

Master Thesis: Agricultural dynamics in the Bang Pakong River Basin: Interrelationship between family dynamics, access to the market and water management



DOUBT PROJECT : Deltas' dealings with uncertainties :
Multiple practices and knowledges of delta governance

Léna AGUILHON

Master International Cooperation and
Development – Faculty of Law and Political
Sciences of Montpellier

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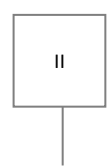


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Abstract

This report presents a socio-economic study of Bang Phluang irrigation scheme. This study aims to highlights the dynamics in terms of farming though three study-cases. These three study cases present differences at three levels: in terms of farming activities, family dynamics and water management. The area faces different water issues such as water scarcity and brackish water. The main farming activities are rice production and fish and shrimp one. By interviewing the stakeholders and especially the farmers in each area, the study assesses how family dynamics, access to the market and water management are involved in the evolution of agricultural sector.

Organisation of the work

The work took place as part of the DOUBT project, (Deltas' dealings with uncertainties : Multiple practices and knowledges of delta governance) funded by the French National Agency for Reseachers for the French partner institutions.

In Thailand, the work was undertaken under the supervision of Nicolas Faysse (Cirad and AIT) and Man Purotaganon (Thai Water Partnership). The support of various persons to help with data collection and translation (and in particular Kassirin Phiboon) is acknowledged.

Introduction

In Thailand, the agricultural sector is quite important. In 2012, it represented 12.3% of GDP and 47% employment (French Ministry of Agriculture, 2012). Rice production is the main production with 31.9 million tons according to the Asian Development Bank (2012). Over the past 30 years, Thailand has been the largest export countries (ADB). The rice production has been developed thanks to the irrigation system. Nowadays, 4.5 hectares were irrigated, about 20% of total farming area (Sivilanonda, Poapongsakorn, 1995 ; Siamwalla et alii, 1990). Mainly in the central part of the country where 44% of the area is irrigated. Thus, water management is essential to the durability of the agricultural sector.

The following report aims to highlight three characteristic situations which occur in Prachinburi Province regarding water and farm management.

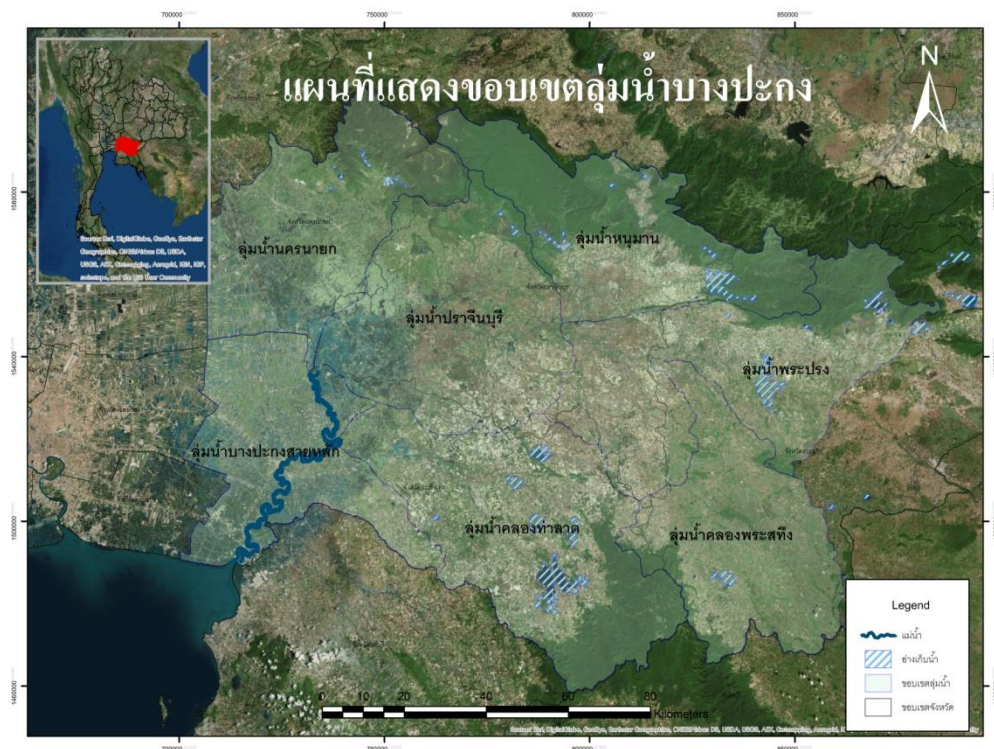


Figure 1: Bang Pakong River Basin

I. Context

The project takes place in the Prachinburi Province, eastern part of the country, and concerns the Bang Pakong River which flows to the gulf of Thailand (figure 1). Traditionally, this province used to grow rice once a year (Nabi rice growing during rainy season), and then with the development of the irrigation scheme, a second crop has been introduced in the farming schedule about 15 years ago (*President of the Bang Pla Ra TAO*). **Nowadays, this area has to deal with different issues linked to water management, market and family dynamics which will be developed below. These issues make the territory an area in transition and it is why it has been chosen to be studied.**

The three first main issues concern the water resources. The first one is the brackish water entering inlands. The topography of the zone is quite flat and because of lower water level in the upstream part of the river; the sea water comes into the land about 80 km from the coast. According to many actors, the low water level might be due to an over water pumping by the industries upstream and due to the introduction of a second crop per year. The presence of a salinity level inland led to develop the fish and shrimp production within the area, activity which had been introduced 15 or 20 years ago. Traditionally, this production was located on the coast. But as the production system was harmful for environmental resources, it was banned. Then as some changes appeared in the production system, less harmful, and in the production techniques, using a lower salinity level, the establishment of the fish and shrimp production has been possible further inland (Flaherty & Brateen, 2001). Nowadays, rice and shrimp productions have to share the same land and the same water resources. However, these two productions do not accept the same salinity level and do not use the same level of water. **This situation might lead to conflicts between both productions.** The second issue to be solved is the water level decreasing. This may have different cause. As mentioned above, this decreasing may be due to an over water pumping by the factories upstream and new type of farming productions (two crops of rice per year). The fact is there are more and more stakeholders sharing the same water resources for different purposes and this might lead to conflicts between them. Furthermore, **this water quantity issue might have impact on the farming production and change the type of farming.** The water management is a key to mitigate this issue. The third issue linked to water is the water quality decreasing. According to the law, the factories have to recycle water before releasing water into the river. But in practices, they release wasted water. Besides the factories, there is also the intensification of agriculture which uses a large of chemicals and fertilizers; and this intensification leads also to decrease the water quality. To highlight this problem, one thing is before there used to be fishes in the rice field during rainy season but nowadays there are not fishes anymore. Finally, these three issues are important to be studied to understand how water management is an important stake in terms of both water quality and quantity. Furthermore, it is necessary to assess how this management is organized at a farm level and at a collective level.

The next group of issues concerns the access to the farming market. Indeed, to be sustainable a farming activity needs to be profitable for the farmer and get good outlet. So what type of farming activity to choose? Pursuing the traditional rice production or changing for fish and shrimp production in brackish water? In one hand, the traditional rice production has showed some limits: the price of the rice is quite low (6500THB/T in average). This price is fixed by the government. The rice producers sell their production either to rice mill directly or to middleman. The fact is the rice mill cannot pick up all the production at once. Then the farmers have to wait. But most of them have

loan to pay back and cannot wait. They decide to sell the rice to middleman and are completely dependent on the price fixed by them because they have no choice but sell as soon as possible. Another solution would be to dry the rice first because the price would be higher but the farmer lack of place in their farm and have to sell the rice fresh. In order to deal with these low prices, the rice production over-uses chemicals and fertilizers but how long these practices can be used? Are they sustainable? And as organic rice doesn't receive any certification or recognition which could help farmers to get more incomes there is no chance the farmers change their practices even though they are aware of the consequences over the health.

On another hand the shrimp production allows getting good profits. However, despite the profit which can be made thanks to the high incomes from the shrimp production, this production requires an important investment and knowledge in special techniques and not all the farmers can afford to start it. (Makhora & McCann, 2003). It is important to understand how the farmers have access to the market to be able to understand their choices in terms of activities now and for the future.

Another issue is the land management. Indeed, as the water resources, the arable land resources have become a real stake. Different actors use the land for different purposes (farming, industries, property speculation...). **In this situation what is the place of the agricultural production?** In Prachinburi province, some investors bought the land at high rates, increasing the price speculation. Nowadays, the price of the land is really high (2007: 50 000THB/rai, 2017: 100 000THB/rai figure from farmers in DKY), and most of the farmers cannot afford to buy land; they have to rent the field but even the renting rates are high (100kg of rice/rai multiplied by the price of rice). And only the investors can afford to buy the land. It is a vicious circle. These investors are not necessarily farmers. A part of them come from the Suvhnabhumi airport area. Indeed, as a compensation for losing their lands, they received a large amount of money from the government and are able to buy large area in other province, including Prachinburi Province. Thus, it is important to study how the land is managed: who are the owner and the renter? What is the renting rate? Because the land management will participate to determine the design of the farming scheme within the next years.

The following group of issues concerns the family dynamics. Nowadays, most of the farmer population is an ageing population with a low education level (primary school). These farmers might not be ready for any changes and keep doing what they have always done. However for the study it will be necessary to determine their age and their background. It is also relevant to know how the family is implied in the farming activity because there different cases either all or at least a part of the family members work in the farm or in other situation the farmer is more like a manager and hires labor. Thus it will be important to understand what the place of the new generation is. Indeed, the young people aspire to long studies and a job in a company or factory. They don't seem to think about doing farming though. But farming could be a solution if the employment rate is not good. So it would be interesting to assess what kind of farming activities the new generation would be interested in. Beside these family dynamics, it is also necessary to define the farming organization and typology in terms of size of the land, in terms of the farming activities nowadays but also how they have been developed over the past 15 years because these aspects will participate to determine the sustainability of the farming activity and its development over the next 10 years.

Finally, beyond these 3 keys stakes, all the questions they raise will lead to answer one: how do the water management, the access to the market, the family dynamics and their interactions influence the farm diversity within the Bang Phluang area? How could be developed the farming activities within the next 10 years? Which main scenarios for the next 10 y about the development of agriculture within the area may be defined from the study and according to the current situation?

II. Methodology

To answer the questions, the study focuses on 3 Tambon which present different characteristics. Indeed, these Tambon are different from each other regarding to their geographical situation and location within the Bang Pakong catchment. But they are also different according to farming activities they produce.

1) Study area

Dong Khrathong Yam is the most upstream of the 3 tambon. It is a traditional rice production Tambon. There are 2 crops per year and for the second one (dry season) the farmers use the water from irrigation system managed by a water user group in charge of the maintenance and the respect of the pumping time. This Tambon has to deal with the factory upstream which release wasted water. Bang PlaRa is the middlestream tambon. The main farming activity in this tambon is the fish and shrimp production. (Need more details). As it is located next to Dong Khrathong Yam Tambon, it is interesting to understand why these two locations have chosen different production and it will allow us to compare both rice and F/S production in terms of water management and economic sustainability. Bang Taen is the most downstream tambon. The farming activities are mix. There is a group of organic rice farmers which is interesting to interview in order to assess the access to the market and the value given by the organic production compared to traditional one. This Tambon, according to its position within the catchment, faces to strong salinity issue.

2) Interviews

In each tambon, interviews will be performed focusing on the farmers. These interviews will be done according to a sample following criteria: Size of the farm and position along the irrigation canal. The questionnaire has been made in order to get qualitative and quantitative answer to all the questions above with three main parts: farm organization, water management and evolution within the next 5-10 years. In Dong Khrathong Yam the study focuses on the WUG members (about 90 farmers). In Bang PlaRa the study focuses on the cooperative Nikom members. In Bang Taen the study focuses on the organic group farmers. 27 farmers will be interviewed in each area. We consider as farmers, family's members involved in the business. We will be more accurate about the role of some members whether they are part-time involved such as student. The questionnaire (annex 1) is divided in four parts which covers all the research question. The first part is dedicated to the family and farm organization in order to understand who is involved in the business, to know the family's background and eventually the fam activities. The second part aims to get information about economics: costs of production and incomes from farming business. This will allow us comparing different farming activities. The third par questions water management and water issues met at the farm level and tambon level. Eventually, the fourth part focuses on the future:the project at both farm and tambon project and farmer's point of view about evolution of water management. The interview is perform by my self and translated directly by the translator from English to Thai. It lasts about two hours per farmer.

In order to get an overview of the territory, the local institutions such as TAO, RID, extension office and the actors of the farming sector such as middleman will be interviewed.

In terms of schedule one month will be dedicated to each Tambon from mid-March to end of June beginning with Dong Khrathong Yam from 14th of March to 20th of April. Then, followed by Bang Taen from the 2nd of May to the end of May; And finally, Bang PlaRa area from beginning of June to

end of June. The analysis will be done in July and August. End of August, presentation will be performed in order to give feedback to the farmers and other stakeholders concerned by the study.

III. Results

Chapter 1: Dong Khrathong Yam

Dong Khrathong Yam is a Tambon located in the western part of Prachinburi province as the map shows (red pin). It is part of the Si Maha Phot District and is composed by seven villages. It is the most upstream of the three tambon of the study.



Figure 2: Map of the location of Dong Khrathong Yam Tambon - source Googlemaps©

The Tambon has been set up 200 years ago when Lao people came for settling down within the area. This ethnic group was called Thai Pluan and nowadays people still convey its alphabet and language, quite different from Thai. They have also their own traditional celebrations. The name of Dong Khrathong Yam has been given for three reasons: “Dong” means forest; even though the current landscape is made of rice paddies we can assume that 200 years ago the forest was occupying a large part of the area. “Khrathong” is related to a festival in November during which they make float banana leaves on the water. These leaves look like islands such as the Tambon during the flood season. Then, “Yam” is related to a traditional Thai instrument; the first inhabitants might have heard its sound from underground and decided to give this instrument name to the Tambon. In terms of agriculture, rice production has always been the main culture within the area, first using the buffalos then 20 years ago, mechanization has been introduced to increase the productivity. However, Dong Khrathong remains a very rural area, about 30 minutes from Prachinburi city. In terms of economy, besides farming, there is a floating market every Saturday, two gas stations, different shops and a Homestay association which develops the tourism. Indeed this association besides to host groups in the member’s houses, they try to develop the tourism by offering different activities (museum, traditional massage, handicraft etc.) always liked to the Thai Pluan tradition.

I. Farm typology

1) Farm organization

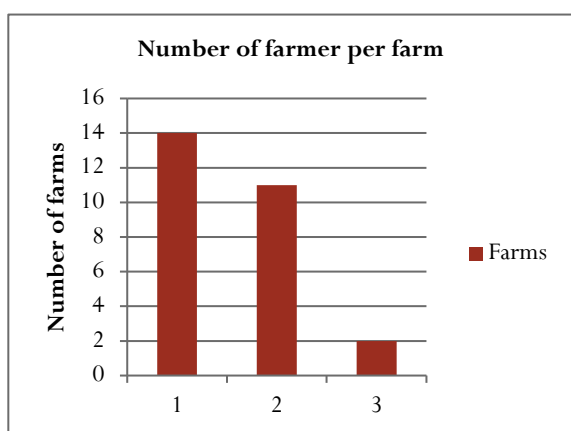
General data: 27 farms have been interviewed. The total number of farmers is 42 who live in the farm and four family members involved in the farm but who live elsewhere. First, the analysis focuses on the farmers living in the interviewed farm.

a) Farmer typology

i. Gender

Most of the farmers are male (60% vs. 40% of women).

ii. Number of farmer per farm



In the interviews farms, fourteen farms count only one farmer with nine male farmers and five female farmers. Eleven farms count two farmers including ten couple (husband and wife) and one father-son couple. Two farms count three farmers. They are two couple and two sons. It is 1.55 farmers per farm in average.

Eventually, among the 42 farmers only 3 children are full-time farmer in the family farm.

Figure 3: Graph Number of farmers per farm – Dong Khrathong Yam

iii. Age pyramid

“The farmers are old” said the president of the TAO. According to the Extension office, age varies from 40 to 70 in the tambon. Looking at the age pyramid, the data are verified for the 27 interviews. Indeed, the farmer population of Dong Khrathong Yam is an ageing population. With a diversity of age from 20 to 73, the average age is 54.5 years old. Only three children living in the farms are involved in the business from 20 to 34 years old.

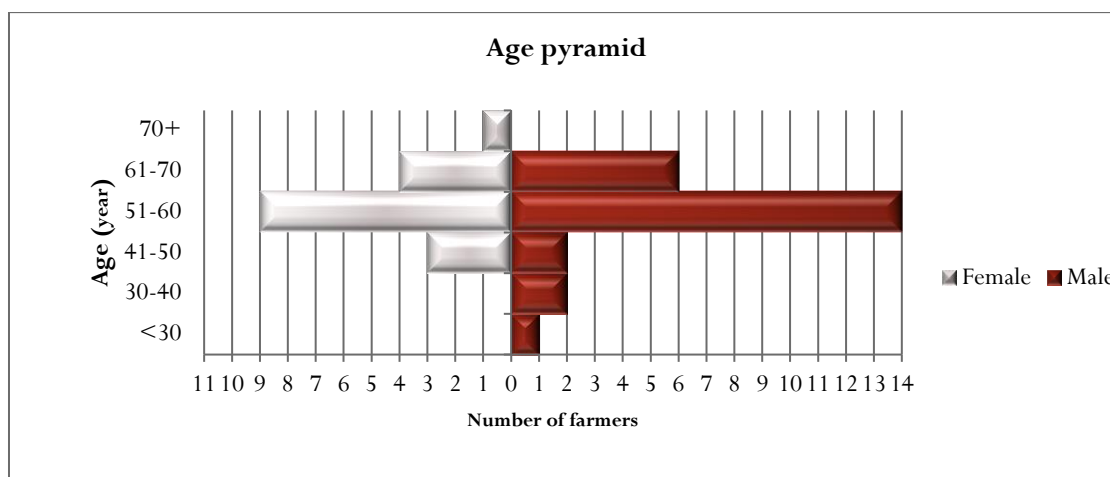


Figure 4: Graph Age pyramid – Dong Khrathong Yam

We notice that the only men (sons) less than 40 years old are involved in the farm business not the daughter. One of the farmers interviewed said that nowadays girls study with success while boys are lazier at school, stop study earlier and go to work as farmer (family business).

iv. Education level

Nearly 50% of the farmers stopped their studies after primary school (20 out 42).

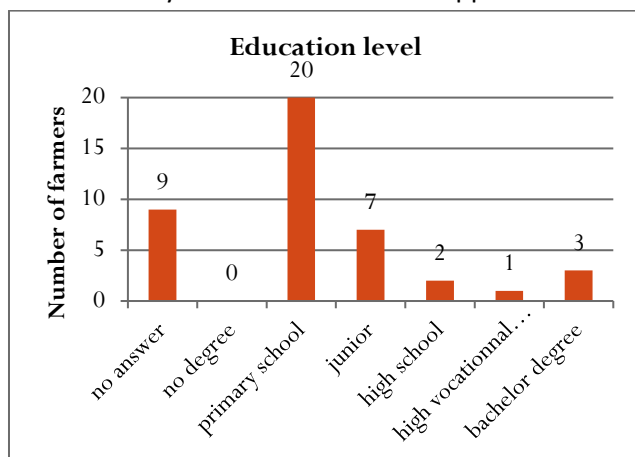


Figure 5: Graph Farmers' Education level - Dong Khrathong Yam

Education level	Gender		Total
	Female	Male	
Bachelor Degree	2	1	3
High school	1	1	2
High vocational school		1	1
Junior school	4	3	7
No answer	2	7	9
Primary School	8	12	20
Total	17	25	42

There is no relevant relationship between male farmers and female farmers in terms of education. Six farmers got a degree above the mandatory degree which is junior school. Pointing the fact that education level is unknown for nine farmers because it was the first interviews and at that stage the question has not been asked.

Table 1: Education Level per gender - Dong Khrathong Yam

b) Others farmers

In the 27 interviewed farms, three of them involve four farmers who do not live in the farm but are part of the farm business. For two of them, the analysis lacks of information. But for the two others, these farmers, from two different farms, are children (two sons 26 and 18 years old with high school and master degree).

c) Other occupations

Only 9 farmers out 27 interviewees do not have another occupation. For the 18 others, they all have other activities which are really diverse. Three of them are members of the Homestay association mentioned in introduction. Five of them make handicraft to get more incomes which corresponds to the program OTOP "one tambon one product". Indeed in Dong Khrathong Yam this product is handicraft, mainly utensils made from metals such as aluminum. The others either work

as TAO officers (3 farmers) or sell food at the market (3). Most of these occupations are secondary compared to the main one in terms of incomes: farming.

2) Family organization

Within the 27 interviews, there are 86 family members including the 42 farmers. Excluding them, 44 other family members live in the farm.

a) Relationship between the interviewee and other family members living in the farm

We find different relationship between the interviewee and his or her family members. We noticed that in many cases 3 generations live in the same house (from grandparents to grandchildren).

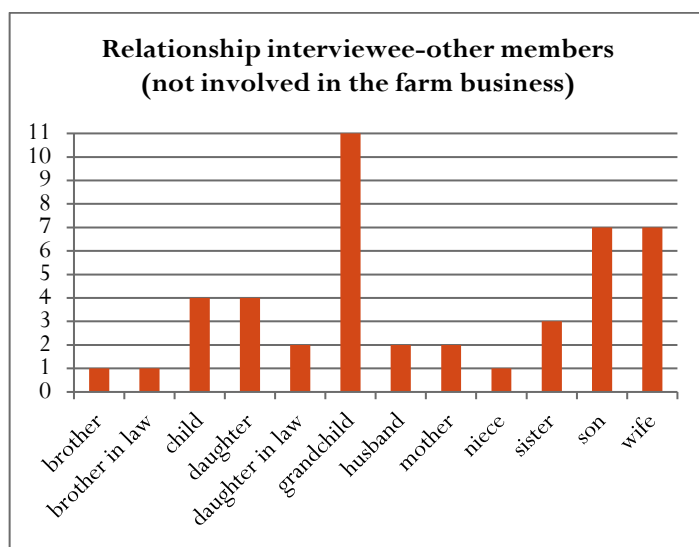


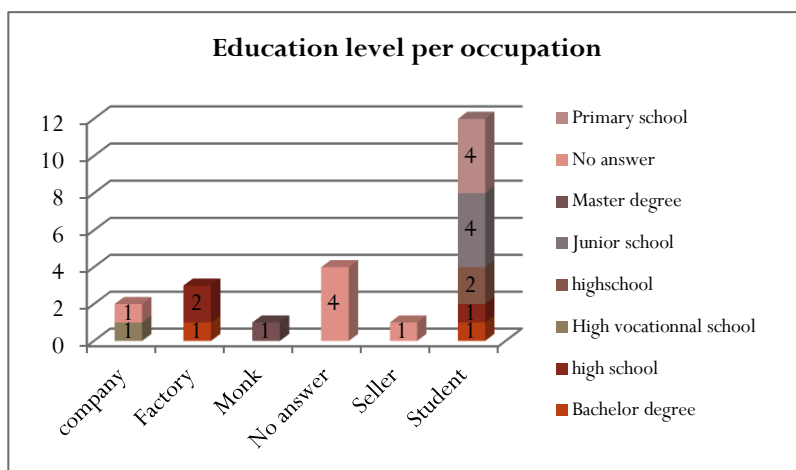
Figure 6: Graph Relationship between interviewee and other members - Dong Khrathong Yam

Average age: 31.4 years old. Three distinct groups can be made:

- Children under school age: 5 kids are in this group (from 2 to 6 years old). This group won't be developed in the next section as they still do not go to school.
- Member under 40 years old part of the so called "new generation", they could potentially takeover the farm business.
- Member above 40, part of the "ancient generation".

b) Education level and occupation of other members living in the farm

i. New generation group



23 members are in this group. It gathers children, grandchildren and children-in-law

They are from 7 to 36 years old and they either study or work. The average age is 19.6 year old. 52% of them are still student: from primary school to Bachelor Degree. The others work either in a company or factory. Besides the unknown answers (7), all of them have a

Figure 7: Graph New generation's Education level per occupation - Dong Khrathong Yam

degree above high school.

ii. “Ancient generation” group

This group gathers seventeen family members from 43 to 78 years old with an age average of 56.2. They are the interviewee’s sibling, spouse or parents. For nine of them we lack of information. But for the rest we can see that the occupations are various but unlike the “new generation” the education level seems inferior. Indeed, two don’t have degree, three finish school after primary school and eventually three of them ended school after high school. We do not notice any superior degree (university or equivalent).

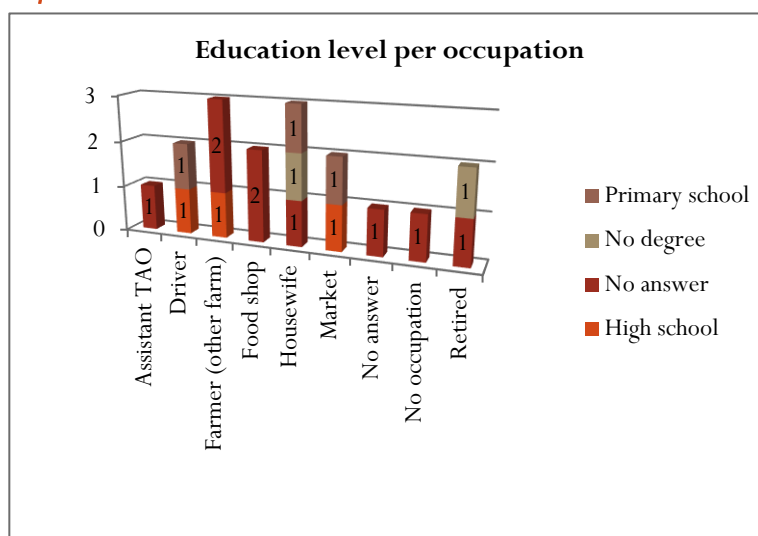


Figure 8: Graph Ancient Generation's Education level per occupation - Dong Khrathong Yam

Most of these occupation incomes will contribute to the living costs of the family. In some of the cases, these additional incomes help to face the low profit from farming activity (to be developed in the next part).

c) Family members who live outside the farm

If we exclude the children working in the farm, 21 family members live elsewhere. Most of these family members are children (19 out of 21 of the off-farm members). These members either study in other city or work and have their own family elsewhere and might send money to their parents in order to help them monthly. In two cases, they are spouses working in BKK and not able to live with their family.

3) Land management

a) Land area

According to the Agricultural extension office, the average size of the land in Dong Khrathong Yam is about 15 rai which corresponds to the Thai average. However, through the 27 interviews which have been done in the area, even though the size diversity is important (from 15 to 200 rai), the average is about 60.8 rai per farm (red line in the graph). The total interviewed area is 1653 rai including 1603 rai of rice production. The rice production will be described more in Part II.

