

A WATER FIELD CIVILIZATION -THE HYDRAULIC SYSTEM OF THREE AGRICULTURE PLAINS IN TAIWAN

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ABSTRACT: The Taiwanese countryside, based on its water-orientated production landscapes, distinguishes itself as a society constructed on water. The irrigation system of paddy fields and fish ponds connects the society in collective units, like families or unions, which frames their social morals and behaviors. In the comparison of the different agriculture plains in Taiwan, the figure ground maps demonstrate a difference in the settlement patterns related to topography and the management of water. It also shows the how early settlers solve water threats and manage a stabilized water source. By reorganization of the water structure and utilization of the ecological value of paddy fields, the study proposes a potential city density which benefits food production, flood control and water purification. Therefore, the concept for the new city structure could extend the timeline of the historical relationship between “water”, “agriculture”, and “city construction”, and develop into a new major landscape composition.

KEYWORDS: agriculture, paddy fields, water management, urbanism, Taiwan

1 INTRODUCTION

We may claim that water is the most crucial factor in an agriculture civilization. Before modern technologies, the supply of water for paddy fields influenced the community relationships of that rural society, which formulated the landscape. J.B Jackson referred to the classical landscape as “a place where men and environment were in harmony with one another and environment where an overall design was manifest in every detail.”¹ The every day details referred to the interaction between man and their usage of water.

As one of the rice production landscapes, water management is not a new concern for the Taiwanese; water has influenced society development throughout history. The cultivation behaviors were driven by the appearance of water, which directly impacted the form of settlements. Under the similar context of a Taiwanese rural society, a comparison of the three agriculture plains in Taiwan showed the pattern of settlements differ due to their topography and water source. Although historically the image of hydraulic systems displayed a mental influence on the rural spatial relation, but with modernization, the image of water had vanished in the urban blocks of Taiwan. Today, by rediscovering the culture of a water field production civilization, along with its ecological value, we can reconsider the rural urban form, where the development should evolve from the local, from the land, and from the form of water. Spatial planning should also take into account food production, energy saving, water purification and retention, to target a sustainable society.

2 PROBLEM STATEMENT

Vacating farm towns and rural landscapes are the result of the economical shift from the primary industry. Holiday villas now occupy the countryside, and a weak urbanization process is dispersing dwelling units in the fields. The ever-expanding city is booming beyond the boundary of the zoning patch works. In Taiwan, the farmers cultivate in small and independent units, so as individual farmers retire, an abundance of residual land are fragmented. The disintegration of the rural landscapes signifies the lack of maintenance and cultivation. The Taiwanese countryside is left without long range goals, structure, and without social or

moral order.

The change in global climate resulted in a decrease in rainfall periods, but in significantly larger quantities. Taiwan is located in the monsoon zone of south-east Asia, averaging 3.5 typhoons and dozens of torrential rainfall, causing 2.56 hundred million Euros lost each year. One consequence of this heavy rainfall is the sudden floods from river overflows, which is originated from upstream hinterlands. Another culprit for the damages is the lack of appropriate sewage systems, since they were not built to support the current degree of housing and factory developments. Thus, the runoff water seeks close irrigation channels for relief, and congests agricultural drainage systems which lead to flooding of massive areas. The lack of hydraulic concerns has been a common issue in Taiwan. Therefore, the challenge is how water management could be implemented into the development process.

The vanishing paddy fields are a great loss to the maintenance of surface water bodies. After Taiwan joined the World Trade Organization, the government began subsidizing the farmers more than their earnings from actual cultivation, resulting in half of the farm fields being abandoned. The outcome is a major loss of food production and a change in the urban form where fewer people are willing to farm. On the other hand, the government is replacing the economy with technology oriented industries to redefine its position in the global market. So the transition from farmlands into hi-tech industry zones is a popular investment. Today, the high income engineers are moving towards the outskirts of the new industry platform, but also in environmentally fragile areas, like water plains. This provides a potential opportunity for a new urbanity for a mixture of offices, housing, social facilities and sustainable water systems, while employing water as a part of the source of life.

