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THE WATER- MANAGED PATTERNS OF LOCAL IRRIGATION SYSTEM FOR AGRICULTURE IN MAE KHAN WATERSHED, CHIANG MAI PROVINCE

รูปแบบการจัดการน้ำระบบเหมืองฝายเพื่อการเกษตรในพื้นที่ลุ่มน้ำแม่ขาน จังหวัดเชียงใหม่

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Abstract

This research is a conceptual framework study of the water- managed patterns of local (Muang Fai) irrigation systems for agriculture in Mae Khan watershed area, Chiang Mai Province by using the model of Elinor Ostrom(1) and Lertwicha and Wichainkhiew(2) The objectives were; to study the pattern of water resource management based on the topography, to study the factors affected the existing of water management patterns, and to study the development and the changes of water management patterns in Mae Khan watershed basin. The research methodologies were the field trip survey, questionnaires, and depth interview with the groups of leaders, water users, and community water management experts.

The results of the study indicated that Lertwicha and Wichainkhiew's concept(2), in terms of physical characteristics, economic, social, and government policies, was accepted as the factors affecting some parts of Ostrom's water management pattern and model according to the adaptation of the study area related. There were six water management patterns for agricultural irrigation: (1) a household irrigation system, (2) chief or head of irrigation system, (3) irrigation organization system, (4) water user cooperative system, (5) water user association system, and (6) water user network system. Each system has similar internal factors which made up of 5 important elements: (1) water resources, (2) water delivery system, (3) water users, (4) rules, and (5) governance. This affected the differences of the 6 water management patterns mentioned. At present, the water management has been developed and changed all the time. From the examining, the results revealed that each water management pattern was

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appropriate to different ecologies and sociologies and also expressed that the water user network system in the basin which was just a newly development was accepted as a new water management innovation in form of institutional pattern in Mae Khan watershed, Chiang Mai Province.

Keywords: Water management, Irrigation system, Mae-Khan watershed

บทคัดย่อ

รูปแบบการจัดการน้ำระบบเหมืองฝายเพื่อการเกษตรในพื้นที่ลุ่มน้ำแม่ขาน จังหวัดเชียงใหม่ โดยใช้แบบจำลองของ Elinor Ostrom[1] และพรพิไล เลิศวิชา[2] เป็นกรอบแนวคิดในการวิจัยโดยมีวัตถุประสงค์คือ ศึกษารูปแบบการบริหารจัดการน้ำตามลักษณะภูมิประเทศในพื้นที่ลุ่มน้ำแม่ขาน ศึกษาปัจจัยที่มีผลให้เกิดรูปแบบการบริหารจัดการน้ำที่ยังคงดำรงอยู่จนถึงปัจจุบัน ศึกษาพัฒนาการและการเปลี่ยนแปลงรูปแบบการบริหารจัดการน้ำในพื้นที่ลุ่มน้ำแม่ขาน ด้วยวิธีการสำรวจพื้นที่จริง ทำแบบสอบถาม สัมภาษณ์เชิงลึกกับกลุ่มผู้นำ กลุ่มผู้ใช้น้ำ กลุ่มผู้เชี่ยวชาญด้านการบริหารจัดการน้ำชุมชน