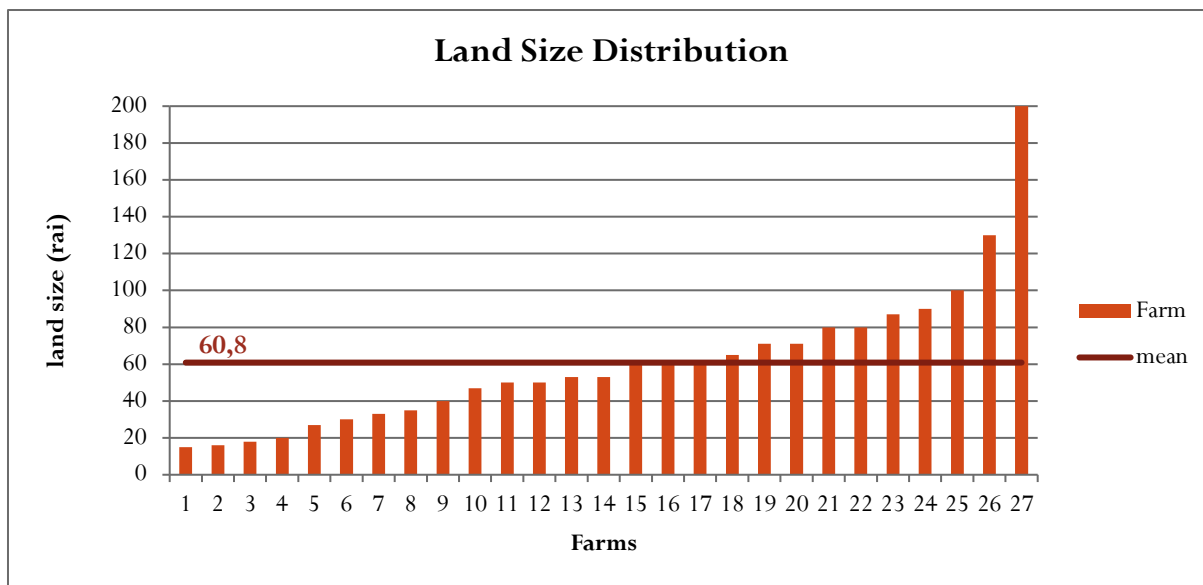


Figure 9: Graph Land size distribution - Dong Khrathon Yam

b) Land status

In this study highlights different types of farm regarding to the land status. Indeed, three cases are observable:

- Ownership (100%)
- Leasing (100%)
- Mixed

Thus, we observe that only seven farmers own 100% of their land (26%) from 18 to 130 rai with 62 rai in average. Eight of them rent 100% of their land from 16 to 65 rai with 41 rai in average. Then, the rate owned/rented in the mixed status farm varies from a farm to another (see the graph). However for this category, we notice that the rented part is more important than the own one. Indeed, in only four farms cases the owned land area is bigger than the rented one (Farm n°8, 12, 20 and 23).

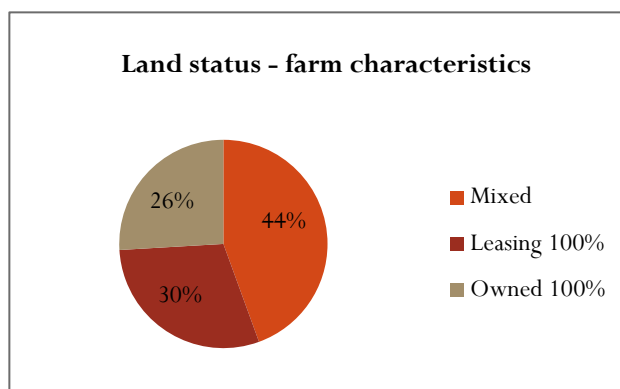


Figure 10: Graph Land Status - Dong Khrathong Yam

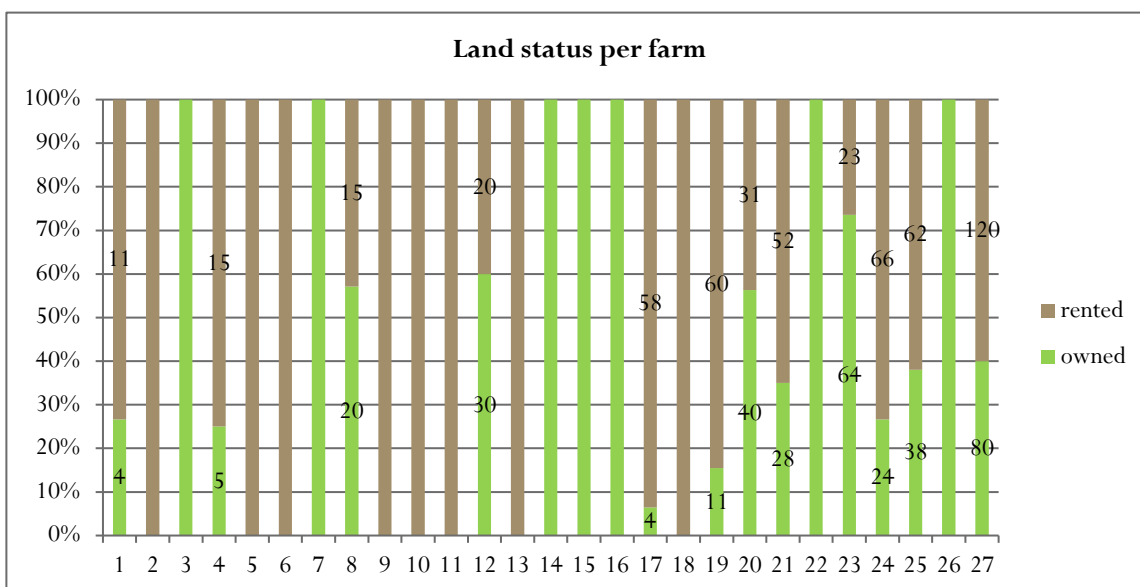


Figure 11: Graph Land Status per farm - Dong Khrathong Yam

c) Owner of the rented land and renting rate

For the twenty rented land cases, apart from two unknown answers, thirteen out of 20 farmers rent land from their relatives (father, mother, siblings etc.). For the rest, they rent from either farmers or people living in city, however no more details can be given.

With regard to the renting rate, it seems that there is no specific rule. It will depend on the owner. The land may be free in some case (one known). But for a majority of cases, the rate depends on both the production and the price of rice. Indeed, the price is based on an equivalent of 10 drums of rice/rai that is to 100kg of rice/rai and this amount will be multiplied by the price of the rice at that moment. For example, if the price is 6,5THB/kg, for one rai the farmer will have to pay 650THB/rai which represents between 10 and 16% of the total gross incomes but this element will be developed in the next part.

These lands produce mainly rice that will be developed below.

4) Evolution over the past 15 years

In terms of family dynamics, regarding to the average age we can assume that there were not that many changes. Indeed, as the age average is quite high (54,5 years old), the farm manager must have been the same for the last 15 years in most of the farms. However, most of the farmers who have been interviewed inherited the land from their parents and they also used to work on their parent's land: here the farmer manager shift remains fuzzy though. In terms of land evolution, little information has been recorded. However as we will see next part, to face the decreasing price of rice, a solution is to increase the land. So we can assume that some of farmers must have expanded the land in order to get enough incomes.

II. Farming activity

1) Main production

Within the Tambon of Dong Khrathong Yam, the main production is the cultivation of rice. Indeed, according to the Extension office of agriculture (EOA), during the rainy season paddy fields cover 15000 rai and 8000 rai are also produced during dry season it means that they use the irrigation system. In the 27 interviews, 21 farms do two crops and 2 farms do only one crop because they stopped to be WUG member as we will see later. For the last four, it is mixed: the plots located nearby the irrigation canal will produce during dry season while the others, too far, will produce only one crop. However, none of the farm produces three crops per year. The total area of rice production during the rainy season is 1603 rai vs. 1280 rai during the dry season.

a) Schedule

Here is a calendar from the rice research center (RRC) of Prachinburi province. It shows four calendar “types”. Rainy season (RS) and dry season (DS) that require shorter rice varieties than the long rice and deep water rice (DWR).

	March	April	May	June	July	August	September	October	November	December	January	February
RS												
DS												
LR												
DWR												

RS: Rainy season												
DS: Dry season												
LR: Long rice												
DWR: Deep Water rice												

Table 2: Season rice crop calendar - Prachinburi source Rice Research Center

For all the interviewed farms, the crops correspond to the calendar of RS and DS. Only one farm has also a crop of DWR. This requires varieties that are adapted to the flood (September and October), because during that time the plot might be flooded, and result in a low quality rice or worse, destroyed crop. Unfortunately, not much information has been collected according to the varieties because they change frequently. However, this “type” calendar is variable. Indeed, two main factors determine it: water supply and variety length. The first one, water, is required at the planting stage and will determine the beginning of the crop (especially important for the rainy season crop as the crop starts at the end of the dry season, at that period water quantity is variable). Then, in function of the planting date, the farmer will choose the variety according to its length. Indeed, the farmer must take into account the two critical period of the year: lack of water (from February) and flood (September). Most of rice varieties last between 90 days and 120 days. For example, if the water quantity is enough around April, the farmer might start the crop at that time and grow a 120 days-variety which will last till September in contrast if the water quantity is not enough the crop might start in May or June, in these cases the farmer will choose a shorter rice variety in order to harvest before the flood, otherwise the crop will be impacted (a lot of moisture) so the price of the rice. All these decisions will also depend on the location: facing flood or not. In some cases, like in the graph, for the DS, the crop length is shorter than 90 days. The farmers have to harvest even though the rice is not 100% mature. It will lead to a loss in the production.

b) Costs of production and machines

Three categories of costs of production have been identified. First, as it will be developed below, labor constitutes an important part of the costs of production in the cultivation of rice. Then, the inputs are the second main part of the cost of production gathering gas, seeds, chemicals and other products. Eventually, the costs specially dedicated to water pumping (gas and maintenance). Unfortunately this section has not been developed in details for Dong Khrathong Yam Tambon. However some resultants may be present as relevant for the study.

i. Labor – outsourcing

Here is an interesting element revealed by the interviews: hiring labor is a common fact in the cultivation of rice and this at five main stages of the production:

- Plowing (preparing the soil for the next crop)

- Sowing the seed
- Spraying chemicals
- Spraying fertilizers
- Harvesting

Even though the data collection in Dong Khrathong Yam is not enough detailed for the labor part, we can present different elements which explain or may explain the reasons why farmers hire labor. Over the 27 interviewed farms, only one farmer does not hire labor for none of the stages. And the reason is that this farmer owns a harvest machine and tractors. Here appears the first element which justifies hiring labor or not. Indeed, if a farmer owns the machines s/he won't hire labor. But, besides the harvest machine that most of the farmers do not own, let's consider the first stage of production: plowing.

Preparing the ground for the crop may require one or two rounds depending on how dry the ground is. Regarding to the ground status, two different tractors are used. For a superficial work, a tiller (manual tractor) will be enough while for a deeper work a bigger tractor will be necessary. If most of the farmers own the tiller it is not the case for the tractor. And if they do not have it, they hire labor or an operative it is to say someone who owns the machine and can do the work.



Figure 12: Picture of a field after plowing April 2017 - Dong Khrathong Yam

The price of plowing will depends on the ground status and varies a lot in function of the operative. The average price ranges from 130THB/rai up to 250THB/rai. In some case it will include the gas otherwise the farmer will have to pay it. The main reason which explains that the farmer do not all own the tractor is the investment costs. We interviewed an operator which is hired by farmer to do the plowing. He just bought a new tractor for 950 000THB which is expensive

regarding what a farmer earns (see the next part). He also mentioned that driving such tractor requires a certain driving skill that would explain the farmer do not buy it additionally to the cost.



Figure 13: Picture of a tiller - Dong Khrathong Yam

Then, for the three other stages: sowing, spraying chemicals and fertilizers, what factors imply that the farmer hires labor or not. Here are two hypothetical factors:

- Number of rai per farmer
- Age

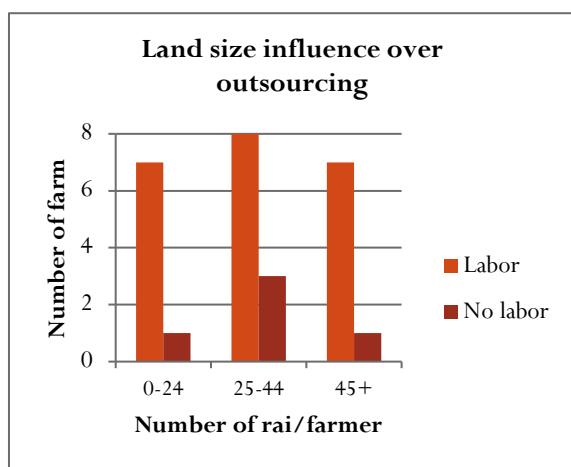


Figure 15: Graph Land Size influence over outsourcing - Dong Khrathong Yam

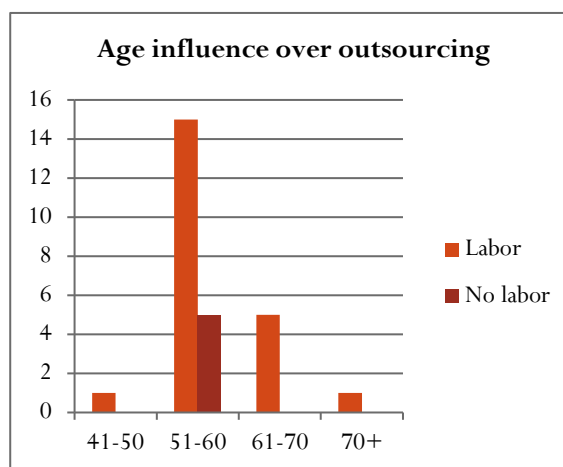


Figure 14: Graph Age influence over outsourcing - Dong Khrathong Yam

According to the collected data, these factors are not decisive in term of hiring labor because it is very common. Indeed, only 5 farms out 27 hire labor. Looking at the graph, we observe that the size of the land per farmer is not determining because hiring labor cases are higher than no hiring labor cases in the three land size categories. However, regarding to the age graph, we notice that in the six cases above 61 years old, the farmers resort to labor. We can assume that as ageing the farmer decide to hire more. Furthermore, some farmers mentioned that they started hiring labor because they were getting old.

Moreover among the 27 farms, farmers of 16 of them hire labor to apply chemicals and other substances (fertilizers). According to the farmers' explanations, this is due to a health concern. Indeed, most of the time by spraying chemicals the labor or the farmer does not wear any protection (mask, gloves) and walk barefoot because it is muddy. We can assume these practices might have an impact on the health of the one who sprays. In terms of costs, the labor is usually paid 70THB/rai for any kinds of tasks.



Figure 16: Picture of chemicals spraying - Dong Khrathong Yam

Eventually, the interviews highlight the fact that the farmers do not actually do farming. Indeed, as they hire labor for the different tasks, we may wonder when they actually go to their field to see what it is going on as they seem to be more manager than farmer. Furthermore, we could assume that as they are not involved 100% in their field, this fact might slow down the potential innovation and changes of practices which could eventually increase the production. This assumption is reinforced by looking at the interviews that the past 15 years there were no relevant innovation in the rice production. The farmers have just changed the rice variety every year in order to maintain

the yield. But to go further, it would be interesting to assess the correlation between outsourcing and yield whether the fact to hire labor decreases the potential of the production. According to the farmers present at the restitution meeting, even though they hire labor they spend a lot of time in the field looking after any problems, finally according to them, hiring is not a impediment to the innovation.

The harvest is not manual in most of the cases. As the farmers do not have the machine, they hire operative to harvest. In our study, only one famer has his own machine. Otherwise the 26 others hire a operative between 300 and 500 THB/ rai.

ii. Inputs

As said in the introduction of this part, the data in term of costs lack for Dong Khrathong Yam Tam bon. However, we can say that the main inputs of rice production are seeds, chemicals and fertilizers substances. For the seeds, the price will depends on the quality and the types of variety but in average it is 18THB/kg according to the rice research center (RRC) which sells the seeds. This center provides also technical support. They recommend to the farmers to spray 15-20kg seeds/rai if it is a manual spraying and 10kg/rai if it is made by spraying machine. But according to the RRC, as the farmers do not believe them, they spray about 30kg/rai to be “sure”.

In terms of water pump, most of the farmers own the pump. Or as they own the tiller they use its engine in order to pump water as showed in the picture. In some cases, farmers do not own the machine thus they have to rent it.



Figure 18: Picture of a water pipe - Dong Khrathong Yam



Figure 17: Picture of a irrigation system - Bang Taen

c) Incomes and outlets

The incomes are a blend of two elements: yield (Tone/rai) and prices. The yield is function of many elements such as soil quality, water management (quantity, quality), rice variety, crop that cannot be directly assessed here. However, the price of rice, besides the general market influence, depends on two main factors: the quality of the production and the outlet.

First of all, from the data collection in Dong Khrathong Yam the yields do not vary a lot between dry season and rainy season. Indeed, for the dry season the average yield is 709kg/rai versus 720kg/rai for the rainy season. They range from 500 kg/rai to 940kg per rai. The optimum yield is 1 tone per rai. We can see that if some farmers nearly reach the optimum yield some others are far from this optimum. As it has been mentioned, the yield depends on many factors and thus varies a lot from one year to another.

According to the middleman who was interviewed, the prices are linked to the quality. And the main quality factor is the moisture. To get an example, if there is 15% of moisture the price will be 7800THB/T, if there is 20%, it will decrease down 6500THB/T. According to her, during dry season the moisture percentage is about 23-25% versus more than 25% during rainy season which seems logical in terms of humidity level regarding to both season. However, according to the interviews, the

average price for the rainy season is 6550THB/T and ranges from 5600THB/T to 7200THB/T versus 6400THB/T ranging from 5600 to 7000THB/T for the dry season. It seems that the price during rainy season is more important. But, it must be taken into account that 11 out of 27 farmers gave an average price for the year regardless of the crop. The prices announced above might change if there were more details in terms of price per crop.

The farmers sell the production either to a middleman (16/27) or directly to the rice mill (11/27). According to one of the farmers, the choice of one of the other outlets depends on the room in the truck of the rice mill. Indeed, he mentioned that the rice mill collects the rice of some farmers but at some point there is not enough room in the truck to collect the whole production. The farmers could wait for the next round but most of them must pay back the debt (loan) so they must sell the production as soon as possible. They sell the production to the middleman. In this case, different middlemen are contacted by the farmers before the harvest (one week) as the middlemen may check the plot in advance. Then the day of the harvest, these middlemen show up and the farmer bargains the price with them. In some cases the middleman is in charge to carry the rice to the rice mill, in some other cases, the rice mill will send a truck. These elements will influence the final price (including transportation costs). The middleman sets up the price depending on the rice mill price including the commission s/he gets. The middleman who was interviewed gets 100THB per each sold ton paid by the rice mill. In our study we cannot assess the difference of price between middleman and rice mill because as mentioned other factors such as quality must be taken into account. Another solution for the farmer is to sell to the rice mill bringing directly their production to it but for this requires owning the truck which is a supplementary investment. Another solution would be to dry up the rice before to sell it but this requires having a specific area to do so and here again it represents another investment.

But above all, it must be mentioned that globally the price of rice is low. During the last government (from 2011 to 2014) the price reached 10 000 THB/T. But since the change of government, they stop this policy and the price varies at the same time as the international market. In the interviews, a lot of farmers complained about it. But despite the farmers' bitterness regarding the profitability of their business (they graded 3 out of 5, often less their business profitability), we can assume that, in Dong Khrathong Yam, it seems that the farmers manage quite well because of the important size of their farm. Indeed, this cost leadership strategy allows getting better profit thanks to an economy of scale of the costs of production.

2) Other production

As mentioned above, rice production is the main production within the tambon. However 50 rai out of 1653 total rai (interviews) are used for another purpose but rice. About six farmers (about 40 rai) raise fish. Only three of them raise fish for a commercial purpose, the others raise fish for household consumption. The rest of the 50 rai are vegetables area both used for household consumption and sold in the market. Most of the interviewed farmers grow vegetables around the house area (<0,5 rai) for their own consumption but the area has not been recorded as it is not for a commercial purpose. There is also one farmer who grows bamboos and corn (1 rai).

The main reason why some farmers multiply the farming activities is to follow the King's project or to do "integrative" farming. What is this project? As explained by the Extension office of Agriculture (EOA), this project was made by the former King of Thailand, Rama IX. He drew up a self-reliance theory. It is associated to the concept of integrative agriculture mentioned by the farmers.

This theory aims to encourage the farmers to diversify the farming activity in order to reach certain autonomy with 30% of rice; 30% of fish pond; 30% of vegetable and orchard and 10% livestock (poultry for example). The farmers are also taught to make their own fertilizers. The project is supported by EOA only with knowledge (no financial support), all the farmers who want to join are free to do so. According to the EOA officer in charge of Dong Khrathong Yam Tambon, only 10 farmers joined it.

3) Role of Extension office of agriculture

EOA is in charge of following the National master plan of agricultural development and applying it at district and sub-district level. In general, this institution is in charge of providing training and knowledge in order to increase the quality and quantity of rice production and other production. It also tries to lead the farmers to process agricultural products to get additional incomes. They may also provide financial support in case of natural hazard. But more specifically, within the tambon of Dong Khrathong Yam, the EOA is in charge of following the farmers who signed up the King's project. It also supports the center of soil management in each village that the Modin (doctor of soil) is in charge of it. In this center, farmers may have information about fertilizers and solutions about soil quality issue. They can also test the pH and minerals of their soil for free. "If the farmers do a better management of soil they should decrease the costs of production" according to Mrs Thanyada, officer in charge of Dong Khrathong Yam area. EOA also supports smaller scale project such as the project associated with other government departments which aims to promote the production of plant in order to process them and use them as medicine in Prachinburi hospital. It also supports the group of wife who process food to get alternative incomes.

Moreover, EOA supports the production of alternative crop using less water such as corn or bamboo. To do so, EOA is in charge of the coordination between the farmers and the cooperative. The cooperative will offer loan with low interests: the farmers will have to pay 4% out of 7% of interest while the government would take care of 3% remaining. According to the EOA, 30-40 farmers from Dong Khrathong Yam registered to join the project but only one has actually started the production. To the EOA, the others did not start because they might be afraid that they are not able to pay back the loan as they do not know what income they can expect from these productions.

Eventually, the EOA provides knowledge about innovating agricultural techniques through the Smart Farmer Program and the Young Smart Farmer Program (focuses on the farmers under 45 years old because according to the EOA "young people have more creativity in terms of marketing channels"). Beyond this aspect of innovation, these programs could encourage the new generation to take over. By now, this is not obvious as we will see further. However, in Dong Khrathong Yam only 2 farmers joined it.

4) Evolution over the past 15 years

In terms of farming activity, no noteworthy changes have been recorded. The rice production has been the main production over the past 15 years. Only the other productions resulting from the different project explained before are new. The farmers have just changed the rice variety over the years in order to maintain the yield, following advice of Rice research center or by sharing knowledge with other farmer, or again saving the seeds from their good crops and reusing them for the next one. Doing so, they also save money by reducing the cost of production. The farmers have increased their land size in order to face the decreasing rice price and some other farmers have started diversifying the production to get various incomes.

III. Water management

1) Water user group

a) History

In Dong Khrathong Yam, a water user group is in charge of the water management. This group lead by Mr. Jdapon Paiboon was created the 9th January 2005. Before its settlement it was hard to get support, since then as a collective initiative the farmer s have got more legitimacy to ask financial support from official institutions. The group was set up because of an increased need in term of water. Indeed, it is around that time the farmers started a second crop. At first, the group was set up with farmer from Dong Khrathong Yam and Hat Yan tambon, both sharing the main canal from the Bang Pakong River (see map.). Hat Yang farmers were the first to start the second crop. The reason could be that their lands are located closer from the river but this is just an assumption. Then, seeing their success doing the second crop, the farmers in Dong Khrathong Yam started the second crop. At the beginning, the group covered about 700 rai (mainly in Hat Yang). But as the number of farmer doing a second crop increased, the group split into two groups around 2010. Indeed, Hat Yang Tambon set up its own water user group with another main canal.

Here, we focus on the group of Dong Khrathong which is in charge of the main canal mentioned before (from the beginning of the collective initiative). However, as the main canal flows through Hat Yang Tambon as well, some farmers from this tambon are registered in the Dong Khrathong Yam group.

b) Organization

Last dry season (from November 2016 to February 2017), the group counted 91 members in total and 68 users. This figure varies between 60 and 70 because some of the members even though they are registered as member and pay the yearly fees, do not pump the water from the irrigation canal under the responsibility of the WUG but they use other source of water: from Bang Phluang canal for example (western part of the Tambon, village 6 and 7). They will pump water from WUG only if they need it. The irrigated area of the WUG was 1800 rai in total: 1000 rai in Dong Khrathong Yam and 800 rai in Hat Yang.

The irrigation system is divided in three different zones according to the seven villages' location:

- Zone 1: Dong Khrathong Yam: villages 1, 2, 4 + Hat Yang : villages 1,4
- Zone 2 : Dong Khrathong Yam : villages 3 and 4
- Zone 3 : Dong Khrathong Yam : villages 5, 6, 7



Figure 19: Map of irrigation system management - Dong Khrathong Yam

c) Management

The irrigation system is connected to the Bang Pakong River thanks to the main gate (gate 1, see map). Then the main canal is divided in two parts in order to cover the three zones. The irrigation system stops at the border of the Tambon thanks to gate (gate 4, see maps) or end of the canal (see maps). The main gate is usually opens during the dry season (from mid- November to February). Each zone has a representative who is part of the water committee. The committee is composed by 15 farmers including the representative and the general group committee (President, Secretary, accountant etc). Together they will decide when they open the main gate (around mid November – beginning of December). Then they must notify the authority (Royal irrigation department). However, in some cases (pollution or brackish water), the RID might ask for closing the main gate in order to preserve the production.

i. Water allocation

Each zone pumps water at different moments in order to provide water to all the users. First, once they decide to open the main gate (gate 1), they close gate 4 and open gate 2 and gate 3. Thereby, water from the river flow through the canal till the zone 3. As zone 3 is a large zone, farmers have 15 days to pump water in. They can both pump water directly to their plot and store it into sub-canal or ponds. After 15 days, the gate 3 is closed. Then farmers of the second zone have 10 days to pump water in. After this time period, the gate 2 is closed and farmers of the first zone start to pump, they have seven days. Then, the cycle starts over and this during three months. The number of pumping days may varies regarding to the situation. In case they need more water, the number of days could be extended.

According to the president and the interviewees nobody tries to cheat the system. However, if a farmer tries to pump when it is not his/her turn, h/She will be called to order a first time and usually it works no need to go to a severe sanction.