3 TAIWAN AND ITS HYDRAULIC TRANSFORMATIONS

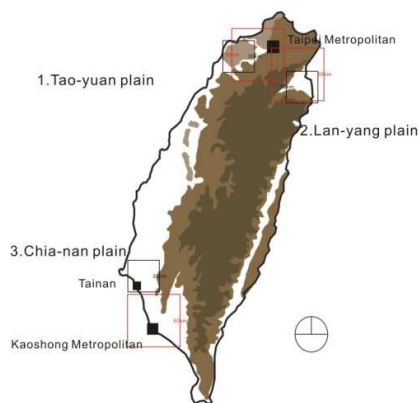


Fig.1. Taiwan and the three agriculture plains
(source: drawn by author)

Taiwan(Fig.1.) is an island located in the Pacific Ocean southeast of China. Two-thirds of the island is occupied with rugged mountains, and 91 large and small rivers run towards the Taiwan Strait in the west plain. The highest point is Yu Shan Mountain, at 3,952 meters, which makes it the world's seventh-highest island. With the extreme variety in topography and concentrated rain falls, rivers along the east plain are mostly torrent and have unstable water levels, resulting in a challenge to live in this territory. During normal periods, the land suffers from shortage of water, while during monsoon and typhoon seasons, bear extreme and heavy rain falls.

Revolution of the Taiwanese hydraulic system has always led to a major transformation in the society. Since Taiwan is located on the corridor where Chinese and Japanese cultures combine, it has been influenced hydraulically and urbanistically also. The first immigrants to form a society are the Han-Chinese, who came from China around 1620. They transplanted their cultivation notions onto the new land, and their relationship with the water for agriculture influenced the original settlements. Later, during 1895~1945, Taiwan was colonized by the Japanese, who were the first to establish a governmental systematic hydrologic system: “great cannels”, which excavated the crop production in the plains. Since then, the vernacular water landscape was transformed, and the central-managed water system no longer relates to the settlement typologies. With the stable supply of water, it lowers the conflict between farmers fighting over water sources, and stabilized the society. Solving hydrology problems resulted in the country's first economical growth. But in modern times, the transportation infrastructure now guides the development, and water no longer influences the urban structure.

4 THE THREE AGRICULTURE PLAINS

The flat plains in the west side of Taiwan are home to most of the island's population. Here, locates the two biggest agricultural plains in the country: the north, Tao-yuan plain; the south, Chia-nan plain. And over the mountains, the Lan-yang plain lies in the valley of Lan-yang river in the north-east corner. Water formulated the landscape patterns differently in the three regions, due to the different topography, soil, and

water source. Today, the spatial experiences are diverse. The next section discusses how the image of water changes, and how it reflects on the settlements and landscape.

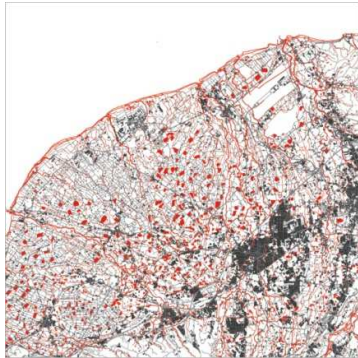


Fig.2. Tao-yuan plain

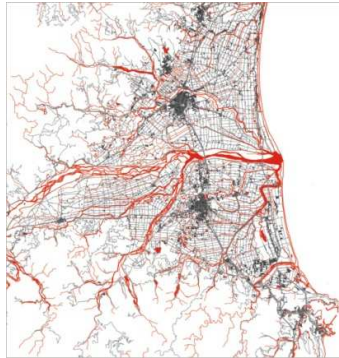


Fig.3. Lan-yuan plain



Fig.4. Chia-nan plain

(source: National Geographic Information System, "Basic and topography map, Version 1982", redraw by author²)

4.1 Tao-yuan plain (Fig.2.)

The farm ponds of Tao-yuan forms a unique landscape compared to other irrigation systems in Taiwan, due to its special soil type. The washout of Gu-shi-men River first formulated the table of the Tao-yuan plain, but with the shifts in the riverbed, the streams in this alluvial fan have lost its stable water source. Also, the land has difficulty retaining water due to the loam soil in this area, and results in major issues during dry seasons. In response, the earliest settlers dug out thousands of ponds for storage use, which formulated the special landscape for this region. The ponds are built following the contour lines, and as the gradient runs gentler, the ponds grow bigger, dispersing into the land. After the construction of the dam in 1960s, water is provided by centralized channels. Three to four families manage a single pond, and the whole water chain becomes a unit of social relationship. Today the Tao-yuan plan is under the pressure of mass population, and farm ponds start losing its function, and are filled in to create more land for estate development. The landscape today is changing radically and no longer reflects its water structure.