ผลการศึกษาคือยอมรับแนวคิดของพรพิไล เลิศวิชา[2] ว่าลักษณะทางกายภาพ เศรษฐกิจ สังคมและนโยบายรัฐมีผลต่อรูปแบบการบริหารจัดการน้ำและแบบจำลองของ Elinor Ostrom[1] บางส่วน เนื่องจากต้องนำมาปรับใช้ให้สอดคล้องกับพื้นที่ศึกษา รูปแบบการบริหารจัดการน้ำเพื่อการเกษตรมี 6 ประเภท ได้แก่ (1) รูปแบบเหมืองฝายครัวเรือน (2) รูปแบบแก่เหมืองแก่ฝาย (3) รูปแบบองค์กรเหมืองฝาย (4) รูปแบบสหกรณ์ผู้ใช้น้ำ (5) รูปแบบสมาคมผู้ใช้น้ำ และ (6) รูปแบบเครือข่ายผู้ใช้น้ำ ซึ่งแต่ละประเภทมีปัจจัยภายในที่เป็นองค์ประกอบสำคัญ 5 ด้านคล้ายกันกล่าวคือ (1) แหล่งน้ำ (2) ระบบส่งน้ำ (3) ผู้ใช้น้ำ (4) กฎกติกา และ (5) ระบบกำกับ ซึ่งมีผลให้เกิดความแตกต่างของรูปแบบการบริหารจัดการน้ำถึง 6 รูปแบบดังกล่าว ปัจจุบัน (พ.ศ. 2556) การบริหารจัดการน้ำมีพัฒนาการและการเปลี่ยนแปลงมาโดยลำดับ ผลจากการพิสูจน์พบว่าการบริหารจัดการน้ำแต่ละรูปแบบมีความเหมาะสมกับลักษณะภูมินิเวศและสังคมนิเวศที่แตกต่างกันออกไป และพบว่ารูปแบบเครือข่ายผู้ใช้น้ำในลุ่มน้ำเป็นรูปแบบที่เกิดขึ้นใหม่ซึ่งถือว่าเป็นนวัตกรรมใหม่ของการบริหารจัดการน้ำในรูปแบบของสถาบันในพื้นที่ลุ่มน้ำแม่ขาน จังหวัดเชียงใหม่ แห่งนี้

คำสำคัญ: การจัดการน้ำ, เหมืองฝาย, ลุ่มน้ำแม่ขาน

Introduction

Surface water resources are the physical characteristics of the two types: (1) Not flow water resources including clarifier, basin, catchment, swamps, etc., Human being can apply the knowledge of still water management well; for, they can almost operate the systems, so they can predict the quantity of water as well as planning and monitoring the use and taking care of water efficiently. (2) The water- flow resources including of waterfall, stream, gully, waterway, rivers, and so on, are managed by fai (local irrigation), dams, canals, etc. The knowledge of water- flow management around the world are facing problems differently because the exact quantity of water each year cannot be assumed; consequently, the planning of water use cannot be done efficiently. This problem, however, is just a quantity manner. In terms of water- used quality in the aspect of economics, it views that the water in water-flow resources is a public product that everyone can access to it freely. No one can detect another on the use of water

if there is the use by someone else. From that point, there are always the problems followed up: the unfair of water use, the competition of using water, the worthless use of water, etc. From those reasons, there was an effort to find the solution for using water with highly efficiency regarding the effect on the environment, water quality, the ecology of aquatic animals, and the shortage of water for the increasing of population. From the study of the literature reviews all over the world, it found that there are 4 ways of water-flow management: government, private, government and private, and altogether. The first three methods were seen appropriate for the water resource management which the whole system can be controlled. For the altogether, which emphasized on giving the right in group operation, is expected to be another way for making the fairness of water use[3]. There are experts of natural resource management have presented the models to explain the happening of using water in groups: Lertwicha and Wichainkhiew[2] suggest 5 patterns of water management based on geographical characters of water resources: the water management in Fai Nam Hoo, water fall, gully, branch waterway, and rivers. In terms of international level of water management process, Elinor Ostrom[1] proposes the model that the result of water users' agreement in each group will be appeared in the institute form that the group has designed which characterizes as dynamic that can be changed based on the sociological characters. Each of the agreement results are consistent with the area contexts; as a result, the water management which has similar features to the model proposed was found in several places in the north of Thailand. Therefore, the Mae Khan watershed, Chiang Mai Province was selected as a population of this study because it is the area that has elements in all aspects of Ostrom's model variables clearly. To get the results of the study narrowly and deeply, the objectives were:

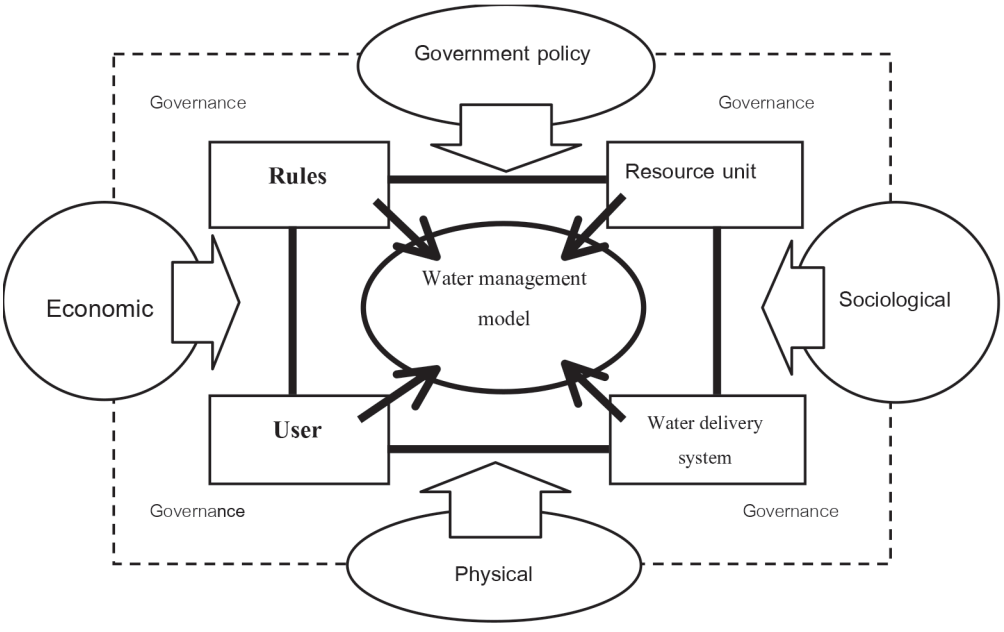
1. to study the water management patterns based on topography in Mae Khan watershed.

2. to study the factors affecting the existing of water management patterns used today.

3. to study the development and the changes of water management patterns in Mae Khan watershed.

The expected outcomes of the study will be taken as deep information for the appropriate planning system of water management for Thai society.

Conceptual framework



This conceptual framework was adapted from the geological water management concept of Lertwicha and Wichainkhiew[2] and accompanied with the resource management theory of Elinor Ostrom[1] to design for internal factor framework leading to a set of variables affecting the water management patterns as the study framework mentioned.

Assumption

Hypothesis "Physical characteristics of landscape, economic, social, and government policy affect the patterns of water management"

Methodology

Mae Khan Watershed, has catchment area covering 5 sub-districts: Samerng, Hang dong, Mae Wang, Doi Lor, and San Pa Tong, consisting of 1,832.45 km^2 (1,145,280 Rai). There are two important waterways: Mae Khan and Mae Wang. The population and sample were groups of local irrigation water users as shown in Table 1.

Table 1 population and samples in Mae Khan watershed area, Chiang-Mai province.

Population and sample In Mae-Khan watershed	Upper topography (Group)	Lower topography (Group)	Total (Group)
1. Mae-Khan major creek	49	8	57
2. Mae-Wang creek	20	15	35
Total population	69	23	92
Total samples	16	8	24

Process of research

To make the research procedures clear, the details of each point were described as follow:

1. to search for the patterns of water management, the researcher had designed the instruments to synthesize and classify the differences of water management for agricultural irrigation as follows: (1) Studying basic information from government bodies (Royal Irrigation Department, Water Resources Department, private organization, Chiang Mai University, Consultant Company), (2) studying the ways to classify the types of water users from each body theoretically and practically, (3) having a field trip to survey the study area for checking and comparing the information, (4) having a small group meeting with the agricultural water management experts for checking the variables used in classifying water users, (5) Comparing the variables gained with Ostrom's[1] and Kanjanaparn's models[4], (6) Developing the variables to be research instruments in form of information checking table.

2. To study the structure of each water management group by using conceptual framework tested it with 24 sample groups of local irrigation water users by depth interview with groups of leaders and members and the small group meeting of leaders and members to transcribe the lesson learned together.

3. To prove that the different physical characteristics of local irrigation water user groups affect the different water management which divided into two kinds of topography: upper and lower, by testing with 24 sample groups of local irrigation water users (the test was divided into 2 pieces for 2 kinds of water users in each group; that is, a group of the leaders and a group of members.) totally 60 people through field trip on the working sites, aerial photography map, the interpretation of aerial photography, depth interview, and the small meeting of the two groups.

4. To prove that economical factors affects the differences of water management patterns by using the index; that is, the gross agricultural production per rai, to compare the total quantity before and after the changes of water management patterns.