In terms of opinion regarding to the collective management of water resource, half of the interviewee think that there is enough water for the users (during dry season) while the other half mention that there is not enough water for everybody. However they do not mention any conflicts among the farmers. Furthermore 18 of them seem satisfied of the management operated by the group. Indeed, even though they allude to the lack of water, they think the organization of the group in terms of water allocation and pumping days is well managed. For the two who are not satisfied they mentioned the fact that there is a form of favoritism from the President towards his relatives or closed acquaintances. That means that the president could allow farmers to pump more than the others. Is it here a form of corruption? Unfortunately, only two farmers alluded it and they might be just angry to the president (personally) and not to the organization.

ii. Materials

The WUG uses two electric water pump located at the main gate. They were bought by the RID ten years ago. According to the President and some users, these pumps are too old now. They made a request to get new one but as they are bought with public money, the procedures are long. The group cannot afford to buy one by itself because they are expensive: 30 million baths for two pumps. If the lack of water is too important, the group might borrow two small gas pumps in order to support the two main ones. In terms of costs, the electric pumps cost 6000 THB per day and are on 20 days (24 hour a day) a months during two or three months which represents between 240 000 and 360 000 THB. When they have to use the gas pump, they alternate daytime: gas pump and nighttime: electric pump. The gas pumps cost usually 160 000 THB in average for a dry season period. The RID supports the gas pump costs while for the main ones (electric) the group finances them with the fees the farmers are charged.

iii. Fees

The WUG collects the money from the users. The money is used for the maintenance and the energy costs of the pumps. Every farmer can become a member. S/he just has to register by the WUG.

The members (91, last dry season) must pay 100 THB per year as a membership fee. Then the farmers have to pay water use according to the size of their land. They are charged 150 THB/ rai only when they start pumping. If they do not pump they do not have to pay this amount.

For some farmers (in zone 3), they also receive water from the Bang Phluang irrigation system because water flows from there to Dong Khrathong Yam area. In this case, they usually do pay the membership fee but do not pay the water use fees. However, as the water from Bang Phluang is more impacted by the brackish water from the sea (located downstream), the farmers in the zone 3 might need water from the WUG at some point. In this case, they just have to pay the group according to the size of their land like the other user (2 farmers in our study).

Some other farmers do not want to pay the member fee because they consider they do not need water from the group (1 farmer in our study). They might have storage pond and sub- canals or receive water from Bang Phluang irrigation system. If they need water someday they can ask to the group but they won't be prior and will pay the fee as everybody does.

According to this system, the number of members and users is unstable and varies from one year to another.

2) Water use in Dong Khrathong Yam

The following map tries to show the distribution of the rice plots of the interviewed farms within the study.

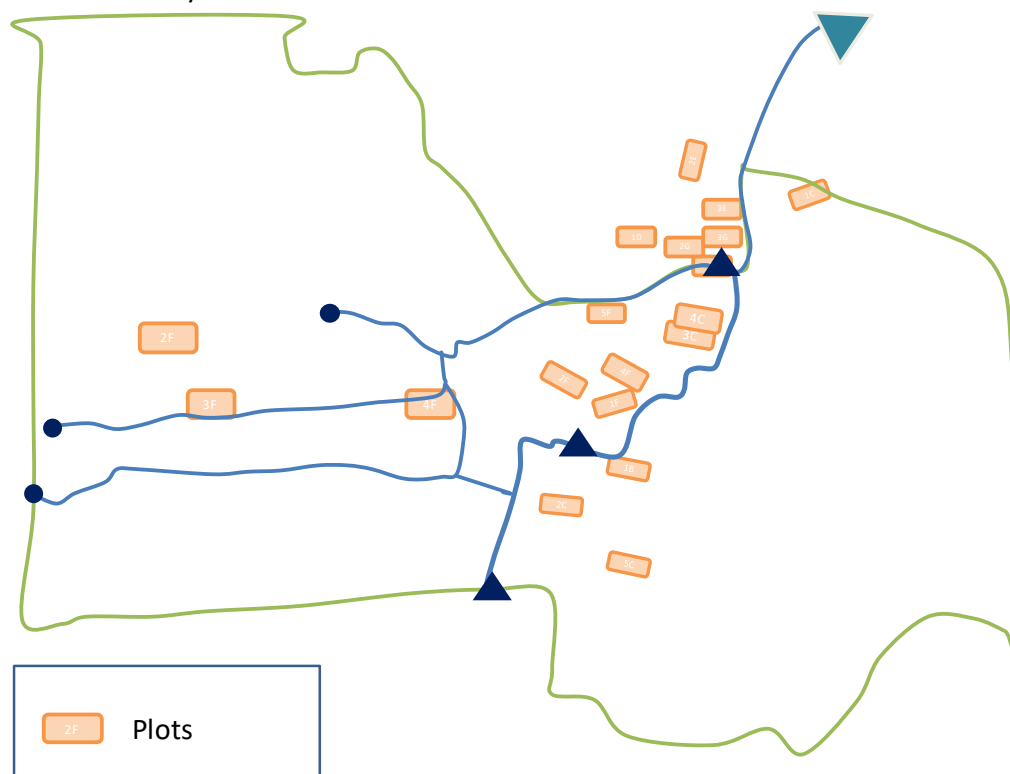


Figure 20: Map Farm distribution within the irrigation scheme - Dong Khrathong Yam

Unfortunately not all the allocations have been recorded because of the difficulty for the farmers to find their bearings on the map. However, we can see that the rice plots are distributed along the canal covering every zone.

Among the interview, 23 out of 27 are members of the water user group which represents an area of 1169 rai out of 1280 irrigated rai during dry season. The four others used to be part of the group but they stopped for different reasons. As said before, 2 out of 27 farmers do only one crop. They stopped because they had to wait too long before to pump water, so now they do not need to be member. For the 2 others, it is because their land is either too far from the canal or as mentioned they use water from Bang Phluang.

All the 23 members interviewed irrigate during dry season. However, 5 of them also irrigate during rainy season because they consider that the rain is not enough or because they do not have enough space to store water in order to use it later. Only seven farmers have one or several ponds where they store water in.

In terms of water quantity used it is hard to evaluate. Indeed, the farmers seem to have a poor idea what volume of water they add to their crop even though they have been asked about the flow of the water pump which might be indicated on the meter. We can assume that they do not pay attention to it. However, they gave information about how many times they pump water in and what

height. In average, they irrigate four times about 13 cm each. Nevertheless these figures vary a lot from a farm to another. Indeed, some of the farmers pump water in only 1 time versus 6 times for others. And if some of them add 2,5 cm each time, others add up to 30 cm. We could make the assumption that the ones who irrigate only 2,5 cm will pump more and in contrast the ones who pump 30 cm each time will pump only few time. But actually, we cannot verify this assumption from our interviews as the irrigation practices are very different. However, there is a trend that the ones who pump a big volume such as 30 cm (4 farmers) pump only 2 to 4 times.

3) Water issues

In Dong Khrathong Yam Tambon, three main water issues have become prejudicial for the farming activities over the past years.

a) Lack of water

i. Tambon level

The issue linked to the water quantity was not specifically an issue 15 years ago but as the second crop of rice has been introduced and it is produced during the dry season (from November to February), water quantity has become an important stake within the area. The introduction of the second crop (8000 rai in 2016 according to the EOA) and the increasing number of farms doing it (700 rai 10 years ago, 1800 rai nowadays) would be the main reason of the lack of water during the dry within the Tambon area. This lack occurs especially in December and January while all farmers pump at the same period. The other reason mentioned by the farmers during the interviews is that the lack of water would be due to the settlement of factory in the upper part of the river. Indeed, there is an industrial area called “factory 304” located in the same district as Dong Khrathong Yam (Si Maha Phot Amphoe) including a paper factory “Double A company limited” and a food-processing industry “European food company limited”. These factories need water in order to process their different products. This may result in an over-pump of water upstream and a lack of water downstream. Moreover, the field trip allows noticing how dirty the canals were. Indeed, as shows the picture, the canals are invaded by weeds and trees, reducing the available room in the canal and thus the volume of potential available water. This picture has been taken end of April while the canals are dry waiting for the rain coming in order to start the second crop in May.



Figure 21: Picture of the dirty and obstructed canal - Dong Khrathong Yam

Moreover, one important fact is that the canals are used to supply the village in term of drinking water and house hold uses. It is important to mitigate lack of water in order to supply enough water to the villagers.

ii. Farm level

Among the 25 farmers interviewed who actually do two crops, six pretend not having water quantity issue because of the location of their land: next to the main canal. One of the farmer, in the village 5, mentioned her land were up hill compared to her neighbors so she does not face flood in September and October and thus she can start before the other farmers. Two of them did not have opinion. Eventually, 16 farmers face lack of water every year. If most of them do not why there is a

lack of water, four of them point out that all the farmers pump at the same time between December and January. Only five out of 25 farmers said that the lack of water impacts the production (delays, loss of yield, stop the crop). However, before, 11 of them mentioned that there was not enough water within the Tambon for all the users. It might mean that the farmers, facing the lack of water at Tambon level and thus at farm level, have already adapted their production in order to not be impacted by the lack of water. Indeed, farmers manage their production (and the lack of water) by changing the variety (90 days-variety versus 120 days-variety) or they store water when they have still the opportunity to do so.

It seems that while the lack of water is a prejudicial element for the rice production, most of the farmers got adapted to it and pretend that there is no impact on their production. Consequently, in this situation, the lack of water seems not being as impacting as assumed. But, as the farmers got adapted, of course they think there is no impact but what if, actually, beyond that, the impact would be the decrease of the yield and the farmers would not be aware of that because the whole system has changed in order to not get impacted by the lack of water.

b) Salinity issue

i. Tambon level

This issue is strongly linked to the lack of water. Indeed, during the dry season while the level of the river decreases, sea water comes inland. Then it flows through the land by the irrigation system. In Dong Khrathong Yam, the salinity does not really impact the farming activity because it is important in April and May which is the end of the dry season when the lack of water is really important. As said previously, most of the dry season crops are harvested by February. However, it may impact the beginning of rainy season crop. Indeed, while there is brackish water in the canal the farmers cannot pump while water is required for the first stage of the production (plowing). So they have to delay the crop. Over the past 15 years, the salinity has increased as the lack of water has done.

ii. Farm level

At farm level, the salinity issue is balanced. 50% of the farmers say that there is a problem indeed versus 50% of the farmers who say there is no issue. Farmers whose lands are located in the third zone (villages 5, 6 and 7) seem to be more impacted by the phenomenon while they are located the furthest from the river. However they are also located in an area where water from Bang Phluang scheme flows yet this water is more impacted by the salinity because Bang Phluang is located downstream compared to Dong Khrathong Yam so when the sea level reach Prachinburi Province it impacts Bang Phluang before Dong Khrathong Yam. A few farmers mentioned also that in these three village the problem comes from underground and thus since a long time (30 years). Unfortunately, we do not have further information about it. Moreover, it seems that the farmers do not have tools to measure the salinity level but they can tell basing their claim on their own experience, looking at the canals and the river.

c) Pollution issue

i. Tambon level

This problem is not the most important in Dong Khrathong Yam besides the two previous ones. However, during the flood period in September and October, water flows through many areas which may be either wasted or clean before to enter the Tambon. The pollution may have many origins. First, it can be linked to the factories which release water from their industrial process. In

theory, according to the law, the factories must recycle water before to release. In Dong Khrathong Yam, people accuse the factories to release wasted water into the river. Second, the production of rice is far for being clean. Indeed, on one hand, the rice production is a monoculture. As a monoculture, it impacts negatively the quality of the soil, thus the yield decreases. In order to maintain it, the farmers use chemicals and fertilizers. And on the other hand, the more the farmers spray chemicals, the more the weeds resist to the synthetic products years after years and the more the farmers have to spray in order to remove them. A vicious cycle. The water quality has been decreasing for the past because of the intensification of rice production by introducing the second crop and also because more and more factories settle down upstream. Additionally, it is an important stake to mitigate the pollution in order to provide good quality water.

ii. Farm level

As mentioned, pollution is not the main water issue within the area, so according to 18 interviewees, there is no problem of pollution in the Tambon. But 9 of the farmers think there is an actual problem. For them, the main reason is the upstream factories (6 out 9). Only one seems aware of the chemicals use might be one of the main reason. They mentioned that before they used to take shower with water from the canal but they do not anymore because of this issue. Also, some of them mentioned that before there used to be fishes into the canal but not anymore. These two reasons might reinforce the idea that the water quality has been decreasing over the years.

4) Water issues management – solution

The management of these issues is essential for the sustainability of the farming activity but also for the water supply within the villages. Indeed, beyond the agricultural aspect, water of the canal is also used for household consumption. In terms of solutions, they are in the range of two types. Indeed, solutions found by the farmers by adapting their production in order to avoid the problem, may be considered as the first type. Then, solutions set up at a global level by the authority or institutions in charge may be considered as the second type.

a) Lack of water

We have seen already that the farmers have adapted their activity in order to avoid the lack of water impacts the production. During the dry season, it might be interesting at a farm level to store water into ponds but this has a cost that some farmers cannot afford or they do not have the land to do so. When it occurs at the end of the dry season and the rain comes late, the farmers chose shorter rice varieties in order to harvest before floods come as they sow late. But these are individual solutions and not necessarily equitable. From the interviews, the farmers seem to accept the current situation as it is. Indeed, when they were asked about the solution, they answered “wait”.

At a tambon level, the WUG has already planned to buy new pumps but as mentioned it takes time to go through the whole public administrative procedures. Then, the WUG committee discussed in May about the possibility to deep the canal deeper (3m) in order to provide a bigger volume of water (increase the water flow capacity and a better storage). The provincial RID agreed but cannot support the initiative. The request was sent to the national RID; to be followed. As the picture of the canal, it is necessary to clean the canal. The RID is supposed to be in charge of the cleaning once a year.

If the farmers seem to agree on the occurrence of the issue, the local authority (TAO) does not. Even though the TAO is not in charge of water management within the tambon, it should be

aware of the issues occurring to the first economy of the territory. But the President of the Tambon thinks that the lack of water is in April.

b) Salinity

As seen, currently the salinity issue is not that important in Dong Khrathong Yam. It is most of all linked to the water level of Bang Pakong River. As we will see in Bang Taen study case, important management is made in order to prevent the brackish water to enter the farming area. In Dong Khrathong Yam, by now, just as facing the lack of water the farmers may store fresh water or delay their rainy season crop. Some of the farmers mentioned having a solution though. Indeed, they apply malt in the field and according to them it helps to prevent the brackish water. In every village, a Mo din (“soil doctor”) is elected by the farmers. The Mo Din must be a farmer, apply for the vacancy and be elected. Then, s/he follows a training provided by the government. The Mo din is a volunteer position “you need to really love what you do because you do not receive anything back” said Mr Som Kuan, Mo din in village 3. The Mo din is in charge of assessing the soil sample brought by the farmers. The tools are provided by the government. Mr Som Kuan was not convinced by the “malt” solution used by the farmer but he does not have any solution.

At a Tambon level, if the phenomenon gets bigger; they will have to find ways to prevent the brackish water.

c) Pollution

If the pollution comes from the upstream industries there is not so much to do but prevent the floods which are not that important every year. The last big one was in 2011. But if the pollution comes from the chemicals within the area, farmers’ awareness must be raised. However, as mentioned before, if the farmers hire labor to spray chemicals it is because they know how dangerous it is. We can assume they are already aware of the impact but they cannot help because they see only chemicals as solution to increase the yield and balance with the low prices. The farmers should be taught alternative practices which would bring satisfying incomes. For the president of the TAO, the only reason of the pollution is the chemicals use. It is why the TAO is in charge of a program which aims to provide training to push farmers to use fewer chemicals. The program includes lectures and practices once a year with two days for each. Unfortunately only 50 farmers can join the program. It is not enough to mitigate the impact at a tambon level. The TAO is also in charge of a program which provides training in terms of packaging for rice. TAO provides the vacuum machine. This alternative could give farmers more incomes and being independent of the middleman. Eventually they could use fewer chemicals. Moreover, organic rice could be considered as a possibility.

IV. Evolution within the next 15 years

1) Project

a) Official projects

The Water user group has planned to dig more the canal and to invert the slope at the rivergate. The first one will help to store more water while the second one will reduce the costs off pumping as the river level will be higher than the canal one (natural flow will be from the river to the canal).

b) Farmer's projects (at farm level)

15 farmers do not have plans for the future. They want to keep doing what they always do. 8 of them plan to grow something else than rice only. They mentioned the King's project and integrative agriculture by diversifying the farming activities in order to get self-reliant. Most of them (21 out 27) do not want to change for fish and shrimp production. They claim different reason for that. Indeed, the main reason (12/21) is the lack of savings and the impossibility for the farmers to invest. Then, the lack of water comes in second position. We may wonder whether the fish and shrimp production requires more water than the rice. To be compared in the following part. Eventually, two smaller reasons are the lack of knowledge and the fact they do not own the land and then they do not want to invest on someone else land.

2) Scenarios outline (tambon level)

This part aims to introduce the work on the scenarios. Indeed, the current study will help to set up scenarios for the next 15 years in terms of water quantity, quality, salinity and farming activity.

At a provincial level, the construction of Huay Samong dam which is currently 60%-full seems to be a (temporary?) solution. It might be interesting to assess the quantity of water will be release by the dam and the (short and long) term impact on the farming activities.

a) Water quantity

11 out 27 farmers think the water quantity will decrease within the next 15 years. The reasons could be the settlement of more factories upstream and also more users but also simply because of the weather which seems to be drier and drier. According to the President of the WUG there will be less water quantity because of the increase in fish and shrimp production within the tambon and also because of the factories. 10 farmers are positive about the water quantity in the future. Seven of them think the water quantity will increase thanks to Huay Samong Dam so does the president of TAO.

b) Water quality

The farmers are more pessimistic regarding to the quality of water. Indeed, 13 out 27 think the quality will decrease within the next 15 years. The main given reason is the factory and then the chemical use. 8 farmers think the quality will increase. Unfortunately they did not always give the reason. The president of the TAO believes that the quality will improve thanks to the training provided to the farmers unlike the president of WUG who thinks that the quality will get worse because of the fish and shrimp production releasing spoiled water and because of the factories upstream.

c) Salinity

In terms of salinity, 14 farmers are positive about it. The first reason is the dam that will push away the sea water by releasing fresh water during dry season. 7 out 27 farmers think the salinity will increase because it is linked to the lack of water. For the president of TAO, salinity won't be a problem anymore as the quantity will increase. According to the president of WUG, it is the opposite. He thinks it will increase as there will be a lower fresh water level in the river.

d) Farming activity and new generation

Even though some farmers have no idea of what the farming activity will look like within 15 years, some of them tried to think about it.

First, in terms of the farming activity itself, 8 farmers answered the question. The answers are not significant but we can see that there is a trend the farmers think that fish and shrimp production will increase while rice production decrease because of the prices. In a next part, we will assess the difference of profit from rice production and from fish and shrimp business. For the president of the TAO, the rice production will remain the same but as the profit won't be enough the farmer will have to find another occupation in order to get more incomes. The EOA believes that the integrative farming as the King's project suggests it will increase. They also mentioned that the main farming activity will remain rice production but some fish and shrimp production might appear. Not that much though because of the lack of water and investment capacity.

Then, about the number of farmers within 15 years, 15 farmers answered the question. Here are the answers: 11 of them think there will be fewer farmers within the Tambon. This assumption is strongly linked to the involvement of the new generation in the family business. Here, the ideas differ. While the EOA is really optimistic regarding to the new generation, the involvement of new generation is uncertain. Indeed, according the first part about family dynamics, we can see that the new generation studies higher than their parents and only 5 children are actually involved in the family business because the others work elsewhere (company, factory, big cities, public institutions etc.). 9 farmers think that the new generation won't takeover because they are not interested or because they will find another job. Only 6 farmers are sure that their kids or nephews will take over and mainly because some of them are already farmers; 9 of them know that their kids won't take over for the reason explained before while 11 farmers are uncertain, first of all because their kids are too young or still studying.

Chapter 2: Bang Taen

Bang Taen Tambon is located at the extreme west of Prachinburi Province sharing the border with Chachoengsao Province. The river Bang Pakong crosses the Tambon from the North to the south-west. The Tambon is part of the District Ban Sang and is composed by thirteen villages. It is the most downstream of the three Tambon.

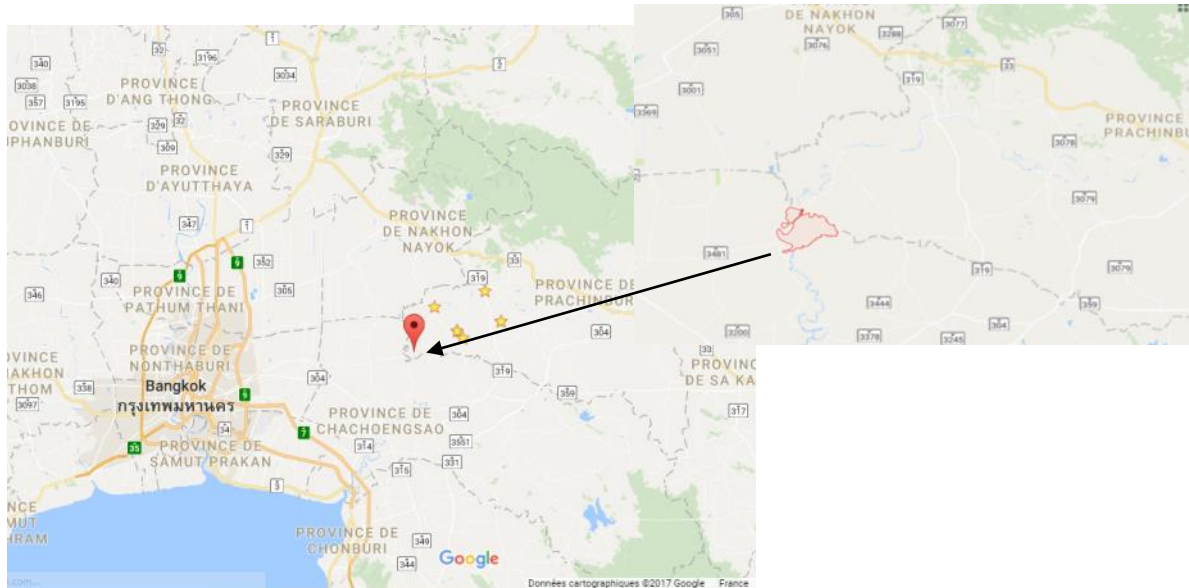


Figure 22: Map location of Bang Taen Tambon – source Googlmads©

The name of the Tambon stands for “the place with hornet”. Indeed, in the past, there were a lot of hornets. A such presence meant that the place had a high ecological diversity. The particularity of the Tambon is that the company Krating Daeng or most known as Red Bull® is installed there and covers about 3000 rai. In the frame of a corporate social responsibility initiative, the company has supported an organic rice group for two years. There is also another factory called Prachinburi glass.

I. Farming typology

1) Farm organization

General data: 27 farms have been interviewed. The total number of farmers living in these farms is 53. The analysis focuses on these 53 farmers.

a) Farmer typology

i. Gender

Among the 53 farmers, there are 25 women versus 28 men. The parity is almost reached.

ii. Number of farmer per farm

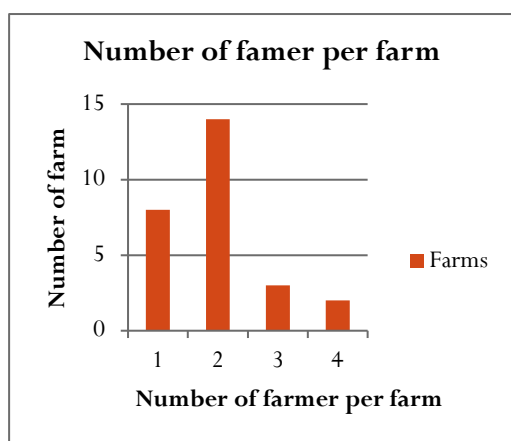


Figure 23: Graph Number of farmer per farm - Bang Taen

The number of farmer per farm varies from one to four. It is about two farmers per farm in average. We do not include here people living in the farm but not involved in the farming activity. Eight farms count only one farmer. These eight farmers are five men and three women. Fourteen farms count two farmers. For 12 of them, these two farmers are husband and wife couples. The two others are a mother-son couple and a father-son couple. Three farms count three farmers. In two cases, they are the married couple and their kid (one daughter and one son). For the last one, the farmer work with his two parents. Eventually, two farms count four farmers. In the first case, the married couple works with the husband's sister and brother. And in the other case the married couple works with the husband's parents. We notice that over the 53 farmers, four children (three sons and one daughter) are involved in the farm. For two of them, it is a full-time occupation while for the two others is a part-time occupation as they have other job. Indeed, the daughter works as TAO officer and the son works in Red Bull Company®.

iii. Age pyramid

The age average for the 27 farms interviewed is 51.2 years old and it goes from 26 to 69 years old. Only eight farmers are under 40. As mentioned before, four children are involved in the farming activity: three of them are 26 and the last one is 30 years old. The age distribution is balanced from 41 to 60 years old for both men and women (16 each group).