4.2 Lan-yang plain (Fig.3.)

The Lan-yang plain is an alluvial fan located on the east side of the Central Range of Taiwan, surrounded by mountains in three directions. The rivers rise here from the mountains, flowing downstream east toward the Pacific Ocean. When the river reaches the gravel fields, it runs underground until the foothill, and surfaces again as springs, formulating a sequence of big and small rivers running throughout the plain. The inhabitants therefore block rivers to store water for cultivation. This area is abundant in rain and fine drainage systems, so the plain is very suitable for agriculture production. The first Han-Chinese settlers assort land in a traditional collective way, but since the Lan-yang plain was the last cultivated territory, along with improved farming techniques, and reduced conflicts between different races in this area, settlements soon divided into smaller and individual plots. This resulted in a dispersed pattern of settlements in this region, where a single family house correlates to each agriculture plot. In 2006, the highway from Taipei to Lan-yang commenced, shortening the transportation time from 2 hours to 40 minutes, making it a hot estate as a suburb for Taipei city.

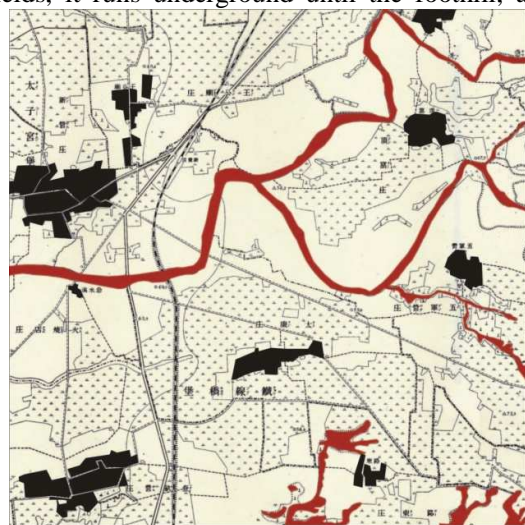


Fig.5. Map of Taiwan Bao-Tu, 1904

(source: "台灣堡圖 (Taiwan Bao-Tu)" Yuan-Liou Publishing Co., Ltd., Taipei, 1996. redraw by author³)

4.3 Chia-nan plain (Fig.4.)

The Chia-nan plain was the first area that the mainlanders settled and cultivated 400 years ago.

Historically, the farm land here was called “the fields relying on heaven”, because the rainfall fluctuates radically in this region, so the non-consistent water source is shared and irrigates the farms in turns. This drove the inhabitants to unite and cultivate each land alternatively, and lived in collective towns. These towns also created a defense line for the Han-Chinese against the aborigines. Thus, the notions of survival and water characters influenced the settlement typology, where these small collective towns formulated a network. Later, the Japanese constructed the Wu-shan-tou dam and the great Chia-nan water way and elevated the production output, establishing the Chia-nan plain as the main rice provider in Taiwan til this day. However, from the map of 1904, we see the Japanese channels were mainly built outside of the existing towns, so it was not planned to supply human use⁴ (Fig.5.). Today, the fields are occupied by factories, and this region is now the most polluted area in the country. With the decrease of agriculture production, the Chia-nan plain suffers both environmentally and economically.

