completion of the linkage of a *Khlong* played a significant role in creating and maintaining the main structural circulation of water flow in an orchard neighborhood.

(b) Progressive Membrane System:

Different from land use for the rice field in the Delta, the KS unit could be considered the most intensive artificial living spatial unit that can enable people to perform the agriculture production in the wetland area for the whole year. Due to its spatial structure, which is conformed by rows of ridges and trenches, a back marsh area with muddy terrain was changed to a place with a well-balanced combination of (1) Land area, which enabled people to make a settlement and vegetation; and (2) Water area, which provided for the reservation of fresh-water use in fruit planting. With the specific characteristics of an orchard unit, which could be gradually expanded one by one like a cell, the land reclamation process of the back marsh area along the *Khlong* could be done by maintaining a balance of land and water area in the whole neighborhood. Without any excessive development, the membrane of orchard units, in both micro and macro scale, could create the inner water circulation of their own block and also maintain their connection with the outer water circulation of entire neighborhoods.

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Figure 1: Boundary of three districts in Samut Songkhram Province, and study area of the Amphawa Neighborhood

R: Mae Klong River	M: Amphawa market	K=1st and 2nd Khlong	k = 3rd Khlong
K1: K.Amphwa	K2: K.Bangpilok	K3: K.Bangjak1	K4: K.Ladtachote
K5: K.WatPhrayayart	K6: K.Daodeung	K7: K.Nongor	K8: K.Daodong
K9: K.Tapak	K10: K.Chang	K11: K.WatNangwang	K12: K.Suanluang
k1: K.Sai	k2: K.WatChulamanee	k3: K.Bangjak2	k4: K.Suanchang
k5: K.Bangphrom			

Figure 2: Map shows the distribution of waterways network in the Amphawa Neighborhood
Base on Land property map surveyed by the Land Department in 1922, and aerial photographs taken by the Royal Thai Survey Department in 1975 and 1994

Flow from the secondary to the primary Khlong at WatPrayayart at ebb-tide

Flow from the tertiary to the socondary Khlong at WatAlongkorn at ebb-tide

Flow from trenches into Lampradong in the Garden-plot unit at ebb-tide

Garden-plot of coconut tree consisting of ridges and trenches

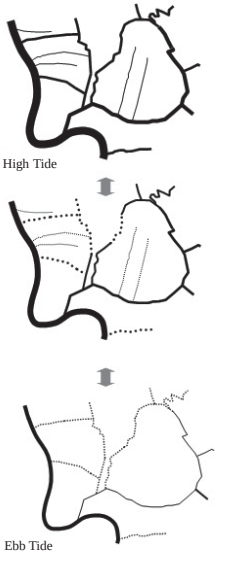

Figure 3: Pictures and models show the transformation process of water level during the dry season