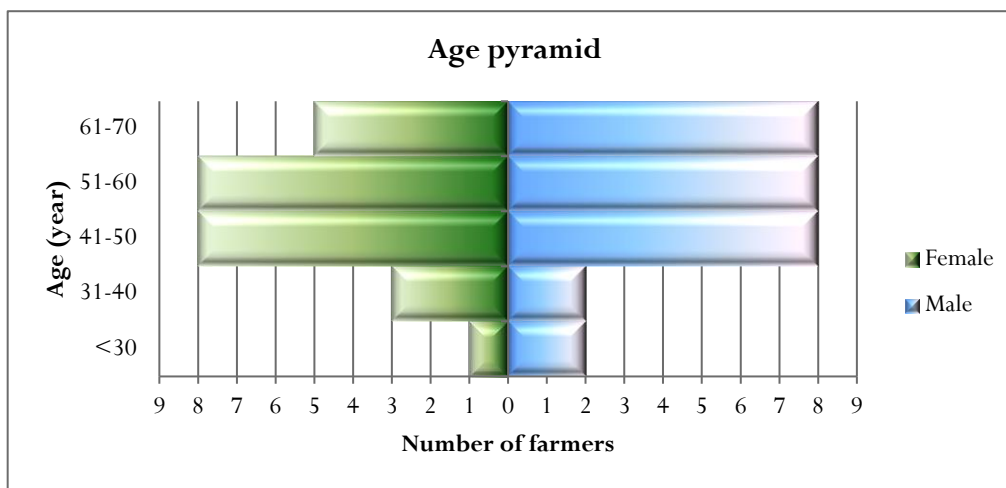


Figure 24: Graph Farmers' Age pyramid - Bang Taen

iv. Education level

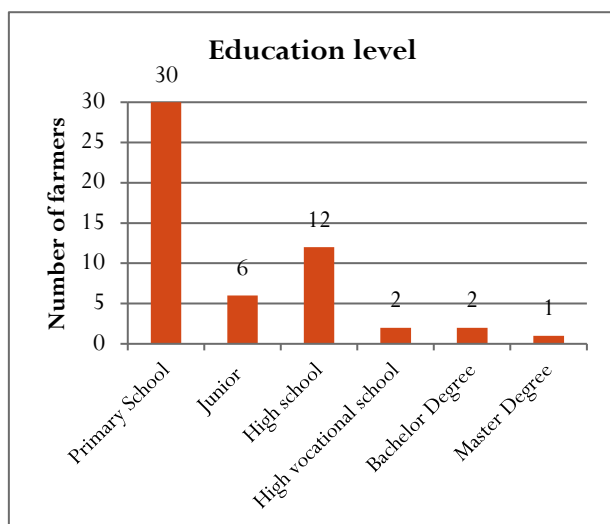


Figure 25: Graph Farmers' Education level - Bang Taen

About 56% of the farmers stopped their studies after primary school. We notice one master degree. It is a farmer's daughter working as TAO officer and Part-time farmer. A farmer got his bachelor degree by following evening classes when he became head of the village. Two others farmers graduated from junior high school followed evening classes and got their high school degree afterwards. They are head or assistant head of village. The other bachelor degree used to work in Red Bull Company® before she inherited land from her parents.

v. Backgrounds

Regarding to the backgrounds of the farmers interviewed, 17 out of 27 have always been farmers working with their parents then inheriting the land from them. 10 out of 27 had other occupation before: eight of them used to work in a factory or a company. One used to be driver and the other one used to be government officer in Bangkok. The reasons why they started farming activity are various. Indeed, four of them gave the family reunion as a reason. The others mentioned health problems (two of them). One of them inherited land from parents and came back to continue the business. The countryside and its better quality of life have been mentioned once as a reason. Indeed, the couple had enough with Bangkok and its polluted air. Eventually, one farmer started farming business because her son wanted her to invest in land and the last one said she used to be farmer with her family a long time ago but after her family sold the land she worked in a company before to start farming again. Five of these ten farmers were already farmers 15 years ago while the other five started farming six years ago in average (between four and eight year ago).

b) Other occupation

Twelve farmers out of 27 interviewed do not have another occupation. Among the fifteen others who have other occupation, four of them are head of village and earn 8000THB/month. One of them is assistant head of village and earns 5000THB/month. There are also three operatives, as we will see in the next part; these farmers have the machines and work for other farmers. Two others are member of the community bank (one president and the other assistant). The last ones have various occupations. Despite the facts that these fifteen farmers have another occupation, their main occupation and incomes remains the farming business.

2) Family Organization

Within the 27 interviews, there are 121 family members including 53 farmers described before. Excluding them, 68 family members live in the farm. There are from two to nine people living in the same house. It is about 4.5 people per house in average.

a) Relationships between the interviewee and the other members (not involved in farm business)

From one to four generations live in the same house. Indeed, in one case out of 27 four generations share the same roof. The relationships are diverse. They are from less than 1 year old up to 95 years old. The average age is 29.

We identify three groups:

- Children under school age: 10 are in this group
- Member from 7 to 40 years old part of the so called “new generation” because they could potentially takeover the farm in the future: 44 out of 68
- Member above 40 years old “ancient generation”: 14 out of 68

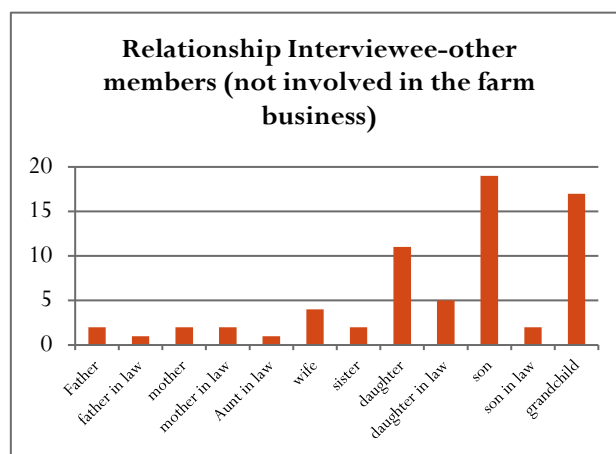


Figure 26: Graph relationship between interviewee and other members - Bang Taen

b) Education level and occupation of other members living in the farm

Here we will develop only for the two last groups mentioned above (new generation and ancient generation). Indeed, it is not relevant to present the ten kids under school age because they do not have any degree or occupation.

i. New generation group

In this group, people are aged from 7 to 40 years old. They could potentially takeover the family business in the future. 44 members are in this group. The average age is 21.8 years old. 21 of them are still studying, including three bachelor degree, thus they are not mentioned in the following graph which presents the occupation according to degree.

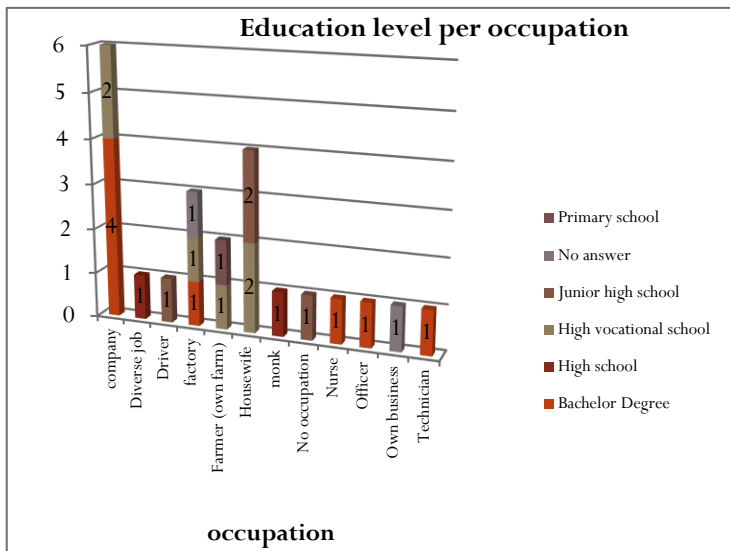


Figure 27: Graph New generation's Education level per occupation - Bang Taen

For the 23 other members, 14 of them got a degree higher than high school (8 Bachelor degree and 6 High vocational school degree). Two got a high school degree and four a junior high school degree. Eventually, one stopped school after primary school. She is farmer in her own farm. For the other, the occupations are various. Indeed, 9 of them work either in a factory or company. We notice four members out 44 are housewives. We can also observe that two members are farmers but on their own farm. In this case it is a couple (son and daughter in law) working on the daughter in law's land.

ii. Third group: ancient generation group

This group gathers fourteen family members from 41 to 95 years old. The age average is 72.1 years old. Ten of them graduated from Primary school. One stopped school after Junior high school and only one got a high school degree. For the last two, we do not have the answer. Eight of them are retired. There are four housewives. And the last two run a food shop.

We observe that the education level of the new generation group is higher than the education level of this group.

Most of these occupation incomes will contribute to the living costs of the family. In some of the cases, these additional incomes might help to face the low profit from farming activity (to be developed in the next part).

c) Family member who live outside the house

In our sample of Bang Taen, 15 family members live outside the farm. They are only children of the interviewee. Seven of them work either in a company or in a factory. Three of them are still students. Two others are farmers but in their own farm.

3) Land management

a) Land area

According to the interview, the average size of land is 54.8 rai per farm (red line in the graph). The total interviewed farm area is 1478.75 rai including 425 rai of land outside Bang Taen (rice production only).

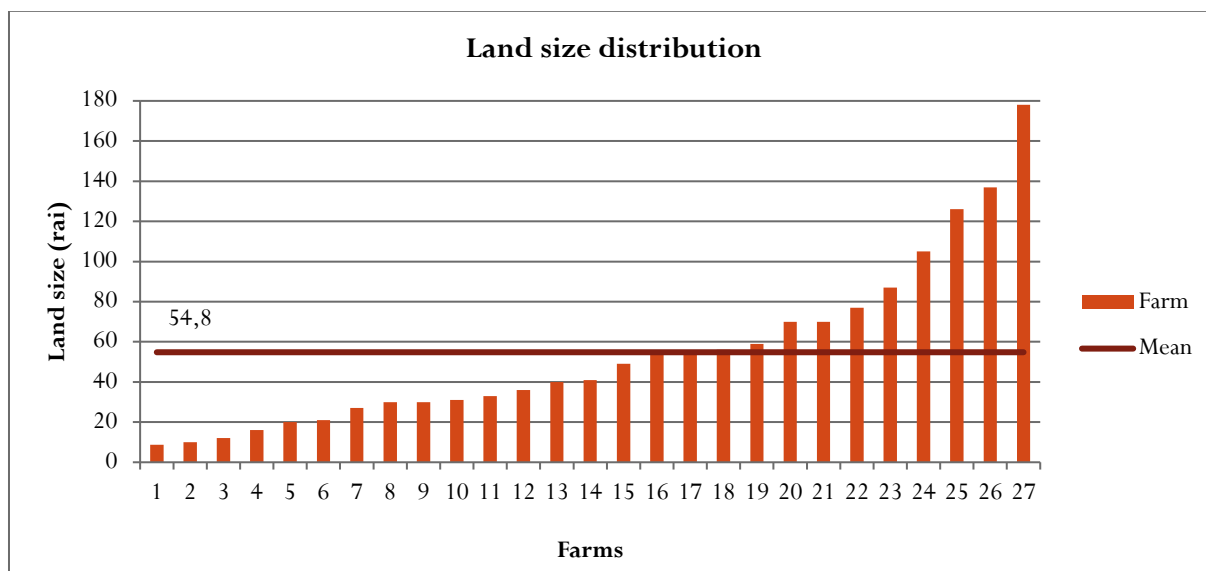


Figure 28: Graph Land size distribution - Bang Taen

The land occupation is mainly rice production (about 800 rai) but there are also about 200 rai for pond (fish and shrimp) production. According to the President of the TAO, the total area within the Tambon is 30 000 rai for an agricultural purpose. Including 24 000 rai of rice production and 1000 rai of fish and shrimp production (15-20 farms) and 2000 rai of Orchard (40-50 farms). These productions will be developed in the Part II.

b) Land status

This study highlights different types of farm regarding to the land status. Indeed, three cases are noticeable:

- Ownership (100%)
- Leasing (100%)
- Mixed

The total owned area is 662.75 rai versus 816 rented rai.

According to this graph, in six farms the land is 100% owned. The areas vary from 10 to 87 rai for a total of 195.75 rai and an average about 32 rai. In another hand, only

three farms are concerned by a land rented at 100%. For these three farms, the size varies

from 16 to 70 for a total area of 122 rai with an average about 40 rai. Eventually, we notice that 67% of the farms (18 out 27) have a mixed status. These farms represent a total size of 1161 rai.

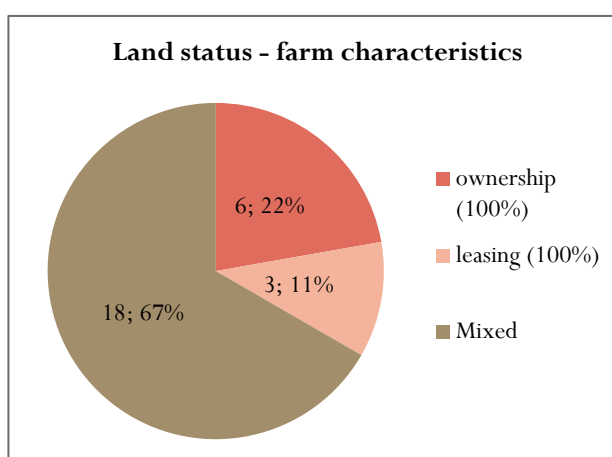


Figure 29: Graph Land status - Bang Taen

The rate owned/rented varies from a farm to another (see the graph n° “land status per farm”). However, for this category we can observe that for 11 farms the rented area is bigger than the owned one.

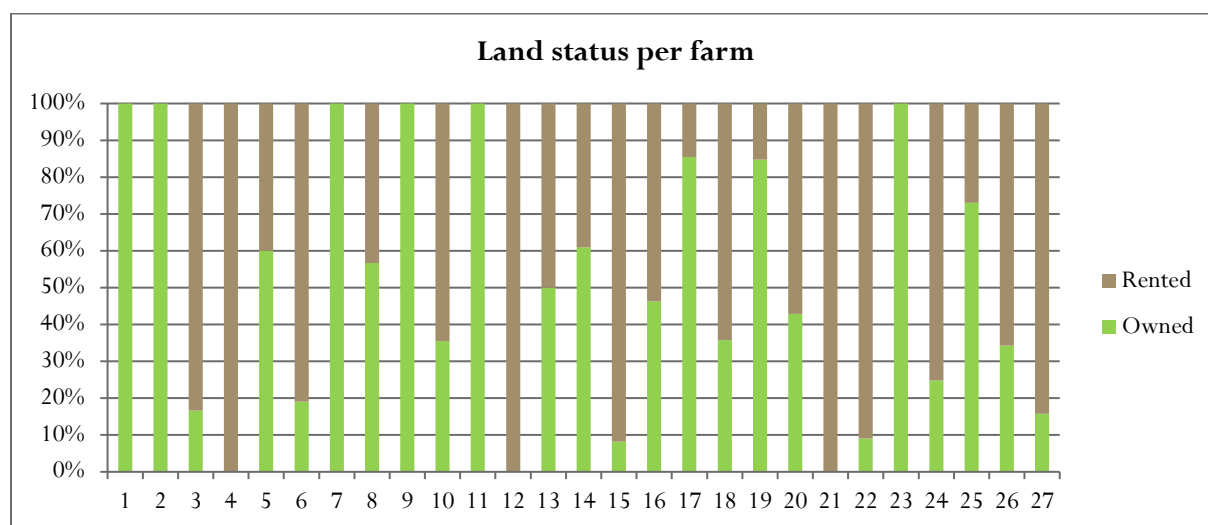


Figure 30: Graph Land Status per farm

c) Owner of the rented land and renting rate

For the 24 rented land cases, the owners of the land are various. Indeed, for 8 of them, the owner is not related to the farmer (other farmers or someone living somewhere else). In 7 out of 24 of the cases, the owner is a family member. And in five other cases, the owner is a farmer's friend or acquaintance. In three cases, Red Bull® is owner. In these cases the renting rate is quite low: 600THB/rai/year. In the other cases the rate varies from 1000 to 2000THB/rai/year.

Four of the interviewed farmers actually rent out the land to their family members. But in three cases, they rent the land for free. And in one case, the farmer rents out for 3000THB/rai/year.

4) Evolution over the past 15 years

The main change mentioned by the 27 farmers is hiring more labor for 10 of them. And seven farmers have expanded the size of their land in order to get more incomes. Few other changes have been mentioned during the interviews. For those who have not been always farmers, we can assume the farm manager shifted (10 out of 27 farmers).

II. Farming activity

1) Typology

Within the Tambon as mentioned above, the total farming area is 30 000 rai including 80% of rice production. 20% include fish and shrimp production (1000 rai; 15 – 20 farms) and orchard production (2000 rai, 40-50 farms).

In our study, the total size of production the 27 farms is 1456.75 rai including 451 rai outside Bang Taen concerning 8 farms. The rice production is the main production 1284.75 rai including 833.75 rai in Bang Taen Tambon. This production is divided in two productions: traditional rice (or normal rice in opposition to the organic one) and organic rice but most of the production remains traditional. The organic rice production has been introduced within the area thanks to the support of Red Bull Company® (see next section). The organic rice production represents 310 rai in total which is about 1.3% of the total rice area (24 000 rai) according to the president of the TAO. In our interviews, the organic rice production represents 174.75 rai and 17 farms versus 659 rai of traditional rice. Among the farmers, 16 of them are members of the organic group while one does organic rice on his own. Most of the farmers introduced organic rice two years ago in order to reduce the costs of production and for a health concern (no use of chemicals).

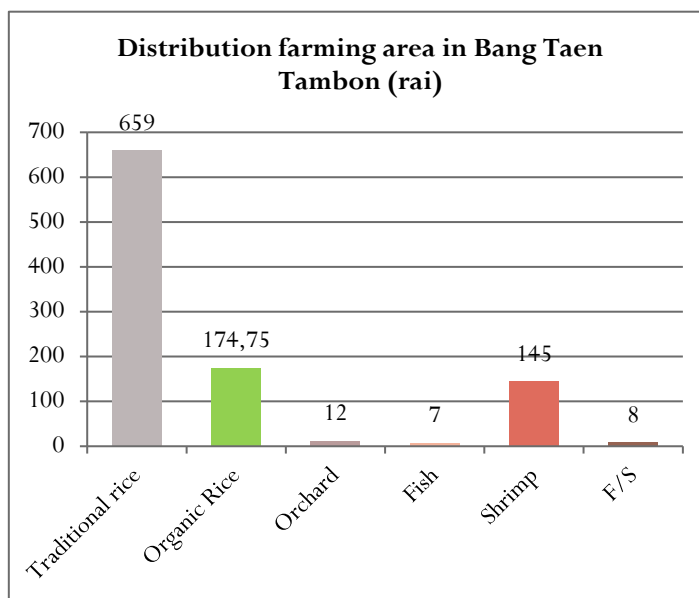


Figure 31: Graph Farming Activities - Bang Taen

The shrimp ponds cover 153 rai including 8 rai of mixed production (F/S: fish and shrimp) and are produced by 10 farms. One farm produces fish for commercial purpose and she has ponds on an area of 7 rai. All these farm produce also rice (see next paragraph) and for 2 of them they produce mixed rice (traditional and organic) otherwise the 8 others produce traditional rice. Eventually, one farm produces orchard (12 rai) besides the rice production (75 rai).

As regard to the graph, all the farms produce rice even though they produce other farming products. And the rice production is the main production in term of size.

However, it is important to mention that three farms produce in Bang Taen only shrimp, producing rice in other province. These farms represent 88 rai of pond within the Tambon area and 150 rai of rice

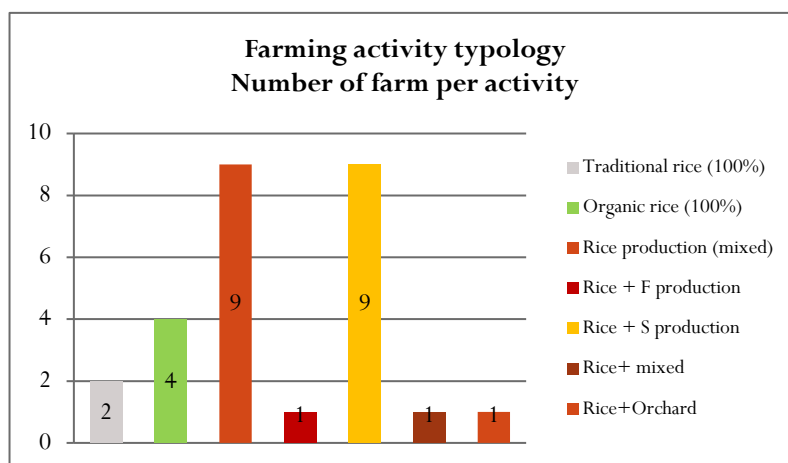


Figure 32: Graph Farming Typology - Bang Taen

outside Bang Taen. In total, 15 farms produce only rice (521.75 rai including 456.75 rai in Bang Taen). Among these farms, four farms produce only organic rice (74.75 rai in total) and two which produce traditional rice only (61 rai in total). However, one farm produces only organic rice but produces also fish; in total 5 farms have 100% organic rice.

2) Red Bull company® policy

a) History

As part of its corporate social responsibility policy (CSR), Red Bull® conducts food safety program at national level. Located in Bang Taen Tambon, Red Bull® started in 2015 CSR policy within the Tambon area. In order to implement a project they focused on a pre-existing group: Sajja Group. This group, the community bank group, mainly compound by farmers, is quite important and influent within the area. Thus, Red Bull® contacted the president of Sajja Group. Then Red Bull® staffs participated at a monthly group meeting in order to discuss with the farmers how Red Bull® could support them. Eventually, they decided to focus on organic rice production and 14 farmers signed up. They were brought to Yasathorn Province where it is 100% organic in order to get knowledge about the production but also to learn how to produce their own bio fertilizers. However, Red Bull® told them the group was not big enough. In order to make it bigger, Red Bull® organized a meeting with the TAO and head of the villages (13) each followed by five farmers. In total about 80 farmers were gathered by the TAO. After being explained the project, 19 more farmers signed up. Thus, in early 2015, 33 farmers had signed up. Currently, there are 29 members. The total area is 310 rai.



Figure 33: Picture of Red Bull Company® Entrance - Bang Taen

b) Organization

The project is conducted during 5 years during which Red Bull® supports the group with financial support and outlet support. Indeed, Red Bull® will eventually buy the rice from the farmers (1T/month from June to December). But during the first two years, as the land has been still in transition, Red Bull® gave to the group 320 000THB each year. This money was used by the group to buy the equipment to process the rice and also to buy the rice from the farmer. The group gathers before each crop and discusses about the price and the quantity of rice they can buy and process as noodle. Usually the price is higher than the traditional market one. However, as we will see not all the production can be bought by the group, thus some farmers have to sell their production through

the traditional outlet (Middleman or rice mill). The group processes the rice as a noodle (1 kg of rice can produce 2 kg of noodles) that it sells every Monday at Sajja group. They sell 80 kg/month and sell the noodles 35THB/kg. After reducing the costs of production (maintenance, materials, wages, rice bought) the group earns 600 THB per month. Besides this support, Red Bull pays 500THB/rai/ crop to every member of the group in order to help them face the transition period in case of lower yield.

3) Rice production: comparison traditional and organic rice

This section refers to the table 2. See above.

For all the interviewed farms, the crops correspond to the calendar of RS and DS. However, one farmer does not a second crop because according to him the price of rice is too low and he focuses on his shrimp farm anyway.

Unfortunately, not much information has been collected according to the varieties because they change frequently. However, this “type” calendar is variable. Indeed, two main factors determine it: water supply and variety length. The first one, water, is required at the planting stage and will determine the beginning of the crop (especially important for the rainy season crop as the crop starts at the end of the dry season, at that period water quantity is variable). Then, in function of the planting date, the farmer will choose the variety according to its length. Indeed, the farmer must take into account the two critical period of the year: salinity (from March to May) and flood (September). Most of rice varieties used in Bang Taen last 90 days. Indeed, the farmers start the production in May or June if the water quantity and if the salinity issue is over in order to harvest before the flood which could impact the production so the price of rice because of the high level of moisture.

All these decisions will also depend on the location: facing flood, lack of water and salinity or not. It will lead to a loss in the production. As example of varieties, an interviewed farmer mentioned the variety Khorkhor-51 which is a 90 days variety used during the rainy season in order to harvest on time and khorkhor-49 which is a 100 days-variety used during dry season. Another farmer mentioned that she uses jasmine rice as organic rice.

a) Costs of production

Three categories of costs of production have been identified. First, the main cost of production is labor costs as developed below. Then the inputs are other important costs of production (chemicals, seeds etc.). Eventually, the costs dedicated to water pumping (gas and maintenance).

i. Labor – outsourcing

According to the interviews, hiring labor is a common practice in the cultivation of rice and this at every stages of the production:

- Plowing (preparing the soil for the next crop)
- Sowing
- Spraying chemicals (only for traditional, not organic rice)
- Spraying fertilizers
- Harvesting

However it is important to distinguish two categories of labor. On one hand, the labor is a person or a group of persons hired by the farmer to realize the stages of sowing, spraying chemicals and fertilizers either manually or with a spray machine. For each stage the persons might change, it

depends on the availability of the group within the area. On the other hand, the labor in charge of the plowing and harvesting, stages requiring tractor or machines will be called an operator and this person is hired because the farmer doesn't own the adapted machine.

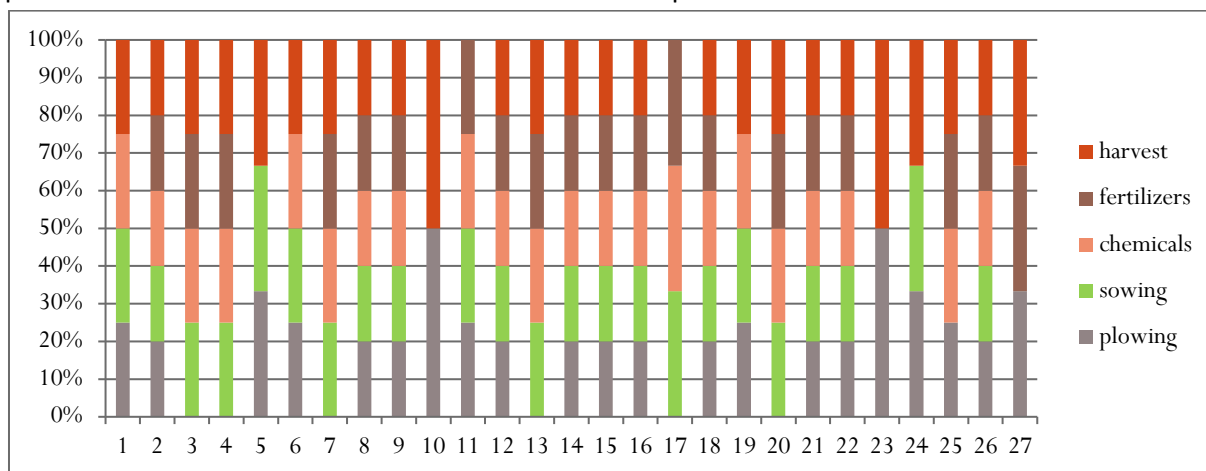


Figure 34: Graph labor or operative per farm - Bang Taen

The plowing stage may require one or two rounds depending on the quality of the soil. The tiller is used if the soil is soft and for a superficial plowing. While the motorized tractor is used for a deeper plowing and in case the ground is very dry. As the graph shows, 21 farmers out of 27 hire labor for plowing. Among them, five farmers do not have any machine so they have to hire an operative. 15 of them have only a tiller and even though they use it for the first round they usually need to hire for a second one. One farmer owns the tractor but as his land area is too large (160 rai) he must hire because cannot do everything by himself. Among the farmer hiring labor for plowing, two farmers actually do it for their traditional rice but not for their organic rice as the area is small (6 and 12 rai). The six farmers who do not hire labor for plowing own the tractor. The prices vary from 150 to 230 THB/rai but can be up to 500THB/rai according to the soil status. In some cases the farmer must pay the gas apart or it is already included in the price.