5. To identify that sociological factors affects the differences of water management patterns of local irrigation water users by using the index about the increasing and decreasing numbers of water users in each group and how the changing quality of the leaders affects the water management patterns via the methods of field trip survey, depth interview with groups of leaders, and the small group meetings with groups of water users (Figure 1).

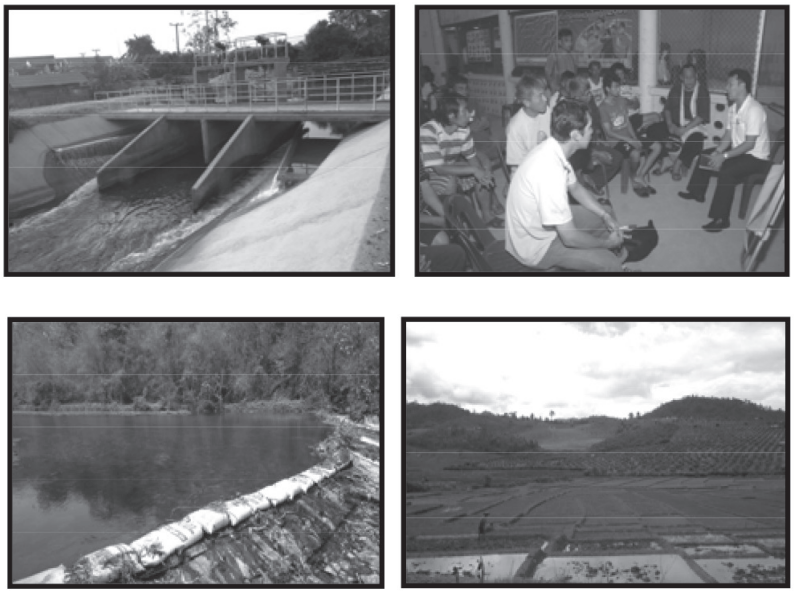


Figure 1 Activities of water user in Mae-Khan watershed area, Chiang-Mai province.

6. To examine that government policy affects the differences of water management patterns for local irrigation water users by using the index of the following of the infrastructure development in the area with the methods of field trip survey, depth interview with groups of leaders, and the small group meetings with groups of water users.

7. to check that how each water management pattern has been developed and changed by using the retrieval indexes: research study reports, printed matters of local government bodies and privates, Lanna's printed archive, interview the experts of chief or head of local irrigation,

the condition of current operation of water user groups in each pattern, and so on.

Result and discussion

There were 6 patterns found from the study of the patterns of local irrigation water management in Mae Khan Watershed (Figure 2).