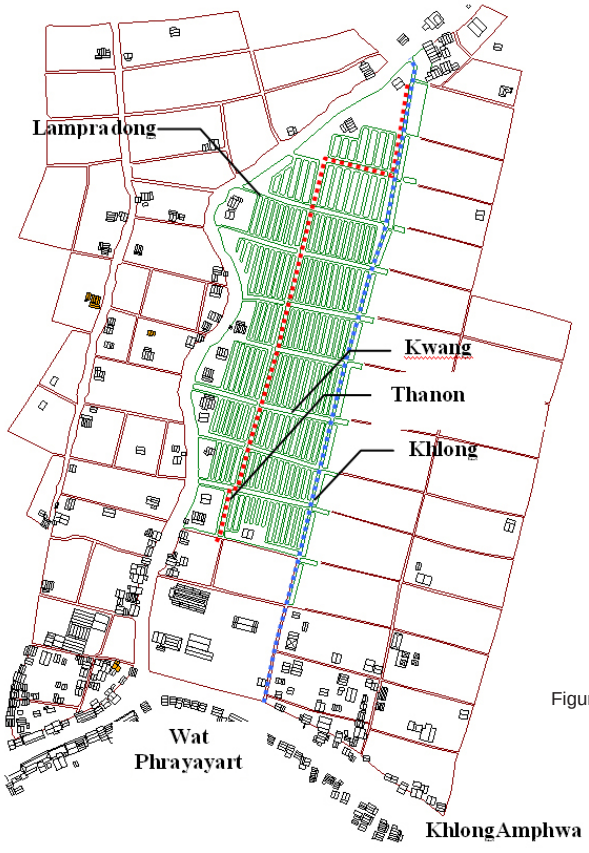

Figure 4: Plan of orchard units near Wat Phrayayart

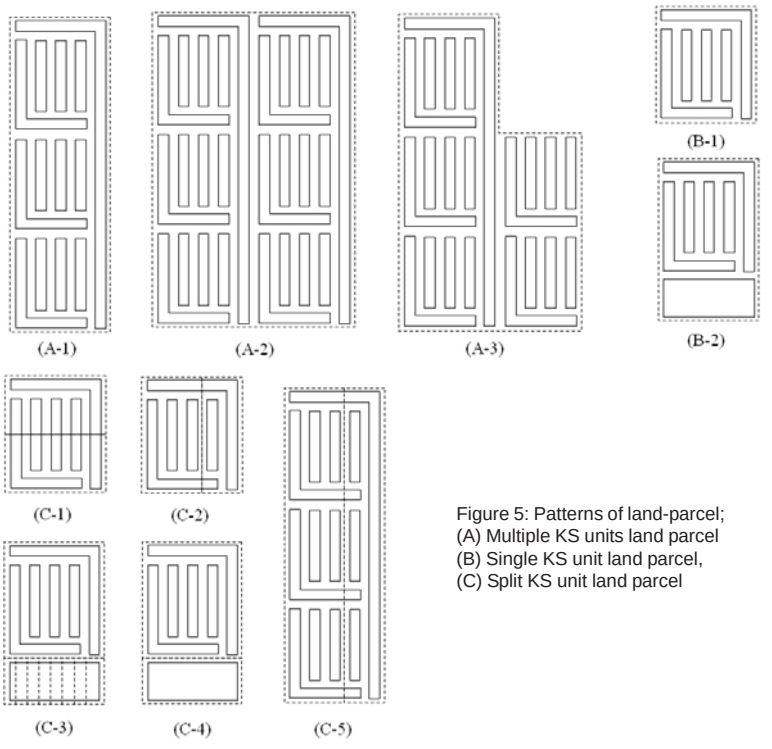

Figure 5: Patterns of land-parcel;
(A) Multiple KS units land parcel
(B) Single KS unit land parcel,
(C) Split KS unit land parcel

Figure 6:
Type of land-parcels
Based on Land property map surveyed by the Land Department in 1922, and aerial photographs surveyed by the Royal Thai Survey Department in 1975 and 1994
Multiple KS unit land parcel
Single KS unit land parcel
Split multiple KS unit land parcel
Split Single KS unit land parcel
Temple compound
0 300 600m

Figure 7:
Grouping of land-parcels

Based on Land property map surveyed by the Land Department in 1922, and aerial photographs surveyed by the Royal Thai Survey Department in 1975 and 1994