Figure 35: Picture of field after plowing May 2017 - Bang Taen

Then we can observe that 25 out of 27 farmers hire an operator for the harvesting for the reason that they do not own the harvest machine. The two other farmers have possessed their machines for 20 years already. They also work for other farmers as an operator. One of them owns four harvest machines and hires three labors to drive them. He works in Prachinburi Province but also in the surrounding provinces.



Figure 36: Picture of labor working in the field June 2017 - Bang Taen

For the three other stages (sowing, spraying chemicals, fertilizers), we notice that 18 farmers out of 27 hire labor for the three stages. However, 11 of them produce

also organic rice and thus they do not hire labor for this part of the land as chemicals are forbidden in organic production. We can also observe that two farmers do not hire labor for none of these stages. However it is important to notify that these two farmers produce organic rice only thus they cannot hire labor for spraying chemicals. Besides these two farmers, three farmers do not hire for spraying chemicals for the same reason that they are 100% organic or that they do not want to use chemicals for their traditional rice (1 farmer because he plans to convert 100% organic in the future). The four last farmers hire labor for sowing and spraying chemicals (3 of them) and one only for spraying chemicals and fertilizers. Looking at the data, 25 farmers out of 27 hire labor with various ages from 39 to 65 and size of land per farmer from 5 to 68 rai, thus we cannot assume these elements are the main explaining factor of outsourcing. The two farmers who do not hire labor, first as mentioned they produce organic rice only and also because their lands are small: 8.75 and 10 rai.

Nevertheless we can assess the evolution of hiring labor over the past 15 years: have the farmers always hired labor? Among the 25 farmers who currently hire labor, 12 of them have always hired labor. They gave different reasons such as they have other occupations (3/12) or because they are concerned by their health and they do not want to apply chemicals themselves (3/12): “I do not apply chemicals

myself because it is dangerous” said one of the farmers. Then 13 farmers have not always hired labor about 9 years ago in average. The main reason they gave (6/13) is because they were ageing. Indeed, five of these six farmers were older than 50 years when they started). Land expansion was a reason for two of them. Indeed they increased the size of their land from 16 to 87 rai for one within 15 years and from 85 to 124 rai within six years for the other. Regarding to this analysis we can notice that age and size are the main reasons which explain that the farmers started hiring labor.

In terms of costs, the labor is paid 70THB/rai for each stage. It depends on the area not on the tasks or the time.



Figure 37: Picture of a Chemicals spraying machine - Bang Taen

ii. Inputs

This part gathers the costs of the farming inputs such as seeds, chemicals and fertilizers products but also the water pumping costs (gas or electricity). But first, we assessed the difference of costs of production between organic and traditional rice. For the traditional rice the figures correspond to 11 farms' data. Indeed, in terms of costs of production unfortunately not all the traditional rice farmers with their land in Bang Taen were able to give us complete information (11 out 20).

	chemicals inputs	fertilizer inputs	seeds cost	plowing	harvest	sowing labor	chemicals labor	Water pump labor	fertilizers labor	truck
	15%	22%	10%	12%	19%	4%	4%	10%	3%	1%
Mean (THB)	297.86	487.72	274.90	240.36	414.20	72.03	80.11	256.97	64.57	134.31
Standard deviation	197.31	371.05	202.58	119.22	51.16	10.42	47.48	263.93	12.97	8.93

Table 3: Average costs of production per inputs – normal rice – Bang Taen

The above table presents the average cost per category per rai and per crop. If we put aside the costs of truck as it concerns only two farmers, the average cost of production 2188.71 THB/rai/crop. Nevertheless, must be added the renting rate about 500THB/rai/crop when a farmer rents in. As we can observe on the table, the main part of the costs of production is the chemicals and fertilizers inputs. The totals inputs (seeds, chemicals and fertilizers) represent about 40% for 785 THB/rai/crop for chemicals and fertilizers products in average. For the seeds, the costs are unstable because either the farmer re-uses the seed year by year or s/he buys new one. The labor costs (sowing and spraying) are not the most important. Indeed, they represent less than 11% all together.

On another hand, for the organic rice production the figures correspond to all the organic farmers. However, data about water pumping costs are missing but the average costs are 132 THB/rai/crop.

	Plowing	Sowing labor	Sowing costs	Fertilizers labor	fertilizers costs	Harvesting labor	water pumping costs	truck
pourcentage	13%	5%	31%	1%	9%	35%	5%	1%
Mean (THB)	164.93	9000	818.14	55.00	317.40	372.94	132.14	80.67
Standard deviation	66.18	69.71	1021.45	21.21	386.66	82.44	106.12	8.14

Table 4: Average costs of production per inputs - organic rice - Bang Taen

As for the traditional rice, if we put aside the truck costs but also the fertilizers costs which are not used by a majority of farmers (6 out 17), the average cost of production is 1578 THB/rai/crop. The renting rate must be added when it is needed about 500 THB/rai/crop. The main saving is made on the chemicals products as they are not used in organic production and as the fertilizers become bio fertilizer in organic production (made with natural products).

b) Incomes and outlets

The incomes are a blend of two elements: yield (Tone/rai) and prices. The yield is function of many elements such as soil quality, water management (quantity, quality), rice variety, crop that cannot be directly assessed here. However, the price of rice, besides the general market influence, depends on two main factors: the quality of the production and the outlet.

i. Traditional rice

For our study in Bang Taen, the figures rest on 18 farms' data, these farms produce two traditional rice crops. The yields during the rainy season vary from 390 kg/rai to 990 kg/rai. The average yield is 753 kg/rai. The dry season yields are not that much different they range from 380 kg/rai to 990 kg/rai and the average is 754 kg/rai.

The main outlet is the middleman (13 out 18) and only four farmers bring their production directly to the rice mill. The last farmer uses both outlets. From the prices data we cannot notice a difference between middleman and rice mill prices because as mentioned the price depends also on the quality of the rice. On one hand, for the rainy season crop, the prices range from 6300 THB/T to 7200 THB/T. the average price is 6670 THB/T. On the other hand, for the dry season crop, the prices range from 5800 THB/T to 7400 THB/T and 6690 THB/T in average. Even though we do not see a significant difference between both crops, we observe that the prices amplitude is higher for the dry season crop. The farmers are unsatisfied of the rice price which is too low according to them. One farmer said "One year you may have a good production but bad prices and another year you may have a good market price but a bad production". In average, the income per crop is 5166 THB/rai. **The profit would be about 2977 THB/rai/crop** but the renting rate must be added in case of renting in.

ii. Organic rice

The figures are based on the 17 organic rice farmers of the study. They all started organic rice production in 2015 and produce two crops per year. As the land is still in transition, the yields are lower than the traditional rice production. Indeed, for the rainy season the yields range from 80 kg/rai to 800 kg/T and vary between 140 kg/rai and 800 kg/rai for the dry season crop. The average yield for both crops is 450 kg/rai. Three farmers out 17 do not sell their production; they keep it entirely for the household consumption. Seven other farmers keep a part of the production which represents a total of 14 T/year. In total, the organic rice production was 170,6T the last two crops. And the quantity sold was 147.8 T. The organic rice is mainly sold to the organic group (52.8 T). The prices vary from 6200 to 10 000



Figure 38: Picture of a couple of farmers with their organic rice - Bang Taen

THB/T. The average price is 7910 THB/T. The second outlet is the middleman. The organic rice is sold at the same time as the traditional rice and the price does not change. Thus, there is no improvement of the price even though the rice is organic. The prices range from 6500 to 8200 THB/T and the average is 7080 THB/T. Then two farmers sell the rice to rice mill at 6700 THB/T in average. Eventually, one of the farmers packs his rice (picture) after milling it at the community rice mill and sells it to a center in Prachinburi city. He sells his product 90 THB/kg which is 9 times higher than the best price proposed by the group. His product is certified OTOP 5 stars-free chemicals. **The average income per crop is 3847.6 THB/rai.** It is important to remind that Red Bull® supports the farmers with 500 THB/rai/crop during 5 years. That is to say these 500 THB/rai must be added to the incomes of the 16 farmers who are members of the group. So their total incomes are **in average 4347.6 THB/rai/crop**. Only one farmer is not member as he found another way to sell his product. **The profit would be about 2800 THB/rai/crop** but the renting costs must be reduced from this profit in case of renting in.

There is no a big difference between the profit made from organic and traditional rice. We can assume the organic rice is not valorized enough. And even though the prices are higher the production is very low so it might explain the small gap. This might be because there is no certification yet which justify the organic production. Also; the president of the group mention that they bought 22T of organic rice from the farmer while according to what the farmers told 55,8T were sold to the group last year.

4) Fish and Shrimp Production

In Bang Taen, nine farmers produce shrimp besides rice production. Their farms cover 145 rai of pond divided in 31 rai of storage and 114 rai of actual production. However, only four farmers have storage pond. In total these farms have 36 ponds. One farmer produce fish (a 7 rai pond) and one farmer produce fish and shrimp in the same pond (8 rai), besides rice production as well.



Figure 39: Picture of a shrimp pond - Bang Taen

a) Species

For the fish producers, only one farmer gave detail about species. He raises Tilapia. In terms of shrimps, three main species are raised. The main one is Vannamei (white leg shrimp) which is raised by the 10 farmers. Then for the nine producers of shrimps only, they mix Vannamei either with giant tiger prawn (3 farmers) or a Thai shrimp species (6 farmers). For the fish and shrimp producer he only raises Vannamei which are mixed with Tilapia and various other fishes.

The number of shrimp or fish raised per rai and per cycle varies from a farm to another. Indeed, for the Vannamei/ giant tiger prawn farms the average number of Vannamei is 65 000/rai/cycle (it ranges from 35 000 to 100 000/rai/cycle) and the average number of giant tiger prawn is 15 kg/rai/cycle (from 10 to 20 kg/rai/cycle).



Figure 41: Picture of Vannamei shrimp – source <http://www.7siusa.com/products/vannamei-shrimp/>



Photo: Graham Cumming Courtesy of Dreamfish.com.au

Figure 40: Picture of Giant tiger prawn - source Picture of Vannamei shrimp – source <http://www.7siusa.com/products/GTP-shrimp/>

Then, for the Vannamei/ Thai shrimp farms the average number of Vannamei is 28 500/rai/cycle (from 22 000 to 42 000/rai/cycle) and the medium number of Thai shrimp is 10 554 (from 1875 to 13 750/rai/cycle). For the fish and shrimp farm the number of Vannamei is 50000/rai/cycle and the number of Tilapia is 5000/rai/cycle.

b) Schedule

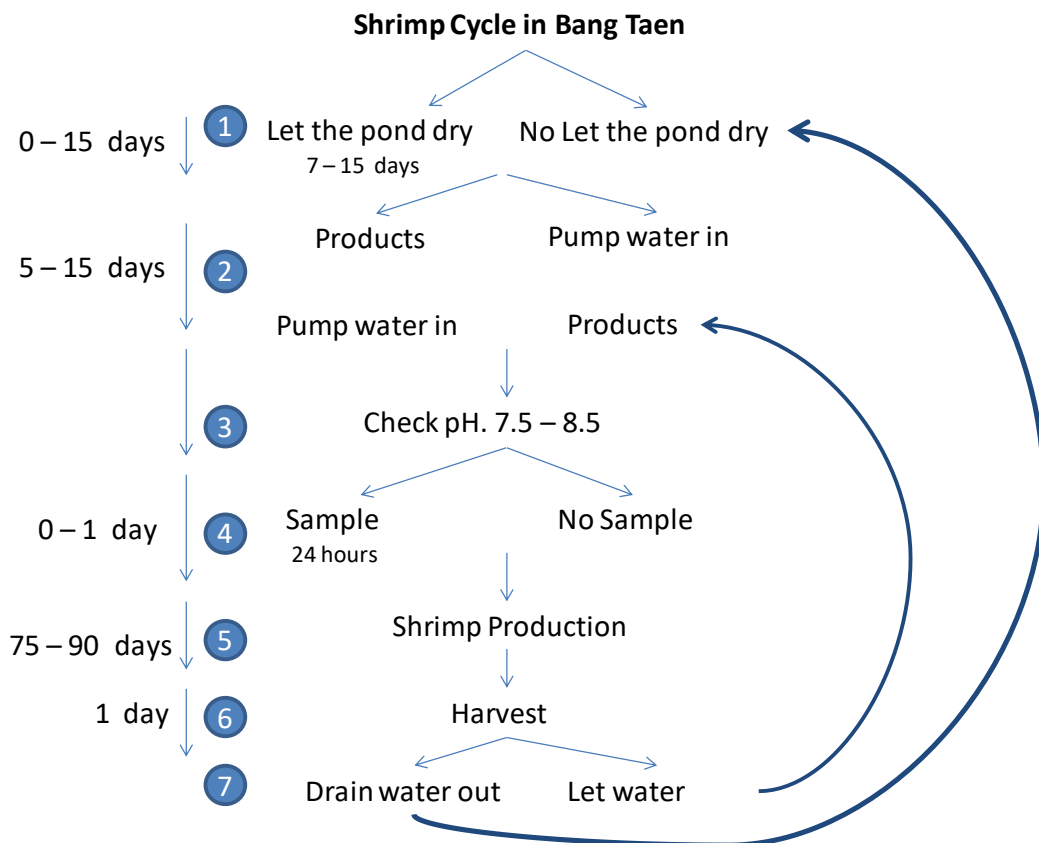


Figure 42: Shrimp cycle - Bang Taen

The above cycle shows the shrimp cycle used by the six farmers in Bang Taen. The last three did not give the cycle in details enough. There are seven different stages. Some of them can be skipped. The first step is the preparation of the pond. This starts by either letting the pond dry or not. In our study, the farmers let the pond dry between seven and fifteen days. The farmer is able to clean the bottom of the pond (remaining shells, dead shrimp) otherwise s/he may go for the next step.

Then s/he has two options. Indeed, s/he can first pump in water and add products or do it in the other way around. Adding the products requires a dry pond and it is more tiring but the application is more accurate. Indeed, as the products are white it is easy to see where it has been applied. While pumping water in first, it is easier to apply the products (the farmer uses the “boat” as the picture shows) to spray the products but it is less accurate. The products used are mainly lime but also calcium and dolomite. They help to control the pH. This step



Figure 43: Picture of a boat used to apply lime in the pond - Bang Pla Ra

lasts between five and fifteen days in our study case. Two farmers add salted water which improved the development of the shrimps according to them.

Then the farmer checks the pH which must range from 7.5 to 8.5 and if it does not the farmer can adjust by adding more products. After obtaining a stable pH, the farmer can test the water quality with a sample of shrimp during 24 hours (five farmers out six).

The next step is the production strictly speaking. The farmers raise the shrimp between 2.5 and 3 months in order to harvest big enough shrimp.

The harvest consists in installing net in the pond equipped with a light. At night, the lights are on; the shrimps are attracted by the light and got trapped into the net. The net are called “ngo” which stands for “stupid” such as the shrimps which get easily trapped according to the farmers. After harvesting, the farmer either drains out water and starts a cycle again or lets water in and add directly the products if needed. In our study, the farmers raise either three cycles per year (8/9 farmers) or two cycles (1 farmer). In this case the farmer prefers let the pond dry during more than two months to clean it properly.

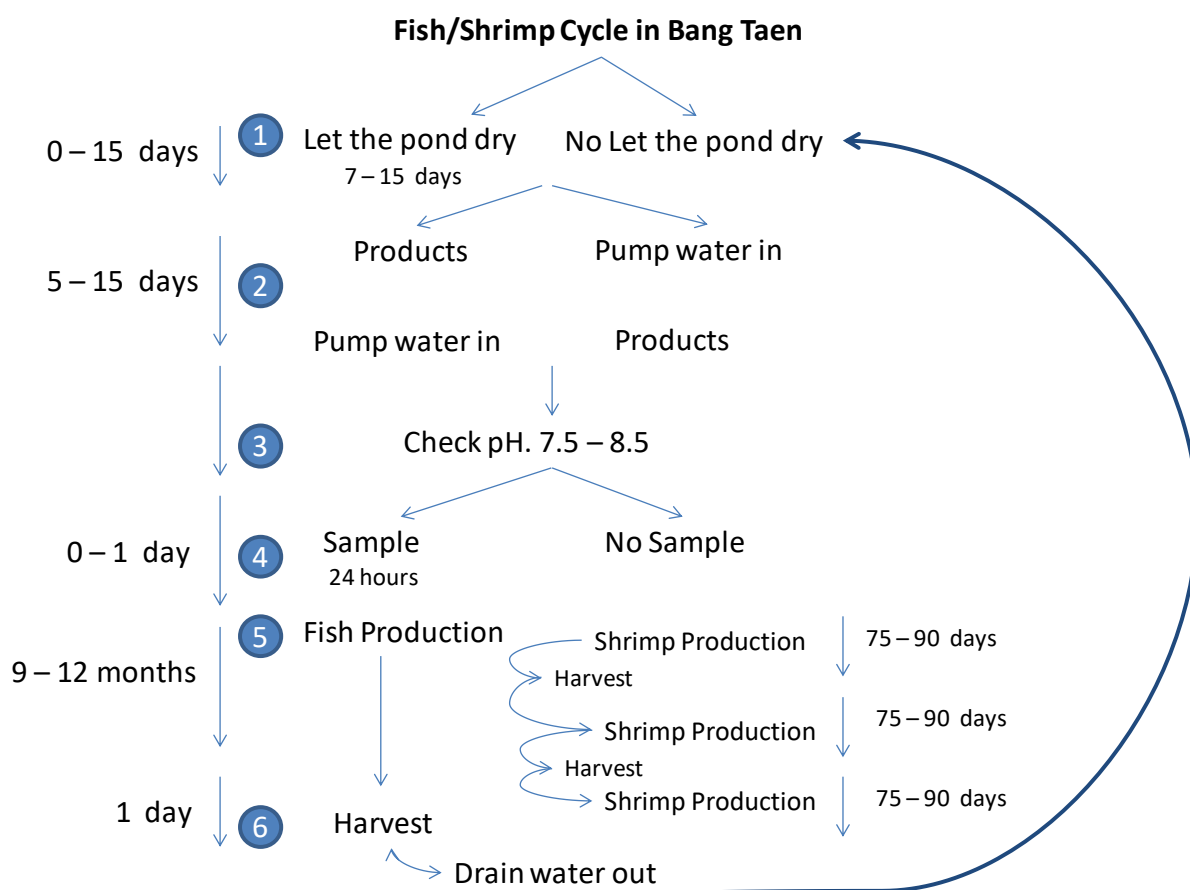


Figure 44: Fish and shrimp cycle - Bang Taen

The fish/shrimp cycle is quite similar to the shrimp one. Indeed, the first four steps are identical. Then the fish production lasts between 9 and 12 months. During that time, the farmer raise three shrimp cycle. He harvests every 75-90 days. Once he has harvested, he adds directly the second or the third cycle. Eventually the fishes are harvested and at the same time water is drained out. Then the farmer chooses to add water directly or to let the pond dry.



Figure 45: Picture of oxygen paddle - Bang Taen

In order to maintain a good level of oxygen inside the pond, some farmers use oxygen paddle (picture).

c) Costs of production

i. Labor – outsourcing

In our study, the labor hired in shrimp production is mainly the labor to harvest the shrimps because the farmers may not have the adapted nets. 8 out 9 shrimp farmers hire labor to harvest the shrimp. The last shrimp farmer has the tools so does the fish and shrimp farmer. The cost of the labor depends on the quantity of shrimp. It is usually 100 THB/ kg but if the weight is lower than 100 kg the farmer must pay between 800 and 1000 THB no matter the weight between 0 and 100 kg. The prices are set up by the labor. Then, only one farmer hires labor to give food to the shrimp because he gets old. The fish and shrimp farmer hires labor the day of the harvest in order to drain out water.

ii. Inputs

The inputs in fish and shrimp farming are divided in five main categories:

- Energy costs (water pumping and oxygen paddle gas or electricity)
- Food
- Products
- Animals
- Labor

	Water pumping costs	Oxygen paddle	food	product	Salted water	Harvesting labor	Labor (others)	Animals
Pourcentage	7%	2%	43%	2%	0%	2%	1%	41%
Mean	1780.13	928.76	10201	830.2	910	507.75	2250	4306
Standard deviation	2340.66	331.91	3973.12	546.57		228.49		6498

Table 5: Costs of production per inputs - shrimp farming - Bang Taen

For the nine shrimp farms, in order to calculate the average costs of production, the costs for salted water and labor (other) must not be taken into account as they concern only one farm. The average cost of production is 18553.84 THB/rai/cycle and it ranges from 11 020 to 33 045 THB/rai/cycle. The main cost of production is the food costs, then the animals. The cost of food is 10 201 THB/rai/cycle in average and it ranges from 5000 to 18 200 THB/rai/cycle. The average price of Vannamei is 0.09 THB/unit. They range from 0.04 to 0.17 THB/unit. The Giant tiger prawn price is about 200 THB/kg and the average price of Thai shrimp is 0.14 and they range from 0.10 to 0.27 THB/unit.

The fish farm the total cost of production for one fish cycle is 5000 THB/rai and for the fish and shrimp farm the total cost of production is 28 000 THB/rai/cycle. The price of Tilapia is 0.4 THB/unit.

d) Incomes and outlets

The outlet for both shrimp and fish production is the middleman who collects the shrimp and the fish at the farm. Except for the fish and shrimp producer, he brings the shrimp directly to the shrimp market in Ban Sang.

The prices depend on the size of the animals. According to one farmer if a kg contains 80-90 shrimps it means the size of shrimp is satisfying while one kg containing more than 100 kg of shrimp means that the shrimps are too small and it will impact the price. Unfortunately for our study in Bang Taen, the data regarding to the unit price are not detailed enough. However, for the shrimp production farms the average income is 31 670 THB/rai/cycle ranging from 18 300 to 45 450 THB/rai/cycle. **The profit would be 13 116 THB/rai/cycle.** For the fish and shrimp farm the total income is 39 700 THB/rai/fish-cycle. **The profit is about 10 000 THB/rai/cycle in average for both shrimp and fish production.**

According to the farmers, producing shrimp and fish increase the total incomes of the farmer while the rice production incomes are low.

5) Other production

As précised by the president of the TAO, there is about 2000 rai of orchard within the Tambon. One of the farmer produce lemon on 12 rai in order to get more incomes. Some other farmers produces orchard on the pond dyke in order to optimize the land. However these productions are marginal because the products are mainly consumed within the family and relative circle. In total five farmers mentioned producing orchard for a commercial purpose and the average incomes is 60 000 THB/year.

6) Evolution over the past 15 years

According to the president of the TAO, the main change over the past 15 years has been the decrease in fish and shrimp production. Indeed, shrimp production has decreased from 55000rai to 1000 rai because of the market prices and diseases. And the fish production has decreased from 450 rai to 100 rai because of the prices. However, in our 12 farms producing fish or/and shrimp, four of them introduced the production in the past 15 years. Only one farmer told that he tried shrimp before but because of the disease they shifted for rice production before to start shrimp production again two years ago. Six farmers out nine shrimp producers started shrimp production about 20 years ago because the price of rice was too low and they used to raise only giant tiger prawn. However, after a few years giant tiger prawns die more and more from disease. The farmers shifted for Vannamei and mixed them with Thai shrimp. According to them, since they started mixing the shrimp die less.

The other main change within the Tambon area is the introduction of organic rice production boosted by Red Bull Company® in 2015. This production will be developed in the next section.

Within the Ban Sang district, 73 farmers signed up for the program SMART FARMERS. They are provided three training per months with Extension office of agriculture officers. They are taught

to produce their own compost and to catch the insects in the fields. There is one experimental paddy field where they can practice. One of the farmers interviewed is the president of the group.

III. Water management

1) Presentation

As mentioned in introduction, Bang Taen Tambon is located in the Prachinburi downstream part of the Bang Pakong River. As the map shows, the Bang Pakong river crosses the Tambon at its western part.

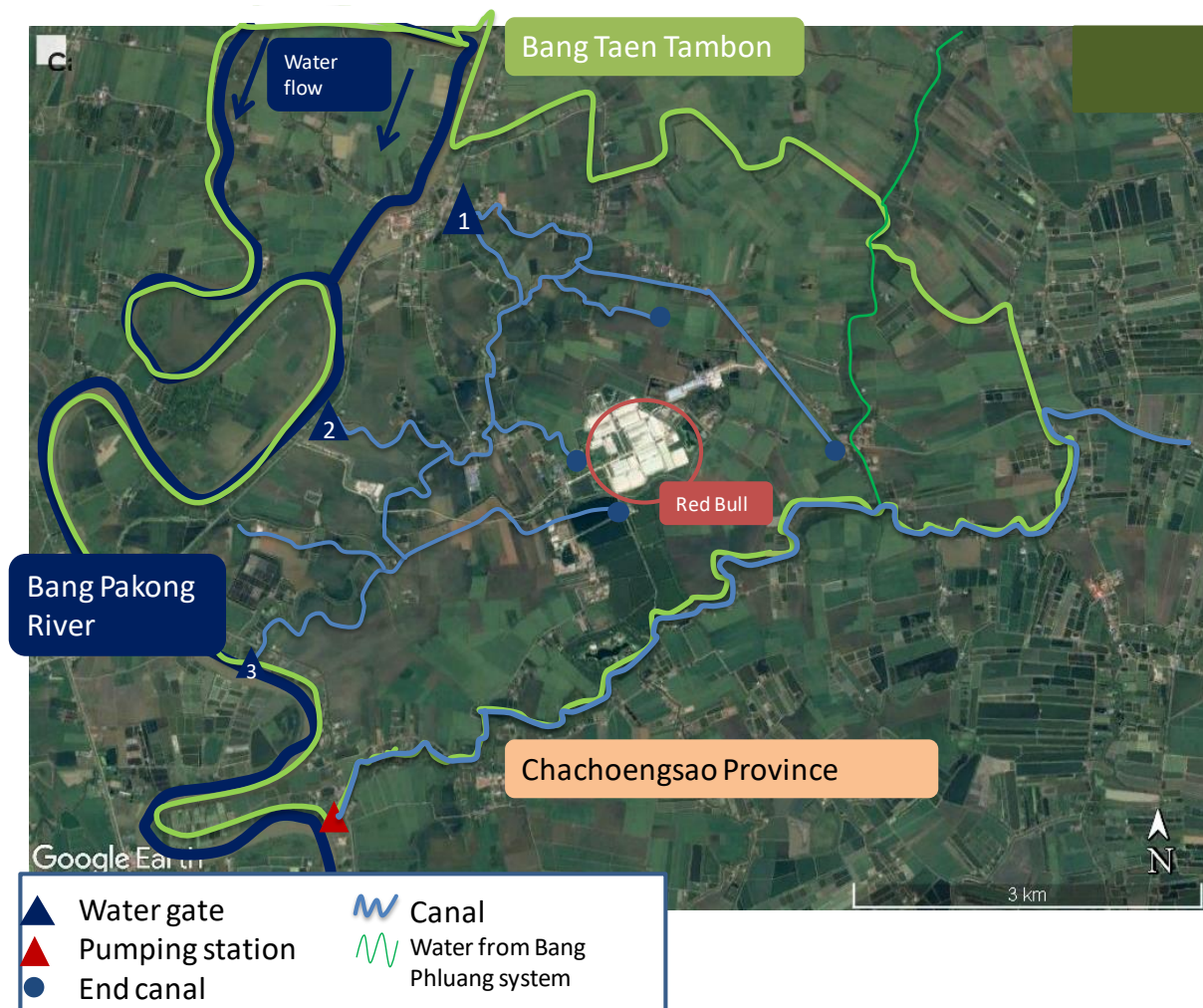


Figure 46: Map of irrigation system management - Bang Taen

There is no water user group in charge of the water management within the Tambon area. Both TAO and Royal Irrigation Department (RID) are in charge of the management. RID provides the water pumps at the gates 1 and 2. The gate 3 is smaller gate and is not equipped with pumps. RID is also in charge of the water irrigation system maintenance by looking after the canal. This office provides a financial support to the Tambon for two years. For 2017 and 2018, the financial support was 3 million baths for the gas costs and the natural hazards (salinity, drought



Figure 47: Picture of Water gate 2 - Bang Taen

and flooding) compensation. This support was 1 million baths in 2011 and 2 million baths in 2013.