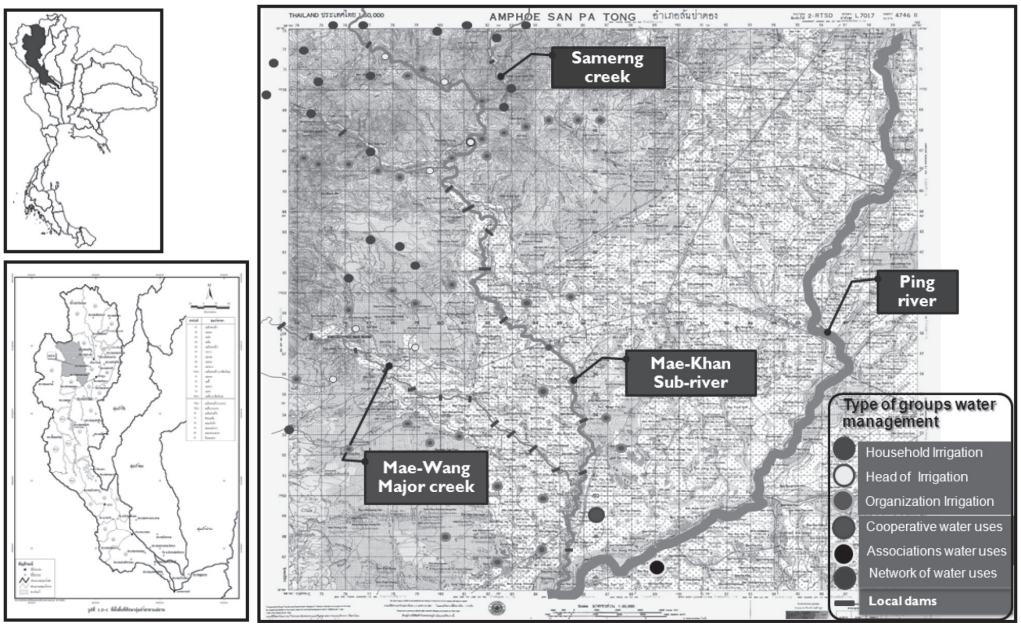


Figure 2 Location and Topography of Mae-Khan watershed area, Chiang-Mai province.

1. Household irrigation, it was occurred from the landscape that has a little plain between the valley, getting the water from the source of river place which features like stream, gully, waterfall, small springs (Nam Hoo), and being the settlement of various hill tribes such as Mong, Tai Yai, Pagagayor. They live in group far away from each other and majorly earn the incomes from agriculture. From this, the hill tribes have to find the way to take the water for their agricultural area by using the law of gravity 'water flows from the high land to the low land'. They work in group starting from 1-3 households to build a local dam detecting a small stream and push the water into their own agricultural field which is not more than 5 Rai in size. Therefore, this caused a lot of household irrigation in the area.

2. Chief or head of irrigation, it was occurred in the area of a big plain that the hill tribes assembled around 30-40 households to build a local dam to stop the water from the gully and to dig the canal for taking the

water to flow to each agricultural field. This caused the pattern of head of irrigation for controlling the water-managed operation to be fair.

3. Organizational irrigation, this pattern is affected from the decentralization in B.E. 2537; besides, there was the act of irrigation B.E. 2482, so the pattern that government was added to be a part of administrative structure of the head of irrigation became another pattern in form of organizational irrigation by getting the water from the gully and river branches. There are 3 sizes of organization irrigation today: a small size consisting of 10-500 members; medium size consisting of 501-1,500 members; and a large size consisting of 1,501-5,000 members.

4. Water user cooperative, there are members around 100-600, was affected from the influence of politic and the need of government who suggesting that all groups of water users are being central, so the government has the right to support budgets for various activities such as building the local dam, digging the canal. This pattern happened in the area that mainly used the water from river branches.

5. Water user association, there are 1,000-2,500 of members, is developed from the cooperative ones with the functions for making a profit; however, the assemble of water users aim to allocate the water to all members fairly and do not want to make a profit; besides, the members also need the help from government, so this causes this pattern happened for the use of main river.

6. Water user network, it is affected from the need of information and operation activities of each water user group in the same watershed. This led to the foundation of network of the area.

Structure of a water management pattern

The use of local irrigation water for agriculture in Mae Khan watershed area, Chiang Mai Province appeared that there is the assembly of local irrigation water users spreading out through both two banks of waterway. The results from variable testing reveled that the main variables affecting the water management patterns included of 5 categories: water resources, water delivery system, water users, rules, and governance; however, from the survey and small group meetings with groups of leaders and experts expressed that the differences of water management patterns caused from the changes of sub-elements as shown in Table 2: When the water resources change from rivers to gully, it affected the reduction of complicated water delivery system, the size of local dam, and the numbers of water users; when the law is used instead of relative

systems for monitoring system, the regulation must be formal and approved legally; so that it could use to enforce the water users and change their systems; the way of getting the leader affects the strength of group as well.

Table 2 Variables and sub-variables of a type water management in Mae-Khan watershed area.

1. Water resource	2.Water delivery	3.User	4.Rules	5.Governance
1.1 Flow water	2.1 Local dam	3.1 Scale user	4.1 Duty	5.1 Act.
1.2 Not Flow water	2.2 canal	3.2 A leader	4.2 Management	5.2 Low
	2.3 Floodgate	3.3 Objective	4.3 Penalty	5.3 Tradition
	2.4 Service area		4.4 Contract irrigation	5.4 Relative system

Evaluation and changes in water management patterns

Due to the 6 patterns of water management, it could be found that there were 3 periods of adaptation for the development and the changes for the existing of water management institute: traditional periods, changing periods, and new equilibrium periods. The study showed that the water users in Mae Khan watershed can adjust to the new equilibrium easily. The summary of details are as followings:

1. The traditional management periods (B.E. 2000-2436), there were only two water management patterns in this time: household irrigation and head of irrigation. The evidence of water allocation found was the water user members who assembled as local irrigation water users must have sufficient water for using based on the logical and necessity. There was planting for the consumption once a year under the structure of water management institute which concluded of 5 aspects: water delivery system, water user system, rules, control system, and water resources; having the process for stopping the opposition by allowing the members came for the negotiation based on the logical and necessity all the time. At this period, the leader was centralization which could make a decision easily, as a result, the water management was well designed and fair to all members.