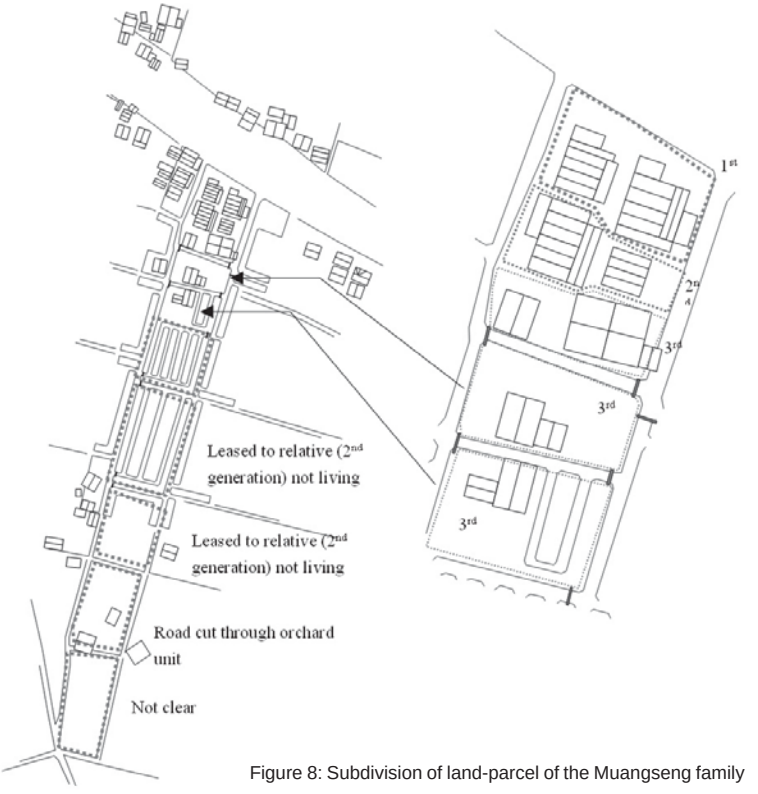

Figure 8: Subdivision of land-parcel of the Muangseng family

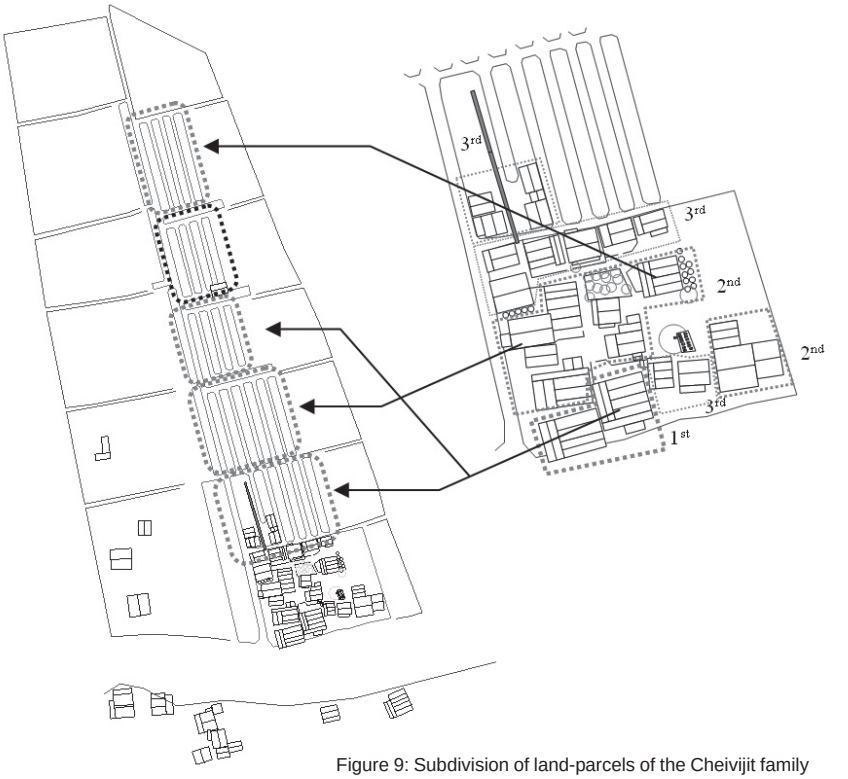

Figure 9: Subdivision of land-parcels of the Cheivijit family

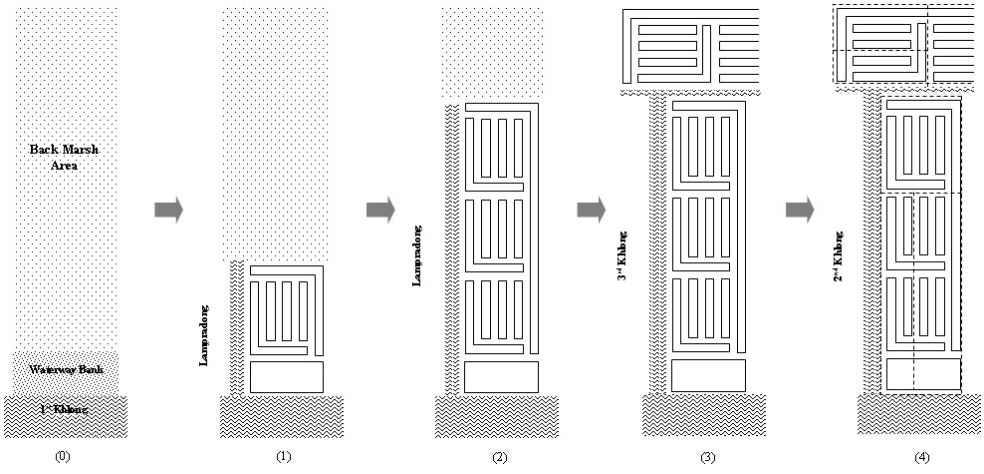

Figure 10: Model shows transformation process of orchard unit development in macro scale