Figure 48: Picture of Water Gate 3
- Bang Taen

TAO is in charge of opening the gate and pumping water from the river to the canal from December to January and pumping water out from the canal to the river in September during the flood period. Farmers do not pay for water use. They only pay their own water pumping gas costs. According to the president of the TAO, as there is not a water law they are no legitimate to charge the farmers.

The main canals within Bang Taen Tambon come from the water gates located in the Tambon. However, one canal (green) comes from the Bang Phluang irrigation system so the decision to close the water gate does depend on the TAO of Bang Taen.

Red Bull® case: Red Bull Company® was located in Bang Bon District in Bangkok Province. They used to pay 30 million baths to the Metropolitan Waterworks Authority for using water. The president of the Tambon criticizes the company saying that it has created noise and dust pollution, immigrant population and water pollution. However, Red Bull® has recycled its wasted water for 25 years. According to the president, Red Bull® should pay 75 000 baths / year for its water uses but it does not pay anything.

2) Water uses

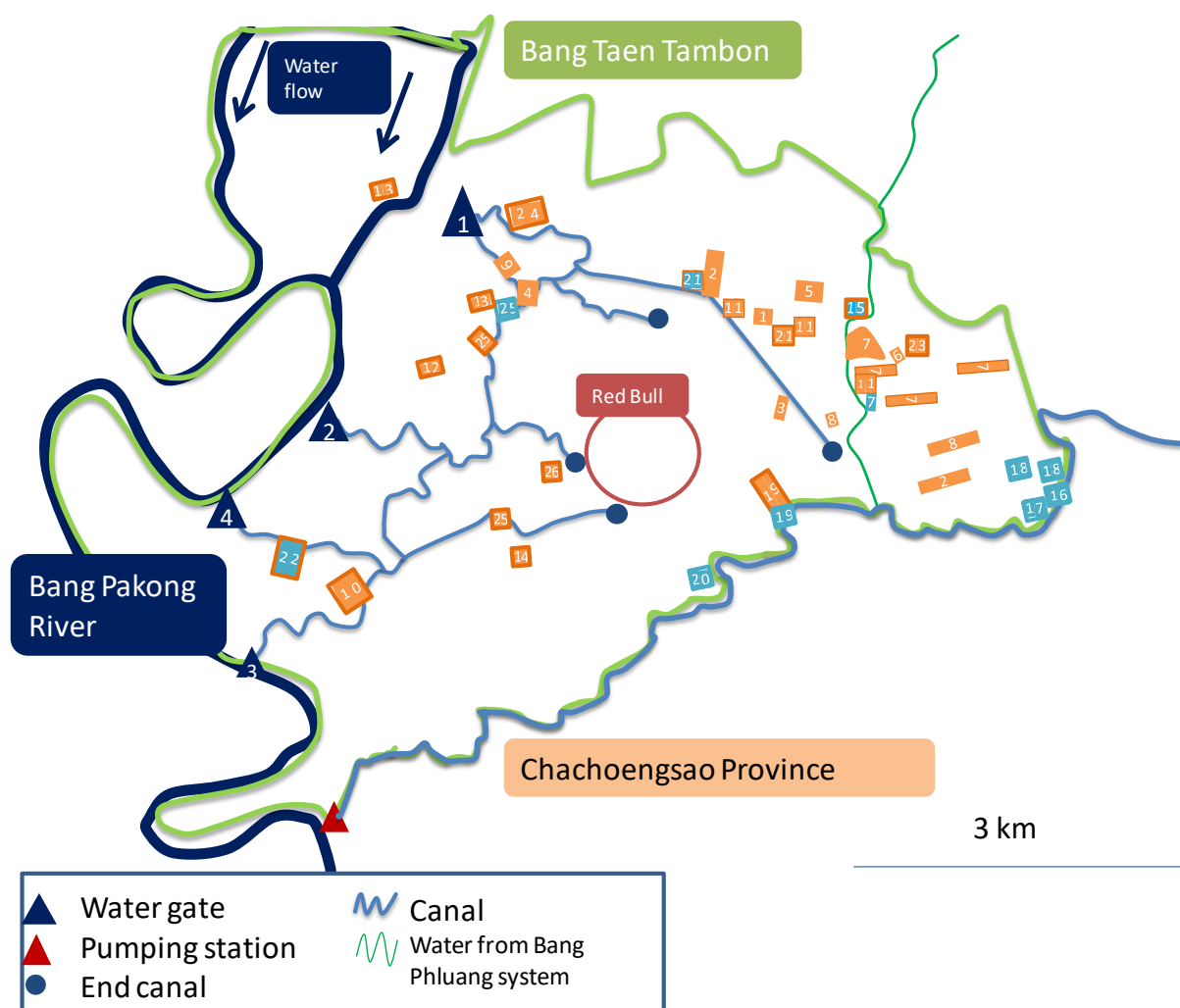


Figure 49: Map of farms' location within the irrigation scheme - Bang Taen

The map shows the location of the farmland. There are located along different canal. Among the 24 farmers producing rice within the area, 23 of them produce two crops, thus they irrigate during dry season. In average they irrigate 5,5 times (from 3 to 9 times) about 11,80 cm. Seven of them have ponds (1 rai) which they use mainly for the organic rice (4 of them) because it is a small area. However, seventeen farmers irrigate also during the rainy season. Indeed, they irrigate in average 3,6 times (from 1,5 to 6 times) about 10 cm. Nevertheless, four of them mentioned that really depends on the rain. If it rains they might not irrigate such as this year (May 2017) the rains came early they did not pump water from the canal to their fields. Unfortunately, the data collection does not have enough details about the fishermen and how many they refill their pond. However, the ponds are 1,7 meters deep in average (from 1,5 to 2 m). Most of the fish and shrimp producers interviewed were located in the same area (the borderline).

3) Issues

In Bang Taen Tambon, three main issues might be prejudicial for the farming activities. The first issue is the salinity or brackish water, this issue induces a quantity issue within the area. The last issue is the pollution but it is marginal.

a) Salinity

i. Tambon level

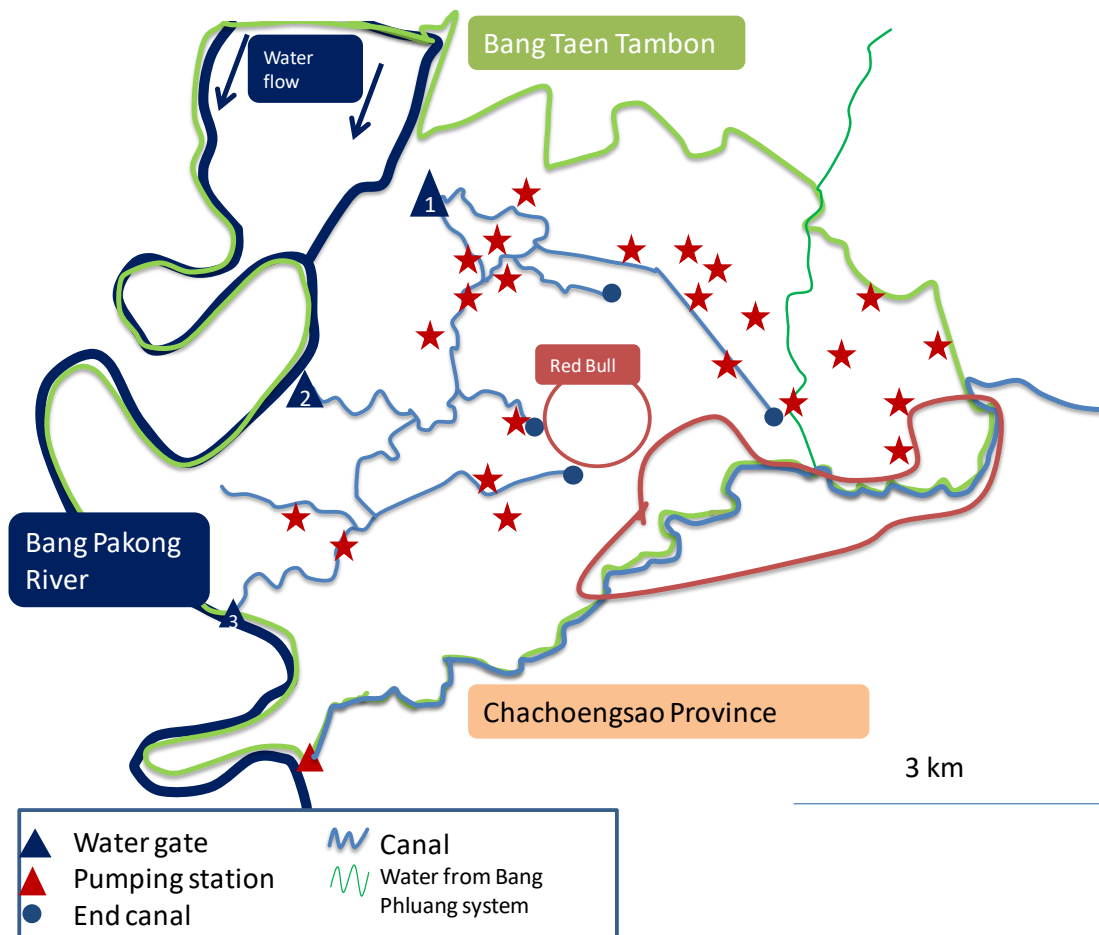


Figure 50: Map distribution of salinity issue - Bang Taen

As Bang Taen is located downstream it is impacted by the sea water coming inland. The brackish water appears in the river every year from January to the beginning of the rainy season (around May) as the map shows (red star) the salinity impacts a big part of the Tambon. The problem is mitigated by the TAO management. Indeed, they close the water gates from January to prevent the brackish water to enter the irrigation canal. However, the president said that this year (March 2017) water was released from the Huay Samong dam which was a past King's project. It is currently 60% full. It is also a challenge to manage this issue because within the area there are both rice and fishermen. The problem does not impact the same way both production. Indeed, the salinity issue is not a problem for the fish and shrimp producers as according to the farmers it even better to increase the production.

ii. Farm level

Despite the Tambon management in terms of salinity prevention, most of the farmers (19 out of 27) think there is a salinity issue (red star). Among them, four farmers mentioned that there used to be a problem but not this year in reason of water released by Huay Samong Dam. However, none of them had the tools to measure the salinity level in the canal. They either heard from neighbors or from TAO. One of them mentioned that he could know looking at the water color: green is salted while clear is fresh. The salinity issue appears from January till June. But it is the most important in February and March according to the farmers.

In terms of impacts, fifteen out the nineteen farmers saying there was a problem answer that question. For six of them there is no problem because they either stop pumping or have stored water before in the pond and in the sub-canal. And the salinity impacts the production of five farmers by for instance delaying the beginning of the rainy season crop for three of them. Nevertheless, looking at the map we notice that the farmlands surrounded by the red circle do not face the salinity issue.

b) Lack of water

i. Tambon level

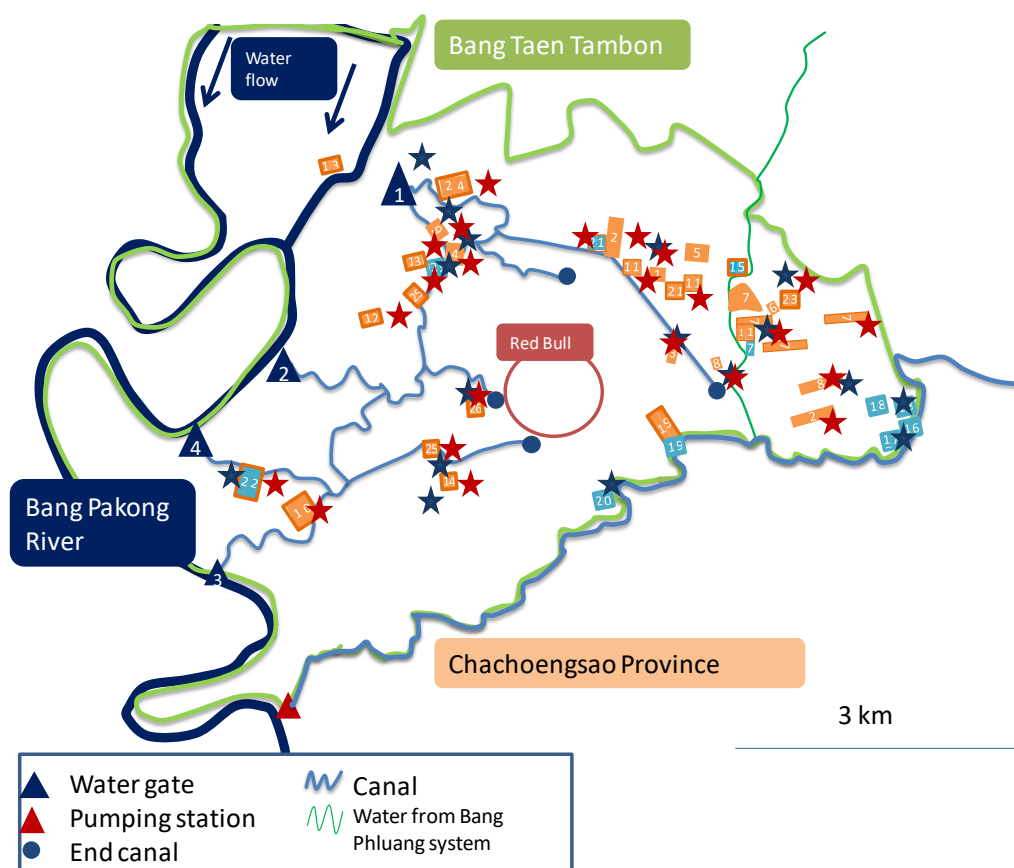


Figure 51: Map of lack and salinity issues - Bang Taen

This issue is linked to the salinity issue. Indeed, as in order to prevent the brackish to come inland, the Tambon organization closes the water gate, the water does not flow from the river to the canal from January to June and thus the quantity stored before decreases. The map above shows that the farmlands face the lack of water almost everywhere they face salinity.

ii. Farm level

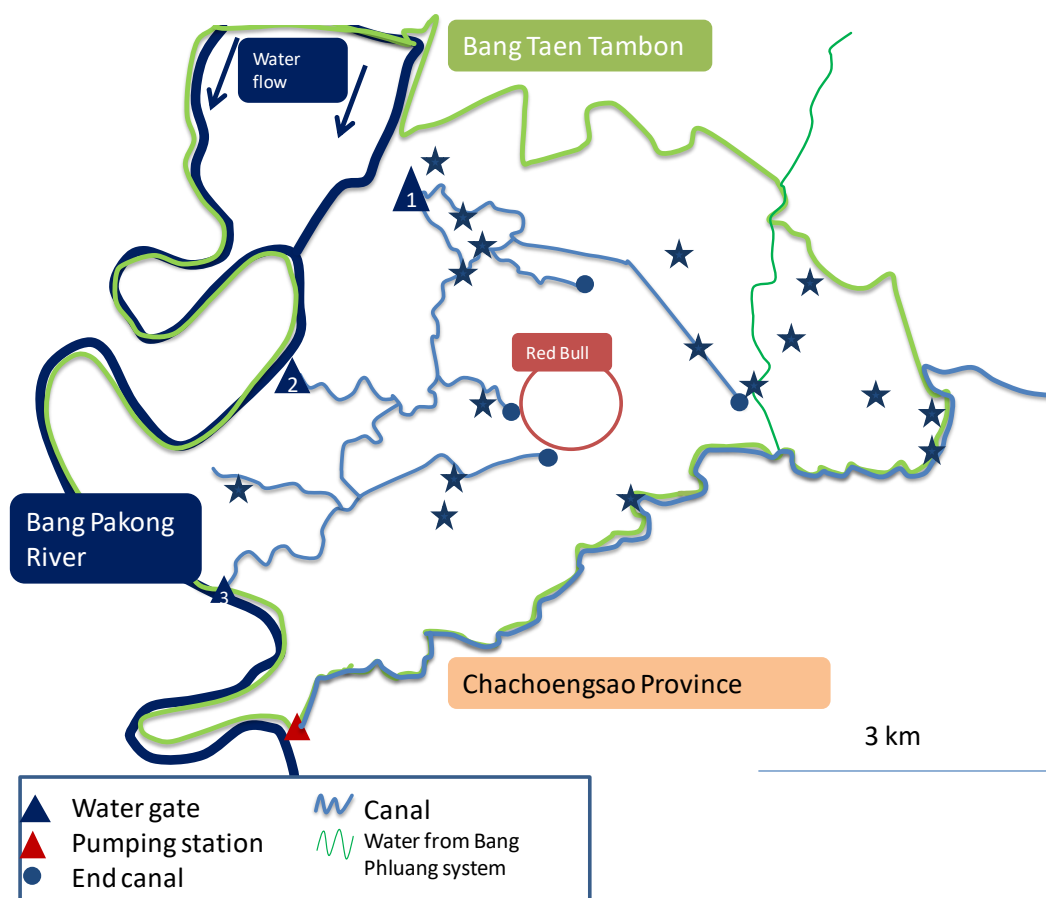


Figure 52: Map of distribution of lack of water - Bang Taen

Nine farms are not impacted by the lack of water. However two of them do not face it because they store water before. Five farmers said the lack of water does not happen every year, it depends on the weather. Then, thirteen farmers face the lack of water but four of them mentioned that there was not issue this year because water was released from Huay Samong Dam last March (3 farmers) and because the rains came early (May 2017) according to one farmer. The lack of water starts from January (when the gates are closed) but it is most important in April according to the farmers. Looking at the map and the blue stars, we notice that even though the farmlands are located in the same area their answer about the lack of water differs. The number one said facing the lack of water while the number 21, 11 and 2 said they do not face the lack of water. In the case of the number 2 it is because the farmer stores water into the sub-canal in order to prevent the lack of water so she does not face it does not mean there is no problem in the main canal. We also notice that the farmlands located downstream the canals face the lack of water while the ones located upstream do not face.

In terms of impact, seven farmers are not impacted. The lack of water impacts the production of five farms. The farmers mentioned the loss of yield (2/5) and the delay to start the next crop (1/5) and the two last mentioned that the lack of water actually impact their shrimp production, they lose production as they have to stop one cycle.

The lack of water is more important for the fish and shrimp producers. Indeed, for the rice producers the issues are less impacting even though they delay the rainy crop because usually from March to May it is the inter-crop period, thus the farmers do not pump water. However, as we saw analyzing the shrimp and fish cycle, the production last the whole year. The farmers must find solution in order to face to the lack of water.

c) Pollution issue

i. Tambon level

The president of the Tambon mentioned that a pig farm releases wasted water. Unfortunately, our study could not highlight this statement.

ii. Farm level

At farm level, the pollution issue is marginal. Indeed, 21 out 27 farmers do not face any pollution problem. Six claimed that there is pollution issue during the flood from September to November because of the factory (5/6 farmers) releasing wasted water which flows downstream during the flood. However, this problem does not really impact because they do not pump at that time.

4) Solution

As mentioned before, the main solution against salinity is closing the gate in January. Then, the farmers must store water as much as they can in pond or in the sub-canals around their field in order to face the lack of water induced by closed gate. Eventually, the farmers have to wait the rain comes (mentioned by six farmers) but it not a concrete solution and the production is still impacted. According to the president of TAO but also to the farmers, Huay Samong is the main solution to the problems as we will see later in terms of evolution within the next 15 years.

5) Evolution over the past 15 years

In terms of salinity, 14 farmers said it has been increasing. Unfortunately they did not give any reason. Five farmers think it has been stable and five farmers think it has been decreasing especially from this year thanks to Huay Samong Dam. Two farmers do not have opinion about it and one claimed that there has been any problem. In terms of quantity, 15 farmers claim that the water quantity has been decreasing over the past fifteen year. Only three gave a reason: rainfall, more users and over pumping by the factory upstream. Eight farmers think the quantity have been stable and three think it has been increasing thanks to Huay Samong dam (especially this year). One said it has been going up and down. Eventually, in terms of quality, 13 farmers said it has been decreasing, 12 farmers mentioned stability and only two said it has been increasing.

IV. Evolution within the next 15 years

1) Farmer's project – farm level

Seven farmers do not have any plans for the future. On another hand, the other farmers have various plans. The main plans concern the production. Indeed, six farmers plan to follow the King's project which advice to diversify the production in order to get self-reliant. Seven farmers would like to increase their organic area and for some farmers reach 100% organic. Seven farmers want to introduce fish or shrimp production in order to follow the King's Project but also in order to increase incomes. Three shrimp farmers want to increase the pond and thus their production. The other plans

are about decreasing the costs of production (2 farmers) and investing in equipment (greenhouse for vegetables and tractor).

2) Scenario outline – tambon level

a) Salinity

The farmers are optimistic about the salinity issue. Indeed, 20 of them think salinity will decrease thanks to Huay Samong dam. Three farmers think it will be stable and three think it will increase because it is linked to lack of water and according to their own experience. According to the president of TAO, salinity will decrease thanks to the dam.

b) Water quantity

As the salinity issue, the farmers are also optimistic in terms of quantity. Indeed, fourteen farmers said it will increase and six that it would be stable. Seventeen of them gave Huay Samong dam as the reason of this improvement. However, four farmers mentioned that it will decrease because of the gate will be always close from January to June or because of the factory upstream. According to the president of TAO, water quantity will increase because as salinity in the river will decrease they will be able to open the gate longer. "Everything is linked to water: if water quantity is good everything will be ok" according to one farmer.

c) Water quality

For the quality, it is the same trend as the other problems. Fifteen farmers said it will increase thanks to Huay Samong dam.

Eventually, regarding to the water issues, most of the persons interviewed agree to say that the situation will be better in the future thanks to the Huay Samong dam. Thus, it would be interesting to assess the impact of the dam and the quantity of water actually releasable.

"We need to realize that humans need water. Without it, we wouldn't survive, so water is our life." He also added, "As I am the leader of the water group, I have met with many villagers and other farmers and educate them the importance of water. I always tell them – do not throw garbage into canals. If they do so, there won't be blockage on the water surface and water can flow freely to the agricultural land, making products grow. We then need to protect our water resources which are the most essential factor for our farming" said one of the interviewed farmers.

d) Farming activity

According to the president of the TAO, fish and shrimp production will increase because the incomes are higher than rice production thanks to good market prices and productivity. For the farmers the main change in terms of production concern the rice production which will decrease in favor of fish and shrimp production (12/27 farmers). Four farmers mentioned that the farming activity diversity will increase (King's project, vegetables, and orchard). Eventually, most of the farmers think the choice of the activity will be done regarding to the market prices. Indeed, if the prices are better for fish and shrimp production the farmers might take over. However, they must think about the investment required by this production. "We must realize that Thailand is the kitchen of the world, we must produce the products for the other countries. New generation of consumers need food security with free chemicals products, it is the farmer duty to improve products quality and reach the certification" said one farmer during interview.

In terms of number of farmers, twelve farmers think this number will decrease while three farmers think it will be farmer and three said it will increase. The number is linked to the future involvement of the new generation in the farming activity. Indeed, nineteen farmers think that the new generation won't take over the family business. The new generation might not be interested (according to 12 farmers) because they study higher or they will work in factory or company (six farmers). The choice of the new generation will also depend on the prices because if the business is stable they might take over while also, some farmers mentioned that their choice will depend on whether the family owns the land or not. "Thai people like comfort so they will do less farming. According to him for the NG it will depends if the family owns the land. If they do, kids will take over otherwise they won't. Also kids might do shrimp instead of rice because of prices" according to one farmer.

Chapter 3: Bang Pla Ra

Bang Pla Ra Tambon is located in Prachinburi Province. The study focuses on Nikom Cooperative members situated in the Nikom Phattana village (moo 6).