2. The changing periods (B.E. 2437 – 2536), after the groups of local irrigation water users have assembled to manage the water for continuously hundreds of years and was affected from the politics changed in several ways for several times: changing from King's system to Siam's system; having government's representative, that is, Kamnan or head of the village; having many national acts; having decentralization;

and the change of production for consumption to for sale, this caused the groups of head of irrigation had to change and adjust their water management into 4 more patterns according to the suggestion of government concerned: local dam organization, water user cooperative, water user association, and water user network. This made them have totally 6 patterns of water management. Those changing affected the core structures of the 5 organizations in all aspects. The results in water- allocated operation of each group found that 94.25 percentage of members did not satisfied with the water management operation under all the four new patterns because they could not adjust themselves to it.

3. The new equilibrium period (B.E. 2537 – 2556), after the use of the increasing 4 more new patterns to be totally 6 patterns for a few years, the results expressed that many groups who had registered for being cooperative and association had returned to their original patterns; that is, local irrigation organization whereas others still keep their status and management as the same. The analyzing about the changing of main structures of organization in all 5 aspects found that the results from the past changes was in trial stage; however, there were many problems found, so they need to adjust themselves to the new equilibrium. The new equilibrium are the change of leader system to get the one who is able to coordinate with government bodies well for asking for more budget to develop their own group strong, the need for help from the government in building cement local irrigation; because of, the manpower who repair the dam are reduced in each year gradually. As a result, they do not have to pay for the repair of dam. The results of this equilibrium make the farmers about 82.65% satisfied with their own patterns created in their group for the fairness of water allocation.

Testing assumptions

1. The hypothesis was accepted that the different physical characteristics of the local irrigation water users affected the different water management patterns. There were two types of topography: upper and lower watershed. The results revealed that both two topographies have clearly different water management patterns. The upper watershed has 3 patterns: (1) Household irrigation, (2) Head of irrigation, and (3) The network of the water users in the same watershed, by using the water resources from spring, waterfall, stream, gully, and reservoir; whereas, the lower watershed has 3 patterns: (1) Local dam organization, (2) water user cooperative, and (3) Water user association by using the water resources from gully, river branches, and main rivers.

2. The hypothesis was accepted that

economic factors affect the differences of water management patterns by comparing the amount of rice per rai before and after the changing of water management patterns. In terms of the changing from head of irrigation system to local irrigation organization which were mostly found in the lower watershed area, the results showed that the amount of rice was 300 – 450 kg/rai for being the head of local irrigation and was increased to 450-650 kg/rai in the local irrigation organization; because the former system produce for life living and payment, but the latter are the production for trade and service. The farmers, therefore, have to increase the production quality and use the more efficiency of water management to support.

3. The hypothesis was accepted that social factors affected the differences of water management patterns by looking at the increasing and decreasing numbers of water users and the changes of leader's quality in each water user group. The results showed that the increasing and increasing of water users affects the water management patterns of household irrigation and head of irrigation only, but not with other patterns. This is because it is being a closed system; that is, there is no outsider in their group except their relatives; if the group has been joined by the outsider, the group will change to be irrigation organization instead because they need the assistance from government to enforce the outsiders to follow the rules. For the changes of leader's quality, it affected all water management patterns; because the leader can lead the members to be any patterns. If the change is not good, it can return to be the same. This happens in the area all the time.