5 THE NOTIONS OF SETTLEMENTS AND THE IMAGE OF WATER

The landscape is a way one understands the man’s habitat and microcosm, and in each site, the typologies of settlements showed a different structure of clusters. The image of the agriculture field, the cultivation behavior is influenced by the location’s social and environmental consequences. In general, there are two forms of county towns in Taiwan: collective towns and dispersed villages. The spatial relations are quite diverse, but we still can find both types of towns in the three plains. However, the morphology of settlements could be generalized following the perception of urbanity which follows the water systems. Where in the Tao-yuan plain, we find three to four families gathered as a unit to manage the farm ponds that dispersed in to the landscape. In Lan-yang plain, the dispersed single family housing is related to the agriculture grid system. And for the Chia-nan plain, the lack of water in this region led the people to cultivate collectively, so small but concentrated towns are mainly observed in this area.

From the human perspective, the image of the irrigation system is not obvious in the fields. The ponds are hidden behind role houses, or abandoned as waste land. The channels are framed by concrete, lacking an ecological base. Elements like pumps or major water gates shows a hint of the irrigation structure, but they



Fig.6. Tao-yuan plain



Fig.7. Lan-yuan plain

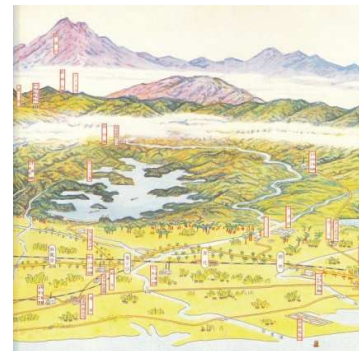


Fig.8. Chia-nan plain

(source: Zhuang, Y.M. etd., “台灣鳥瞰圖(Arial portraits of Taiwan)”, Yuan-Liou Publishing Co., Ltd., Taipei, 1996.⁵)

rarely formulate today’s mental map. On the other hand, while reading historical maps of 1930s, the half-perspective Japanese maps exhibit an extreme image of the field that reflects on the era’s psychological emotions. The maps of the three agriculture fields emphasize the hydrological interpretation in different ways: 1. Tao-yuan plain, the farm pond system (Fig.6.), outside of the town, dispersed as fragments in the fields; 2. Lan-yang plain, the concentrated streams (Fig.7.), where the rivers run peril to each other and framing the grid system; 3. Chia-nan plain, the Yu-shan-tao Dam (Fig.8.), the dam was exaggerated in size. This was caused by advocating the government’s official accomplishment, but also reflected the issue that inhabitants didn’t recognize the “great Chia-nan cannels” to be a part of the land’s spatial character.

DESIGN SCENARIOS

Design scenarios of “agricultural cities” for Asia were first proposed by Kiso Kurokawa in his

“Exhibition of Visionary Architecture”, held in 1961⁶. He diverted from the thinking that farm villages and cities are inherently distinct, and created homogeneous living spaces. The designed town was planned to be constructed as an open architecture element which super-composed itself over the fields, held above the ground by pillars. His scenario was proposed to be located in a well planned compact sub-urban area, hoping in the future it could be a part of the city itself. But here in this Taiwanese proposal, the intention was to build up a new form of urban tissue, where the open development process interacts with the water production landscape.

From the previous research, the dispersed and collective towns represent the cultivation culture of the three different plains, but the current concepts of urban design and territorial planning elevated the development into a chaos of urban sprawl. The differentiation behind the two town types is about density. The absolute density for a collective town is similar to the city tissue; where it is a continuation of urban and rural, and its location mainly follows the infrastructure. But for the dispersed town, the density is much lower, and is driven by the source of water. It reveals a potential for a vernacular approach for the mixture of dwellings, transportation and production.

In the rural areas of Taiwan, due to the shift in application of agriculture fields and water sources for other uses, along with the global greenhouse effect, it is crucial to maintain a certain amount of self-sustaining food production and stable surface water. Today the government is encouraging the upgrade of traditional industries into hi-tech industries, which became the new attraction for urbanity towards the countryside. But taking the southern hi-tech industry zone for example, the total population in the Cha-nan region did not increase significantly after its establishment; which suggests the estate developments shifted from the city center towards the field.