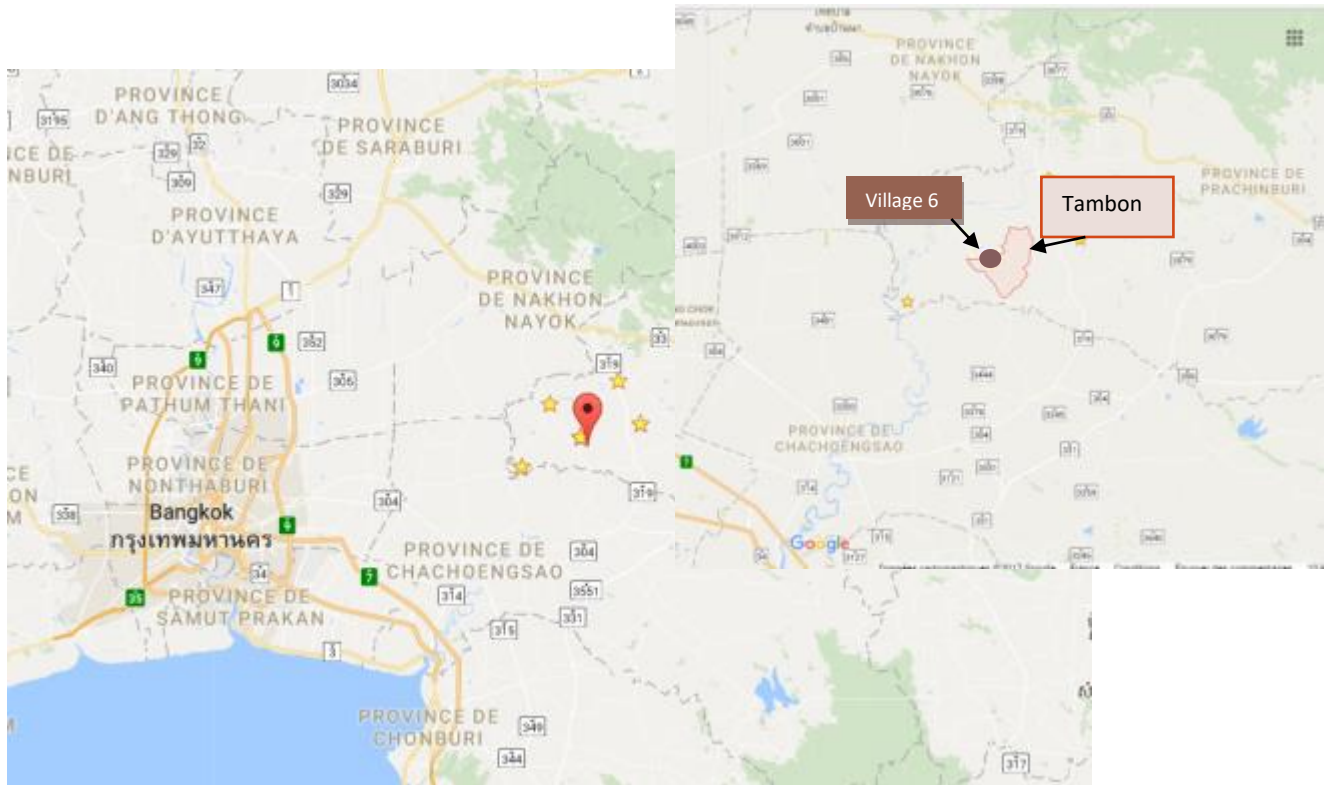


Figure 53: Map Location of Bang Pla Ra Tambon and Nikom Phattana village source: Googlemaps©

Nikom Phattana village used to belong to the royal family. 30 years ago, in order to develop rural areas and more specifically farming activities, the King's project set up a cooperative (Nikom cooperative) and through it they rented the land to the farmers. The family had to pay the rent to Nikom and after 20 years they became owner of the land. The area was divided from 10 to 24 rai depending on the geography. The rent rate was 3000 THB/rai/year. Nowadays, the cooperative provides fish and shrimp food and products. It also provides loan to the farmers. Some training are hold in the cooperative to inform farmers about the animals disease and prevent them to pollute water by using alternative products. The members have to pay 50 THB yearly fees. Currently there are 220 members.

I. Farming typology

1) Farmer typology

General data: 27 farms have been interviewed. The total number of farmers living in these farms is 53.

a) Farmer typology

The analysis focuses on these 53 farmers. It does not include the person living in on the farms but who are not involved in farming activity.

i. Gender

Among the 53 farmers, there are 27 women and 26 men. The parity is reached.

ii. Number of farmer per farm

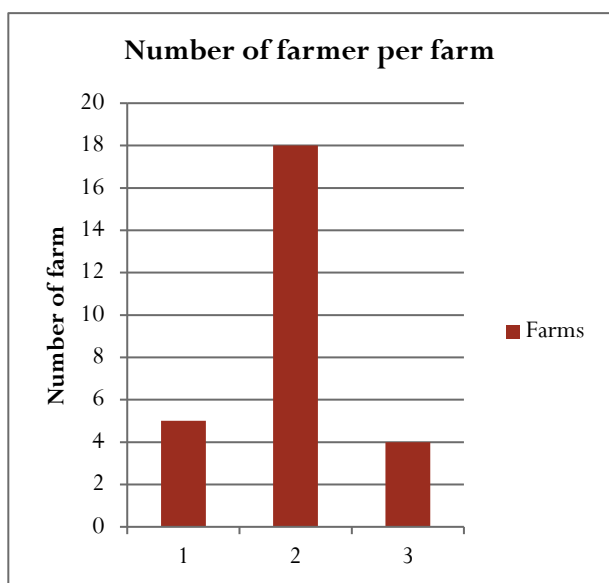


Figure 54: Graph Number of farmer per farm - Bang Pla Ra

The number of farmer per farm varies from one to three. The average is 1.96 farmers per farm. Five farms count only one farmer including four women and one man. Eighteen farms count two farmers. They are all couple (wife and husband). Eventually, four farms count three farmers. They are three couple plus their child and one woman with her two sons.

We notice that over the 53 farmers, five children are involved including four sons and one daughter. For two of them is a part-time job. They work also for their father's business.

iii. Age pyramid

The age average is 47.2 years old and it ranges from 16 to 67 years old. Eleven farmers are under 40. As mentioned before, five of them are farmers' children and are under 30. Then the age distribution is quite balanced between men and women from 41 to 60 years old.

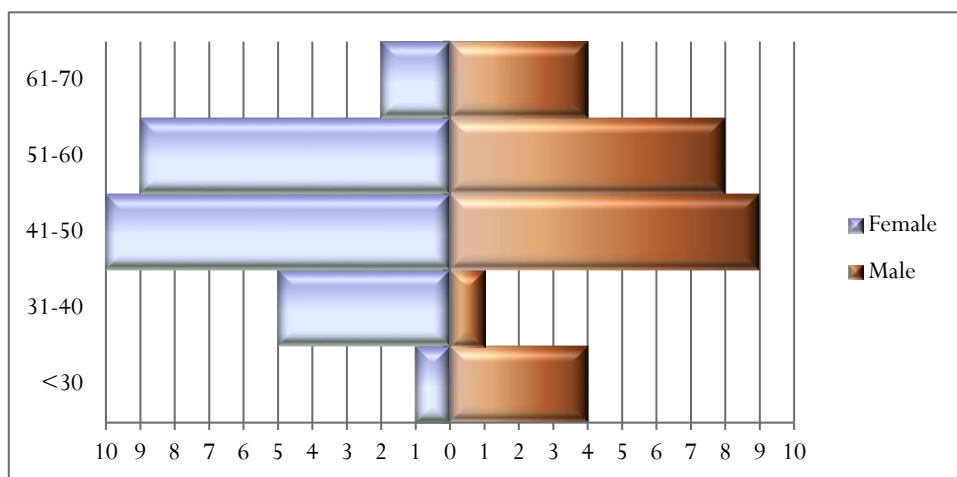


Figure 55: Graph Age pyramid - Bang Pla Ra

iv. Education level

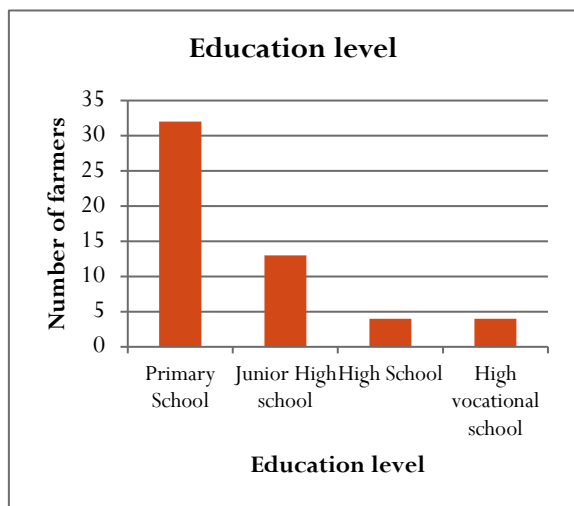


Figure 56: Graph Farmers' education level - Bang Pla Ra

About 60% of the farmers stopped their studies after primary school. The average age of this category is 51.6 years old with 18 women and 14 men. 13 farmers stopped after junior high school. The average age is 38.5 years old and it concerns four women and nine men. Then, four farmers graduated high school. The average age is 49.3 years old. Eventually, four farmers graduated high vocational school and the age average is 37.5 years old. Among the children involved in farming four stopped school after junior high school and one got a high vocational degree.

v. Backgrounds

Regarding to the backgrounds of the farmers interviewed, 17 out 27 have always been farmers (since they stopped school). Among the 10 others, five started farming within the past 15 years. In average they started 6.4 years ago. The rest started farming more than 20 years ago. These ten farms used to have other occupations. Indeed, seven of them used to work either in a factory or a company. Two were farming labor and one ran his own business. They decided to do farming for several reasons. Three of them inherited the land from their parents. Two wanted to run their own business. Three moved back to Bang Taen for personal reasons. And two of them used to be farmers with their family but they worked for a while in a factory then decided to do farming again when they got old.

vi. Other occupations

Among the 27 farmers interviewed eighteen of them do not have other occupations while nine of them get another job. Five of them have an occupation linked to the farming activity. Indeed, two are middlemen, one farmer rents out her water pump machine and two are also farming labor. The four others have various occupations such as head of village, nanny, insurance seller or tailor. These occupations are meant to get more incomes but the main occupation for these farmers remains the farming business.

2) Family organization

Among the 27 interviews, there are 110 family members including 53 farmers described before. Excluding them, 57 family members live in the farm and not involved in the farming business. There are from one to twelve persons living in the same house. It is about 4.1 people per house in average.

a) Relationship between the interviewee and the other members (not involved in the farm business)

From one to four generations share the same roof. The relationships are diverse as the graph shows. The members are from less than one year old to 91 years old. The average is 20.6.

We identify three groups:

- Children under school age (<7): 10 members are in this group.
- Member from 7 to 40 part of the so called “new generation” because they could potentially take over the farm in the future: 39 members are in this group.
- Member above 40 years old “ancient generation”: 8 members out 57.

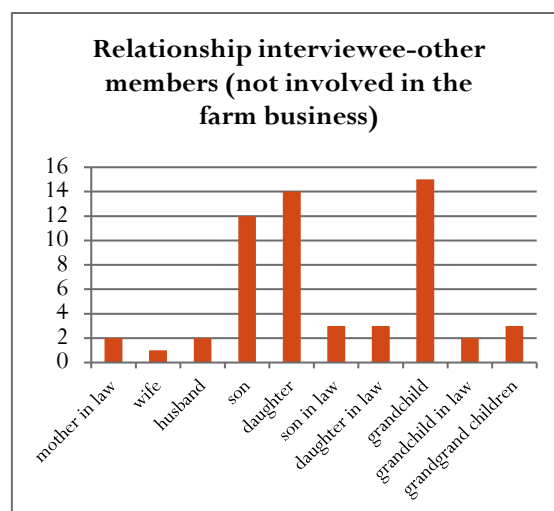


Figure 57: Graph relationship between interviewee and other members - Bang Pla Ra

b) Education level and occupation

Here we will develop only for the two last group mentioned above (new and ancient generation). Indeed, it is not relevant to present the ten kids under school age because they do not have any degree or occupation.

i. New generation group

In this group, members are aged from 7 to 33 years old. The age average is 17.4 which means these members are young.

Therefore, 22 out 39 are still studying. The 17 others, as the graph shows are higher educated than the members who are farmers. Indeed, no one of them stopped their studies after primary school. Six of them stopped after junior high school and ten got a high vocational degree. Seven of them work either in a factory or a company. Six of them have an occupation linked to farming. Indeed, four of them are farming labor. One is a fish driver for middleman and one works at the shrimp market.

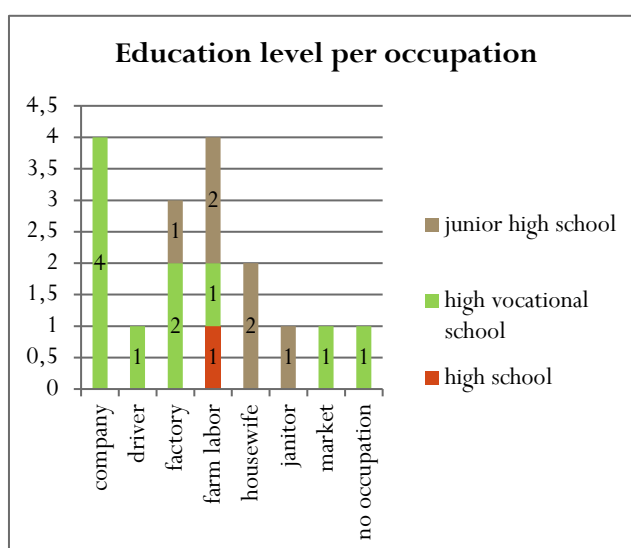


Figure 58: Graph new generation's education level per occupation - Bang Pla Ra

ii. Third group – “ancient” generation group

This group gathers eight family members. They are from 42 to 91 years old. The age average is 58.6 years old. Their education level is lower than the previous group. Indeed, five of them stopped school after primary school and two after junior high school. One the oldest one does not have any degree. In terms of occupation, two of them are retired (above 80 years old). Three are farmers in their own farms and two run their own business. The last one is a housewife.

c) Family members who live outside the farm

In our Bang Pla Ra sample, 28 family members live outside the farm. They are 27 children including 15 sons from 20 to 40 years old (27.4 in average) and 12 daughters from 18 to 41 years old (29.5 in average). 17 of these 26 children graduated from High school to Bachelor degree (9). The last one is one farmer’s husband (51 years old) he gets a bachelor degree and works in a company in Bangkok.

3) Land management

a) Land area

According to the interviews, the average size of land is 27.6 rai (red line in the graph). The total interviewed farm area is 746 rai ranging from 6 to 100 rai. However, it is important to mention that the actual production area is 623 rai. Indeed, the pond dykes represent a part of the land area (113 rai) and the rest is a water storage pond (10 rai). So the following graph represents the actual production land size 623 rai.

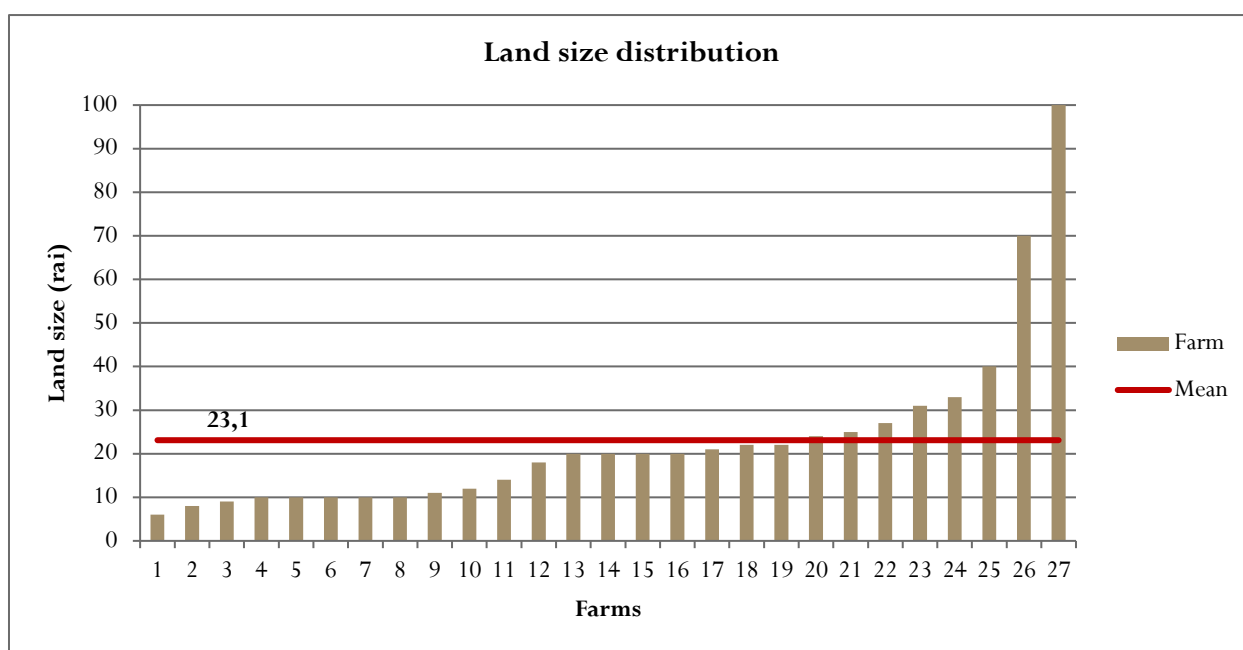


Figure 59: Graph Land size per farm - Bang Pla Ra

In our study case, the land occupation is mainly pond for fish and shrimp production 621 out 623 rai; the two last are a lotus production area. According to the President of the TAO, the total farming land area is 21 000 rai and 20 000 rai of them are dedicated to fish and shrimp production. Within Nikom Phattana, according to the manager of Nikom cooperation, the total land area is 2100 rai located in Bang Pla Ra Tambon and also in Bang Phluang Tambon.

b) Land status

The study highlights different types of farm regarding to the land status. Indeed, three cases are noticeable.

- Ownership (100%)
- Leasing (100%)
- Mixed

The total owned area is 618 rai versus 128 rented rai.

According to the graph, in 21 farms the land is 100% own. It represents 546 rai and ranges from 6 to 100 rai. The average size is 26 rai. Four farms rent entirely the land. It covers 86 rai and the size varies from 10 to 22 with 21.5 in average. Eventually, two farms have a mixed status. But in both cases, the owned land is bigger than the rented one. One farmer rents out 9 rai to his children.

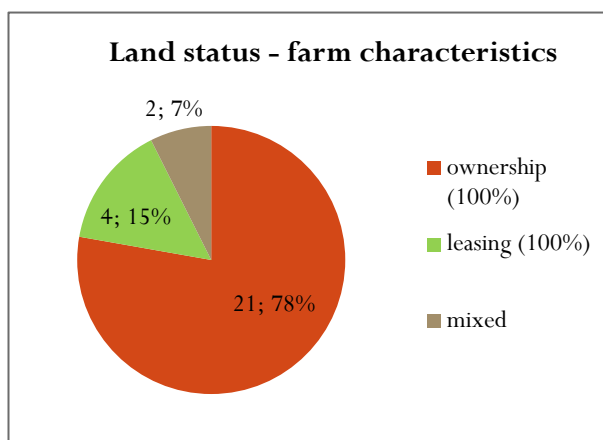


Figure 60: Graph Land Status - Bang Pla Ra

The following graph presents the land status per farm.

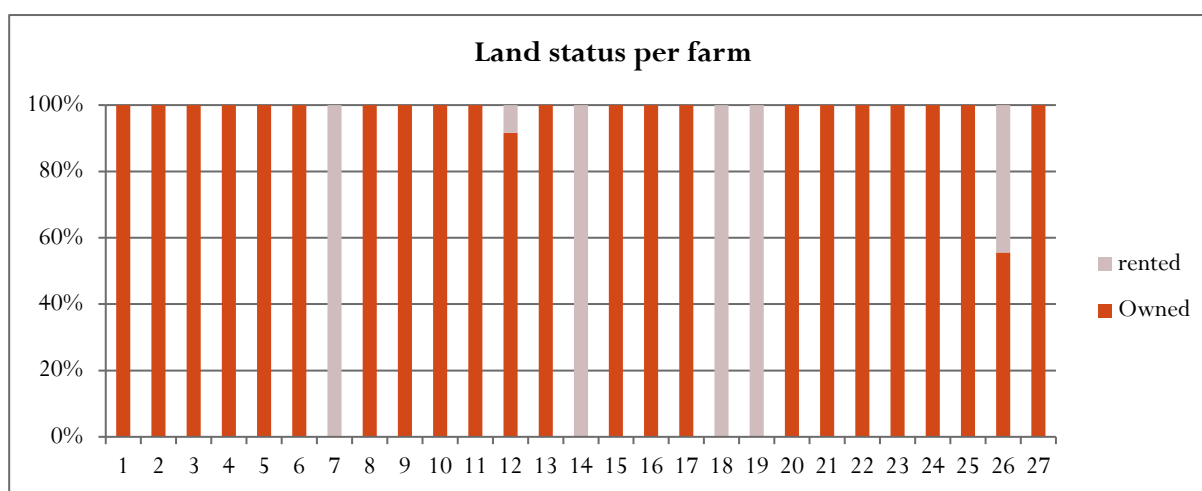


Figure 61: Graph land status per farm - Bang Pla Ra

Within Nikom Phattana area, the price of land varies according to the area. Indeed, there are three types of price. The first category is for the land which are not easy to access to. Thus the price ranges from 30 000 to 50 000 THB/rai. The second category stands for the land located nearby the local road. The price varies from 70 000 to 100 000 THB/rai. Eventually, for the land located next to the main road the price ranges from 100 000 to 200 000 THB/rai.

c) Owner of the rented land and renting rate

As we mentioned before, six farms rent land. Three of them rent to family members, two others rent to farmers and the last one rents to an acquaintance. The renting rate ranges from 750 THB/rai/year to 2000 THB/rai/year.

4) Evolution over the past 15 years

Within the past 15 years, different changes occurred according to the land ownership, land size and the change of occupation. However, for seven farmers there was no change over the past 15 years.

In terms of ownership, two farmers became owner 7 and 10 years ago after renting the land for years and four farmers became owners after inhering land from their family (from 5 to 15 years ago). Three farmers had changes in term of size of land. Indeed, two of them decreased the size of the land within the past 15 years. The first one changed the area and shifted from rice to fish and shrimp production. As she changed the area, the price was higher for the new land so she bought a smaller area. The second one has to give 19 out 25 rai to her sister. The other one increased the size from 17 to 24 rai 12 years ago in order to increase the production.

II. Farming activity

1) Typology

Nikom cooperative members' land covers a total of 2100 rai according to Nikom cooperative manager.

In our study, the total size of production is 623 rai. The following graph shows the distribution of farming activities. As we can see, the main activity is a mixed production of fish and shrimp (F/S production in the graph). Indeed, the 27 interviewed farms have fish/shrimp production which represents 575 rai and corresponds to 56 ponds in total. It is about 10.3 rai in average per pond. Among these 27 farms, five farms have shrimp ponds which cover 26 rai in total and represent 7 ponds in total, an average of 3.7 rai. One of these five farms produces also fish only with another farm among the 27 farms interviewed. The fish production covers 20 rai and counts 2 ponds in total. The last 2 rai belong to one farm and produce lotus in order to make extra incomes.

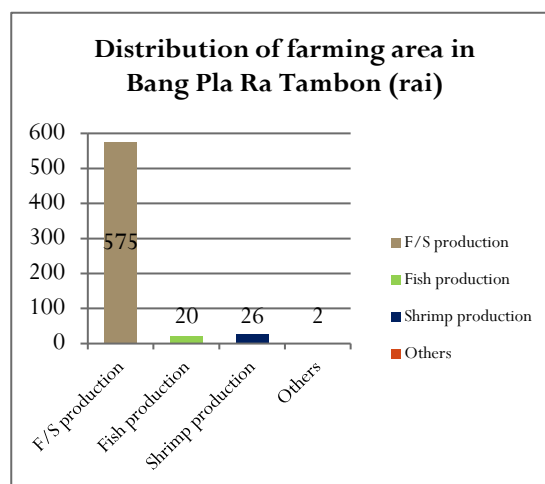


Figure 62: Graph Farming activities - Bang Pla Ra

2) Production

a) Fish and shrimp production

As mentioned above, all the interviewed farms have mixed ponds of both fish and shrimp. We will see which species they raise and what the cycles are according to each farm. First, all the farmers raise only Vannamei in terms of shrimp. In terms of fishes, it varies according to the farms as shows the following tab. As we can see, the main species raised are Tilapia and Seven-striped barb. However, the Tilapia is far the main species raised in term of number of fish per rai.

Species	Number of farms	Average Number fish/rai
Tilapia	26	4837
Seven-striped	26	226
Small scale mud carp	22	174
Big head carp	21	200
Common silver barb	18	296
Cat fish, climbing perch, common snake head	1	
Mix of fish	3	

Table 6: Fish species - Bang Pla Ra

The shrimp cycles take place within the fish cycle. The number of cycles varies from a farm to another. In terms of shrimp production the number of cycle varies from 1 to 5 cycles and last between 2 and 3 months. As the graph shows, almost 50% of the farmers produce three cycles of shrimps within a fish cycle. Five farmers mentioned that they stop the shrimp production when the fishes are big in order to avoid they eat the shrimps. They stop the shrimp production two months before the fish harvest.

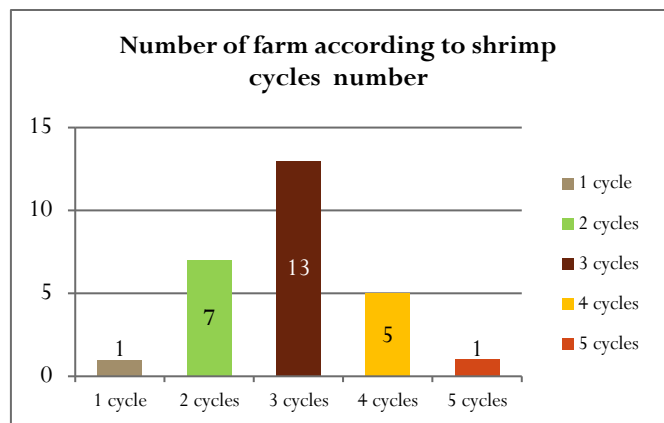


Figure 63: Graph farm distribution per number of shrimp cycles - Bang Pla Ra

Each farm has its own way to produce fish and shrimp. The cycle tries to gather the different method. After the harvest which requires draining out water, the first stage is the preparation of the pond. This one starts by letting the pond dry or not. In our study, 22 farmers let the pond dry between 3 and 30 days. Then, they have the choice to either add water first then the products (lime, calcium and dolomite) to reach the right pH or add the products then water. In our cases, 16 out of 27 farmers put the products first then fill water in. according to those who pump water in first, it is easier to apply products while they use a boat to do so. However, the application of the product is less accurate than to apply it while the pond is dry. After this part which lasts between five and 30 days the farmers check the pH which ranges from 6 to 8. If the pH is good, the farmers have the choice to add a sample before to add the entire production. 8 out of 27 farmers add a sample during 24 hours before to add all the animals.

In terms of production either the farmer add all the animals at the same time (16 out 27) or they delay the release. Indeed, 9 out 27 farmers release shrimp first and add fish from one week to two months after the shrimp in order to let the first cycle of shrimp grows correctly. In two cases, the farmers add fish first then shrimp. This delay might be due also to the delay to obtain the animals. Indeed, some farmers mentioned that they add the animals whenever they receive them from the market they buy them. Most of the farmers release shrimps after they harvest the previous cycle, but four of them bring forward the second cycle which means that they release the next shrimp cycle while the previous one is not harvested yet. They mentioned to do so in order to stimulate the next cycle of shrimp. They release it between one and four weeks before the harvest. Eight farmers said that when fishes get big they may eat the shrimp. In order to prevent this, the farmers either reduce the number of cycles or they reduce the shrimp number cycle after cycle which means that the first shrimp cycle counts more shrimp than the last one.