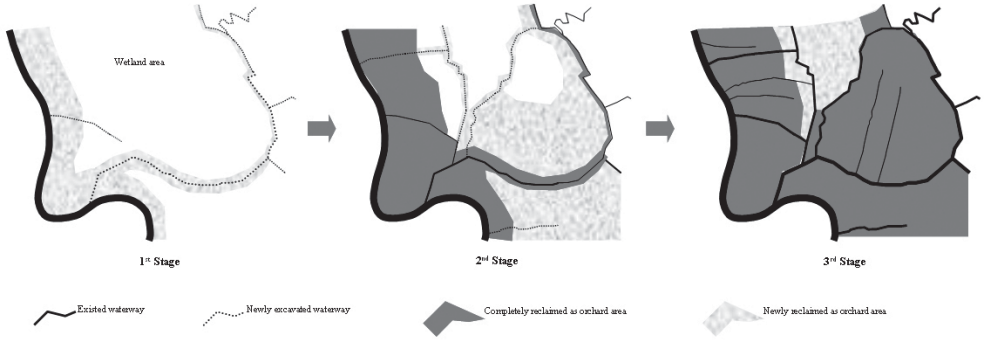

Figure 11: Transformation process of the whole orchard area in Amphawa neighborhood

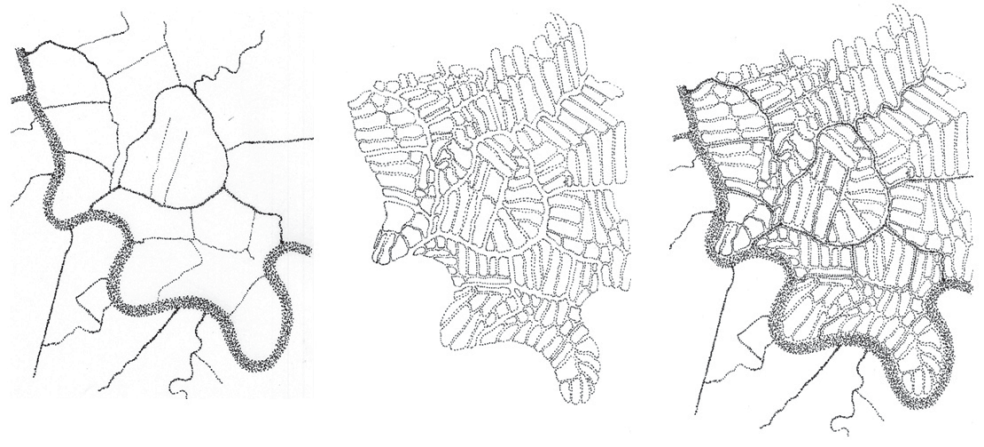

Figure 12: Combination of linkage of waterways network and fabric of orchard units


ท่าเรือ
บริการเรือ