The first stage of development was planned for 4000 families in the new town proposal for the hi-tech industry zone of the Chia-nan region. But instead of the proposed density of 149 families/ha, the design scenario decreased the density to 64 families/ha, as in the “collective farm house estate⁷” law. Under this law, the developers must buy off a certain amount of farm land for utilization, and unite the management of farm land production. This defines the agriculture landscape as a semi-public green, and solves both the problems of the cultivating vacant farm lands and maintenance of the fields. The design(Fig.9.) is orientated around the newly established train station, and existing irrigation channels. The main open space is composed along the irrigation channels, heading towards the rail line. The water stretches out into the land, linking water fields and purification systems. Parts of the wet fields can be drained, and function as sport fields and playgrounds, while most of the land still retains water.

In the design, the production landscape becomes crucial, because it defines the spatial quality and image of the countryside. First, we should divide the agriculture production in two types: the water fields and dry fields. The water fields distinguish the rural-scape of south east Asia from the rest of the world. It is based on loam soil. Mainly utilized as paddy fields, but also includes lotus fields and fish farms. And for the dry fields, they are based on sand and clay, its main production can be corn or vegetables, and is mostly located at the end of the irrigation channels where the water source is least sufficient. The water fields could adjust the temperature in the microclimate, absorb waste carbon, and stabilize the underground water. Most of all, the water fields can retain the overflows in peak rain seasons to buffer excess flooding. Therefore, to increase the surface water is critical, and while parts of the land could be paddy fields, it could also be substituted by lotus fields for beautification. The element of water thus penetrates through the fields and shifts as a part of

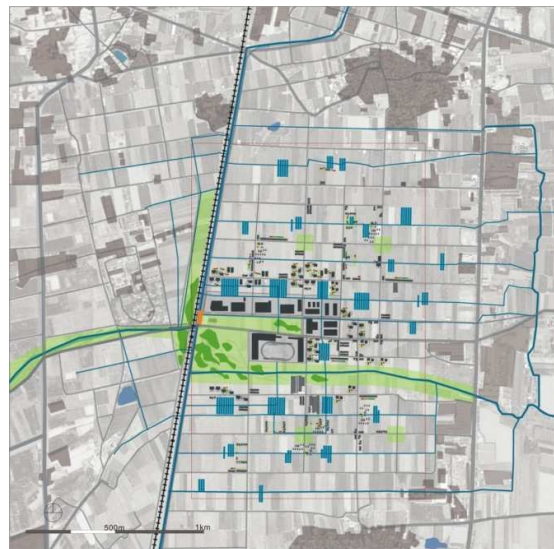


Fig.9. Proposal site: new town for the southern hi-tech industry

(source: P.C.Wen, “Water urbanism- agriculture and the city edges, Chia-nan plain, Taiwan” ,EMU thesis, Delft, 2008.⁸)

production, a part of purification systems, and a part of water retention pockets. The water defines the new spatial dimension and the new density (Fig.10.)

CONCLUSION

Today we start to understand that we can play a profound role in shaping our future by hydraulic structures with an urbanistic perception. We are required to understand the water morphology in a planning procedure, and to view the water system not as a concern, but a basic structuring foundation. Thus, in order to assess influence of the water tissue on urbanism, the perceptions and integrated water management maps, a complete ecological structure can be established.

The current field of landscape architecture is trying to find the design problems through analysis and experiments of the landscape. So landscape theories are more based on observations of past experience, and one should find its meaning from the site as given. Thus, looking through maps from different perspectives show hints for the genius loci of the place, and the site becomes the catalyst of creating new programs and space. The proposal intends to utilize the existing landscape notions of the native irrigation systems and water fields, and incorporate the agricultural program as a part of the new developments.

The re-configuration of urban and rural became a new unit of development which is beyond the division of zoning in Taiwan. The perceptions through the rural-scapes exhibit concepts behind the transformations of the territory which is oriented from the landscape. But we must say the best way to maintain the landscape is through a constant usage of land, by cultivation or by a new economic but environmentally friendly industry. The concept of a hybrid urban and agriculture city form is embedded in its development procedure, and the argument refers to an open process, where the tissue is filled in by elements that support a sustainable environment.



Fig.10. The new dispersed landscape of dwellings, purification systems, and production fields (source: P.C.Wen, “Water urbanism- agriculture and the city edges, Chia-nan plain, Taiwan”, EMU thesis, Delft, 2008.⁹)

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