4. The acceptation of hypothesis that government policy affects the differences of water management patterns by looking at the following effect from developing infrastructure in the area; for example, building the road to get through the land would affect the changes of using land, rice field, or orchard to be a place for residence, factory, shops, and so on. The findings revealed that household irrigation and head of irrigation were mostly affected because it is a small system with a little area (not more than 20 rai). The effect can make the farmers quit their jobs. The other patterns were slightly affected because there are big systems that they can negotiate with the government to put them the pipe when they want to fill up the land across the canal for the waterway based on the law specified.

Discussion

From the study of 6 patterns of irrigation water management, it was found that household irrigation system was very sensitive to the external factors. It could be

changed easily if it was forced by the factors because it is the smallest system that has the area not more than 10 rai for 3 people who do agriculture. For example, the policy of promoting tourism makes the need of more land for building resorts along the edge of water resources; as a result, the farmers sold their agricultural land to the investors. Moreover, they did not get the support from local government according to the loss of investment. The strength of this system is that it helps to keep moisture of agricultural area and help to delay the destruction of surface from the flow of tide; hence, it is good to promote this system for agriculture. Besides, irrigation organization is the most suitable pattern for the water management in the area according to the mix and match between local government and water user community. Also, local government and community prefer this system because it is convenient in many aspects; consequently, this system was found most in the area of study. The patterns of irrigation organization, water user cooperative, and water user association were noticed that if there is the change of the pattern to be another one, it is the change for more efficiency of internal organization management not the increase the amount of water used for agriculture.

Economical character affects the change of household irrigation pattern and head of irrigation only because it is mostly located in the upper watershed. Also, it is taken care from the local government. The villagers have to spend money for repairing their own irrigation themselves; whereas the others get the budget from the government.

Social factors affect to the changes of every water management pattern because the size of water users and the status of the leaders become important for leading the water management institute sustainably; that is, the management process must be adjusted if the numbers of water users decrease continually. In case the leaders are not responsible for their duties in administrating local irrigation, the pattern may be quit a small system if there is a corruption of the budget. For cooperative system, it needs to change to be another pattern instead.

Also, the factors from government policy affect the changes of every water management pattern; since the infrastructure which is developed to serve the growth of town becomes the destruction of agriculture area rapidly. This means that it also destroys natural catchment area; thus, the water flows from flood area to another dry place instead. Apart from the effects mentioned, the government now tries to make water as public product that the government has to control it as a whole by dividing the

administration into 25 watersheds totally. However, from the study based on the theory, the watershed administration by giving the right to various water users to operate under the terms of different sociology and geography will make the strength and fairness in water allocation. The watershed administration that government takes charge in control and species the rules only will not make the acceptation and serve with the context of the area.

Conclusion

To summary, the irrigation patterns for agricultural water management systems are divided into six categories: household irrigation system, head of irrigation system, organizational irrigation system, water user cooperative, water user associations, and water user network. Each pattern concludes the same five elements factors: water resource, water delivery system, users, rules, and governance system. The structure of water management model can be written as shown in Figure 3.

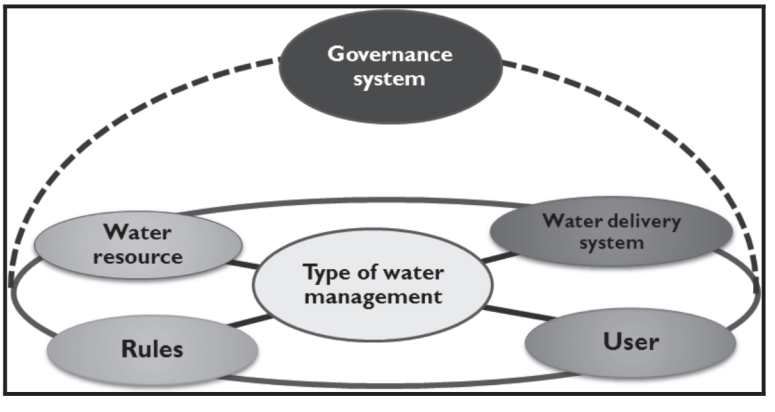


Figure 3 water management model in Mae-Khan watershed area.

The evolution and changes of the water management models in Mae Khan watershed which were cooperatively managed in form of household and head of irrigation in 1994 became organization, water user association, and water user cooperative in 1999 to serve the decentralization. Later that, the patterns of irrigation water user network was formed in 2005; since, the water users need to know information from each other.

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