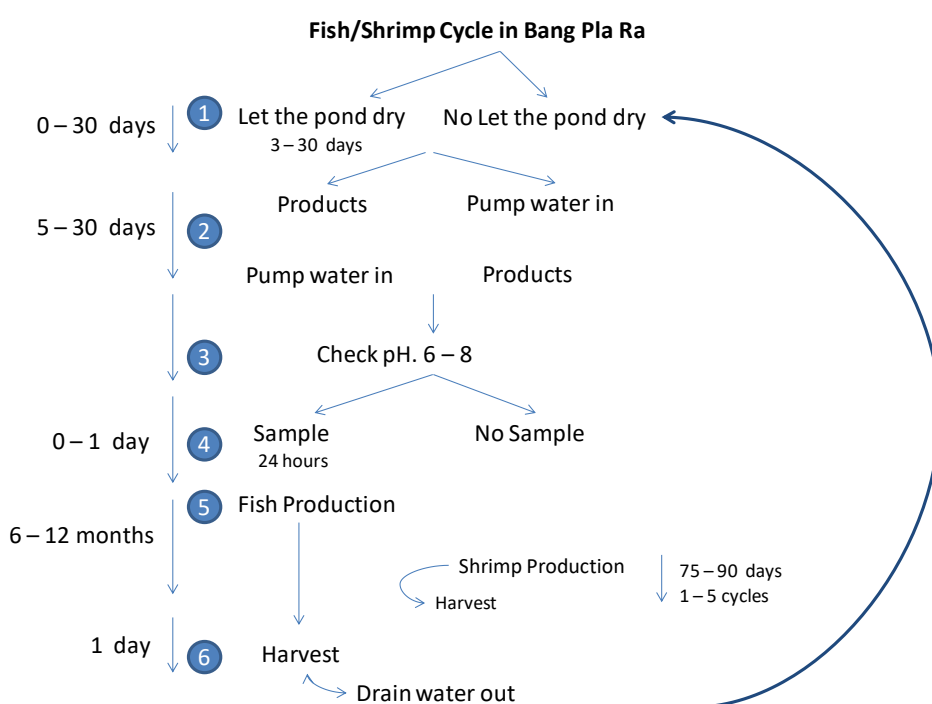


Figure 64: Fish-shrimp pond cycle - Bang Pla Ra

b) Shrimp production

As mentioned in the typology part, five farms have some shrimp ponds. Two of them raise Vannamei only while three of them raise both Vannamei and giant tiger prawn. The number and length of cycle depend on each farm. However, we notice that the Vannamei cycle lasts between 2 and 3 months while the giant tiger prawn cycle last between 2.5 and 4 months. The number of cycle is about 3 in average. The following graph gathers all the cases.

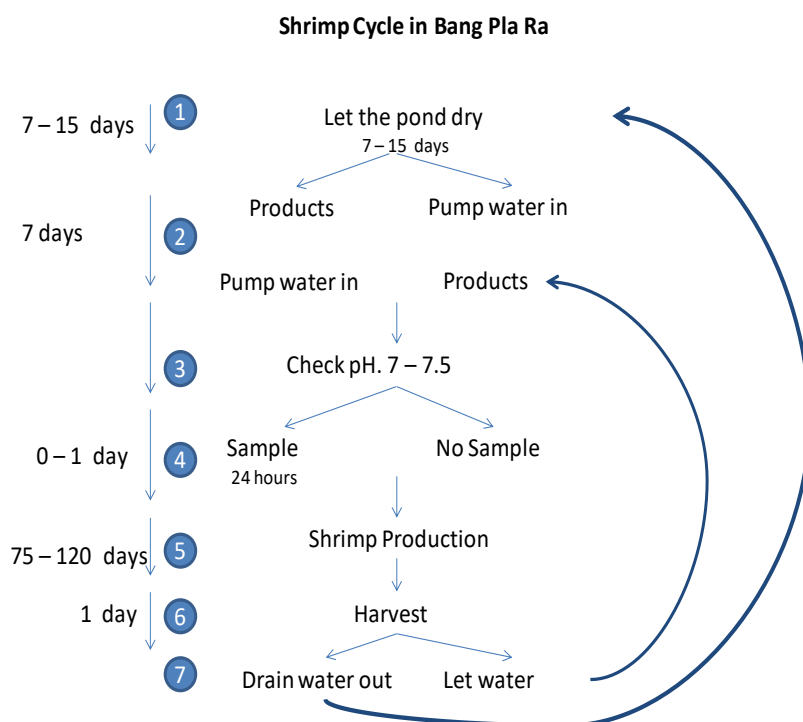


Figure 65: Shrimp pond cycle - Bang Pla Ra

As for the previous type of production, the farmers follow the different stages presented by the graph. In our cases, they all let the pond dry once a year between 7 and 15 days. Then two of them pump water in before adding products while three of them add the products before to fill water in. they check the pH about 7 – 7.5. Only one farmer releases a sample during 24 hours before to release the entire production. For the production itself, if it is only Vannamei, the farmers release the next cycle after harvesting the previous one. For the mixed Vannamei and giant tiger prawn ponds, one farmer releases and harvests at the same time both species. One farmer as his GTP cycle is longer he releases them before but harvests at the same time both species. The last farmer produces two Vannamei cycle within one GTP cycle. Indeed, he raises GTP during four months during which he can raise two Vannamei cycle lasting two months each. This farmer does two GTP cycles within one year so four cycles of Vannamei.

c) Fish production

As mentioned before, only two farmers raise fish pond besides their mixed fish and shrimp production. They have each one pond of 10 rai. The fish species they raise are Tilapia, seven-striped barb, common silver barb, small scale mud carp and big head carp. The cycles last between 8 and 10 months.

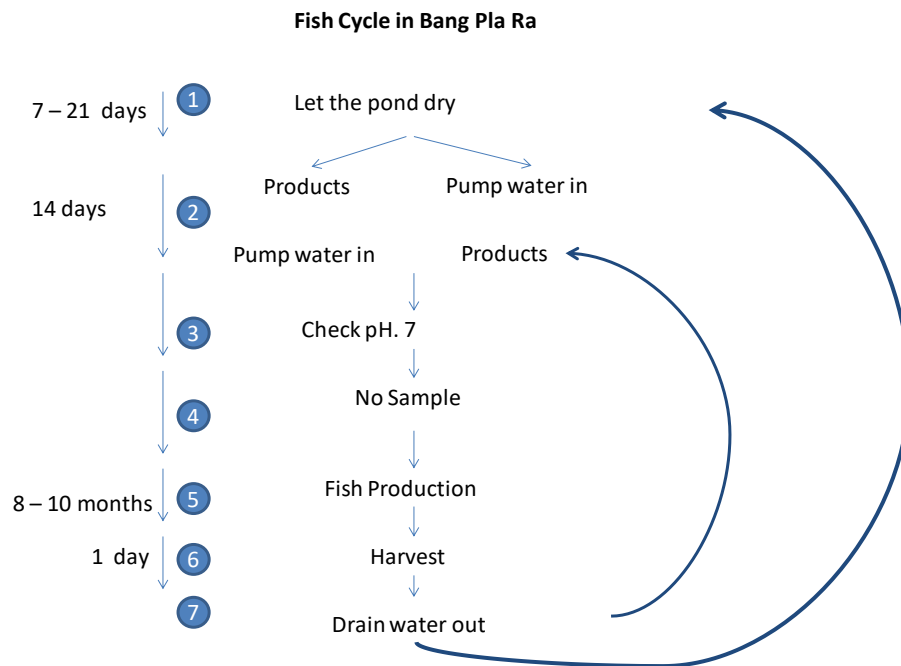


Figure 66: Fish pond cycle - Bang Pla Ra

3) Costs of production

i. Labor – outsourcing

In our study, the farmers hire labor for two main tasks. The first one is the shrimp harvest. 20 out of 27 farmers hire labor for harvest because they do not have the adapted net. The “ngo” or nets cost between 300 and 400 THB each, the number of net per rai depends on the quantity of shrimp in the pond. The nets are set up before night time and after sunset, the light are switched on in order to coax the shrimps into the net. The labor price depends on the quantity of shrimp. Indeed, if the quantity is lower than 100 kg, the labor set up a fixed price varying between 800 and 1200 THB and if the quantity is higher than 100 kg the price will be 10 THB/kg. In terms of fish harvest, the middleman who collects the production has his/her own team who will harvest the fish. According to the labor we met in Bang Pla Ra, he works with a 30 people – team. He earns usually 300 THB/day but it can be up 400 THB if the amount of fish is high. He mentioned that the other labors are mainly Cambodian people. He is also labor for hanging net against the birds and also to apply products. One of the farmers interviewed is also a labor. She hires two teams of two people from the Tambon.



Figure 68: Picture Fish Harvest -Bang Pla Ra



Figure 67: Picture of Fish Harvest 2 - Bang Pla Ra

The second task for which farmers hire labor is to apply the products in the pond. 16 out of 27 farmers actually hire labor. The price depends on the quantity of products used. It is about 300 THB/T. As mentioned before, this can be done either the pond dry or filled. In this last case, the product is sprayed thanks to a boat as we can see on the picture. According to one of the labor interviewed, she works in a team of four people from her family and they are hired by neighbors in order to apply the products. They have to share the 300 THB/T among them. The farmers interviewed also hire labor for different task but it is marginal. Five of them hire labor to harvest muddy fish which means the fishes remaining in the mud after the main harvest. Two farmers hire labor to give food to the animals. One farmer hires labor to pump out and pump in water because he does not have the machines.

Eventually, hiring labor is mainly for the harvest of shrimp and the products. Otherwise most of the farmers do everything by themselves. In terms of labor, the people are either from the Tambon or other province or even from other countries. They are versatile. They are labor for many purposes.

ii. Inputs

The inputs in fish and shrimp production are divided in five main categories:

- Machines costs (water pumping and oxygen paddle energy costs and maintenance)
- Food (chicken manure, instant food, bread, rice bran)
- Products
- Animals
- Labor

In terms of machines, 4 farmers out of 27 do not own the water pump they have to borrow or rent it. 18 out of 27 own the paddle machine but the use of this machine is variable. Some of the farmers use it during all the cycle, some others only at the end when the fishes are big.

For this part, we will present the costs of production for 20 farms producing only mixed fish and shrimp ponds. However as the number of shrimp cycle per fish cycle and hiring labor vary from a farm to another the costs of production are presented per category.

	water pumping costs / rai	Oxygen paddle costs/rai	Maintenance costs/rai	food costs / rai	Products costs/rai	Labor products / rai	Labor other costs / rai	Fish costs/rai	Vannamei costs/ rai/ cycle	Labor harvest shrimp / rai /cycle
Mean	1173,27	1633,77	783,96	11804,64	1355,51	272,58	2212,13	1177,49	737,90	352,60
Standard deviation	766,59	1777,89	676,36	7311,33	1655,02	250,63	4299,31	505,38	398,21	457,27

Table 7: Costs of production per input Fish and Shrimp production- Bang Pla Ra

The lowest total cost of production is composed by:

- Water pump
- food cost
- fish cost
- product cost
- shrimp cost (one cycle)

In average, the minimum costs of production are about **16 248 THB/rai/F-cycle for one cycle of shrimp**. Then they vary according to the other costs of production of each farm. None of the farms pay for all the categories. Only four farms pay the minimum cost of production.

In terms of animal prices, Vannamei cost 0.04 THB each and the price for giant tiger prawn is about 200 THB/kg. In the following are the average prices of fishes according to the species and the size of the fish when is bought.

	Average price (THB)/ unit	Price range (THB) / unit
Tilapia	0.31	0.08 – 0.43
Seven striped barb	0.36	0.20 – 0.60
Common silver barb	0.27	0.09 – 0.50
Small scale mud carp	0.38	0.20 – 1.0
Big head carp	0.37	0.20 – 0.60

Table 8: Fish price per unit - Bang Pla Ra

iii. Outcomes and outlet

The farming outcomes are based on the same farms data that the analysis of the costs of production. First of all, the incomes vary according to different factors. Indeed, the size and the number of animals while they are collected. The number of shrimp cycles and the way the pond is managed (food, preparation, water, oxygen).

For the fishes besides the size it depends also on the species and the style it is sold. There are two style of fish sold. The ice style the fishes are transported into van filled with ice ((see the picture), the fishes will die on the way and they are sold for industrial purpose. The oxygen style fishes are sold alive and transported into sort of aquarium and sold alive either to restaurants or on market. For the ice style, Tilapia species is separated from



Figure 69: Picture of fish separation - Bang Pla Ra

the others. The price of tilapia is about 25 THB/kg while the others are about 16 THB/kg. However, according to the size, the prices per unit might vary. For the oxygen style, the fish must be big and it concerns mainly the Tilapia and there are three categories of price and it ranges from 25 to 44 THB/kg in average. The last categories of fish sold is fermented fishes (see picture) they are sold about 5-10 THB/kg.

The prices of shrimp vary according to their size. The average price is 100 THB/kg but it ranges from 80 to 200 THB/kg.



Figure 72: Picture of fish categories - Bang Pla Ra



Figure 71: Picture of fish weighing - Bang Pla Ra



Figure 70: Picture of iced style fish - Bang Pla Ra

In terms of fish production, the average quantity harvested per rai and per cycle is 0.96 T. it ranges from 0.3 to 1.83 T/rai. The average income is 21 067 THB/ rai.

For the shrimp, the average quantity collected is 40 kg/rai/cycle ranging from 3.8 to 100 kg/rai/cycle. The average incomes are about 4000 THB/rai/cycle. Calculating the profit for the 20 farms interviews it ranges from **11 550 THB/rai** for four shrimp cycles to **12 749 THB/rai** for three shrimp cycles. It is important to point that three farms have made a loss. For one of them, within the three last shrimp cycle none survived. These profit figures also show that increasing the number of shrimp cycle does not lead to an increase of profit necessarily. Indeed, as mentioned before, some farmers explain that they stop shrimp production while the fishes get big because they might eat the shrimp and they would lose the profit.



Figure 73: Picture of fermented fishes - Bang Pla Ra

In terms of outlet, for the fishes, in 26 out 27 cases of our study the middleman is in charge of the harvest. S/he comes one day and while they drain out water his/her team about 30 people collect the fishes. The middleman may be a farmer as we interview two but s/he may be also from another province and not a farmer. Then the fishes are brought in the markets in the Province or in other Province such as Talad Thai market in Pathum Thani Province. For the shrimp, the farmers bring them to the shrimp market within the area where the middlemen wait for buying them. One of

the farmers interviewed is also a middleman. She has hired 15 people from Bangkok for 10 years. They got 100 000 THB/month net. She pays the labor 400 THB/day each.



Figure 74: Picture of Middleman team harvesting - Bang Pla Ra

4) Pleang-Yai-Pracharat project

This project is a large-scale project of specific farm production taking place under the governmental policy “Pracharat policy” or “state of the people policy” which aims to increase the cooperation among various stakeholders from the public, private and civic sectors and encourage them to work together to reduce disparities and enhance Thailand’s competitiveness. In our study case, the policy focuses on the Vannamei and Tilapia production which explains why most of the farmers follow this template. The project advises to release 2500 fingerlings/rai while from 20 farms data collected the farmers release in average 3844.75 fingerlings ranging from 1700 to 8025 fingerlings/ rai. They also advise the farmers to release 30 000 lava/rai (shrimp babies). According to the data we collected, the farmers release about 21 346 shrimps/rai which is under the figure advised and might explain why the number of fish is bigger than the one advised.

5) Evolution over the past 15 years

In terms of farming activity changes, the main changes occurred between 20 and 30 years ago. At that time, most of the area was dedicated to rice production but little by little the farmers changed for fish and shrimp production. The main reason given is because of the price of rice that was too low. In our study, five farmers shifted from rice to fish and shrimp business within the past 15 years (about 12 years ago in average). According to the president of the TAO, the farmers started first with giant Malaysian prawns because their price was high (200 – 300 THB/kg). But because of disease and sanitary problems, farmers changed for fish production. Then within the past 15 years, the farmers have slowly introduced shrimp (Vannamei) in the production. According to the famers, mixing the species mitigate the diseases. The price is the main lead in the choice of the species. In our study 20 out 27 farmers pointed the fact the prices and profit were too low. Some mentioned that last year the fishes were sold all together while from this year the Tilapia is separated from the others which price is low. According to the president of the TAO, since 6 years ago, the number of farmers has increased because new generation has taken over and new people from other province come to do farming within the area.

III. Water management

1) Introduction



Figure 75: Map of large scale irrigation scheme in Bang Pla Ra

Within Bang Pla Ra Tambon area (red boundary on the map) the water flows from the North through the canal (dark blue line on the map) called Bang Phluang Canal as it comes from Bang Phluang water gate and goes through Bang Phluang Tambon (west) and Bang Decha (east).

The TAO is in charge of this canal and cleans it every year. It has also been in charge of the water user group (WUG in orange on the map) maintenance for 15 years while Nikom community has its own WUG (in light blue on the map). There is no link between both groups. All the farmers can pump water from the main canal (dark blue one) paying no fees, only the water pumping costs.

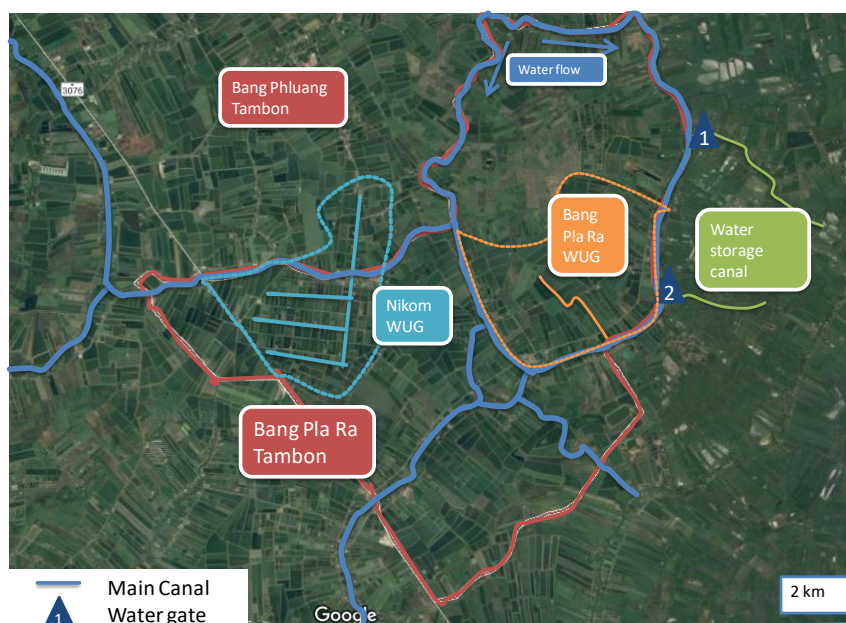


Figure 76: Map of irrigation scheme focus on Bang Pla Ra

2) Water Use groups organization

a) Bang Pla Ra Water user group

Bang Pla Ra TAO is in charge of this WUG. There are 40 members of whom farms represent 3000 rai including 100 rai of rice but it is mainly fish and shrimp production. The TAO pays 100 000 THB/ year for the maintenance fees. The annual water quantity is 5.5 million m³ and there is only one electric water pump.

b) Nikom community water user group

The canal belongs to Nikom cooperative but an independent group is in charge of the management and the maintenance. This WUG is called SML. Unfortunately, the president of the group was not able to tell what it stands for. 100 farms are registered as members covering 2000 rai.

The pumps are located both side of the main canal (dark blue line) and water flows both side through concrete canal (light blue line) then it flows through the sub-canal in green on the map.



Figure 77: Picture of collective canal - Bang Pla Ra

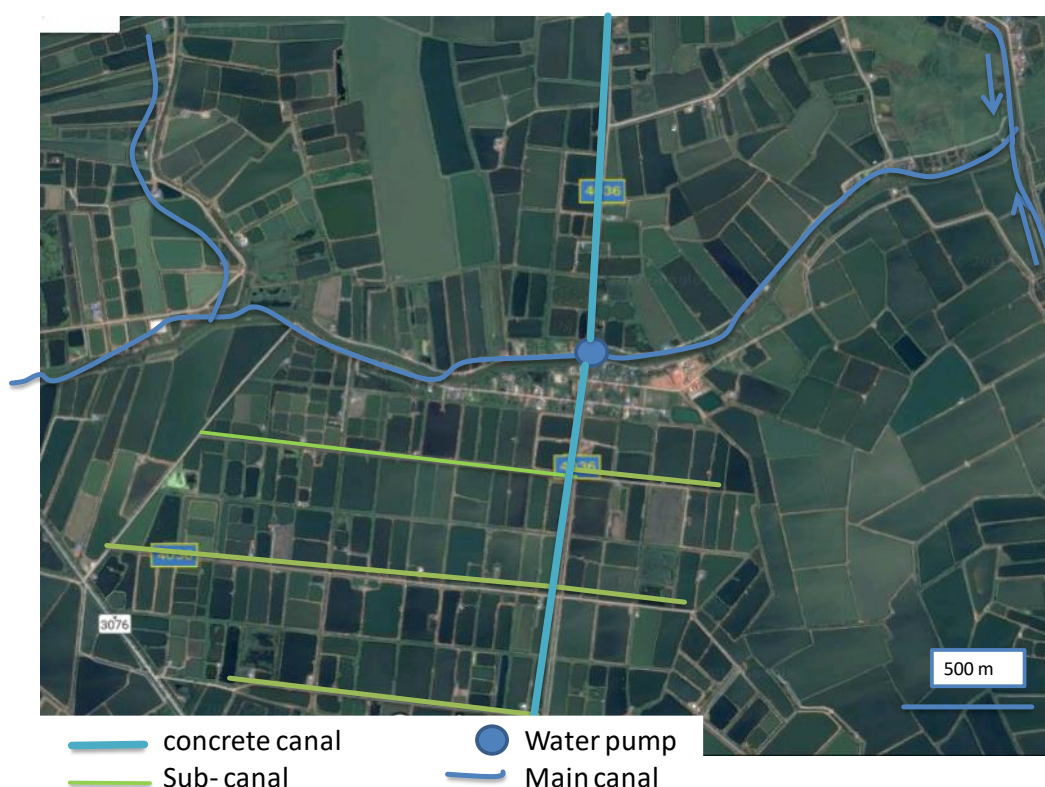


Figure 78: Map of irrigation system in Nikom Phattana

The members have to register on a notebook and wait for their turn. They pump one by one. However, if some farmers have an urgent problem (fish die) they will pump first in order to mitigate the problem. The president is in charge of such decision. There is no yearly fee. The members pay about 130 THB/hour including the electricity fees and 30 THB/hour to pay the person in charge of the maintenance of the pumps (10THB/hour) plus the maintenance fees which are about 30 – 50 000

THB/year for two water pumps. The further the farm is the higher will be the costs because it depends on the time of pumping. The president was not able to tell the quantity of water use per year. Nine farmers interviewed mentioned to be member of this group. However, the answers regarding to the question relative to the WUG were not clear enough as the farmers do not consider this group as water user group really. Some farmers must have answer no while they actually pay fees to this SML group.

3) Water uses

We focus on the farmers of the village 6 as the study has been conducted in this specific area as mentioned in introduction.

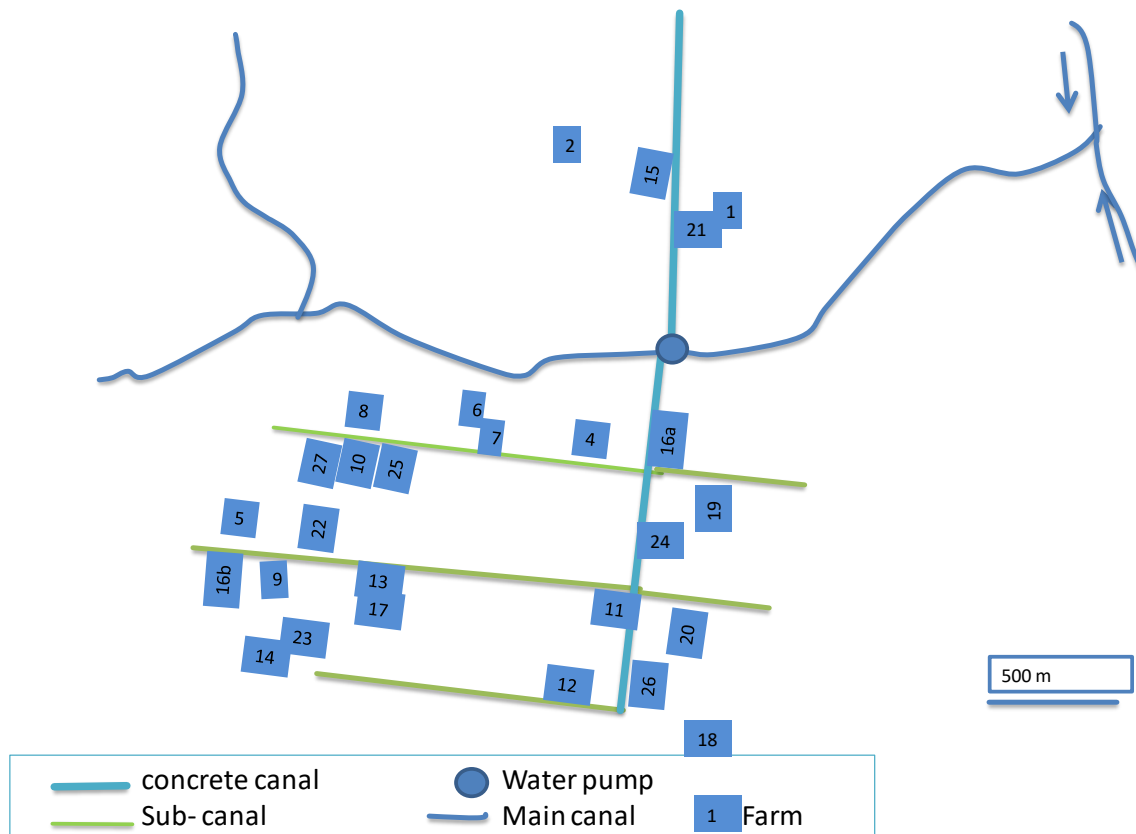


Figure 79: Map of farm distribution within Nikom Phattana area

As mentioned before, the study area is covered by ponds which represent 623 rai. The farmers drain out water after each fish cycle then pump water. The farmers can either pump water from the main canal registering at the WUG or they can re-use the water which flows through the sub canal after draining out the pond. In average they refill the pond 2.32 times per year. The pond depth is about 1.7 in average.

4) Water issues

In Bang Pla Ra four water issues might be prejudicial for the farming production. The first issue is the lack of water, then the salinity issue, the flood management and eventually the pollution issue. However, how we will see, the pollution issue is marginal.

a) Lack of water
i. Tambon level

According to the president of the TAO, the lack of water happens every year from March to April. It is linked to the salinity level. Indeed, when the salinity reaches 2 ppm, they ask to close the main water gate (Bang Phluang water gate) so water quantity decreases. However, the TAO might ask to open it again if the lack is too important only if rice producers are done with the production. In order to prevent such a problem, they store water in to canals (green ones, first map) that they can release if the canal dries up. However, this year the problem was not that important because of Huay Samong dam released water. According to the president of the SML group, the lack of water does not occur every year. It would be in March. They cannot do anything but wait. To him, only farmers with water storage pond can manage.

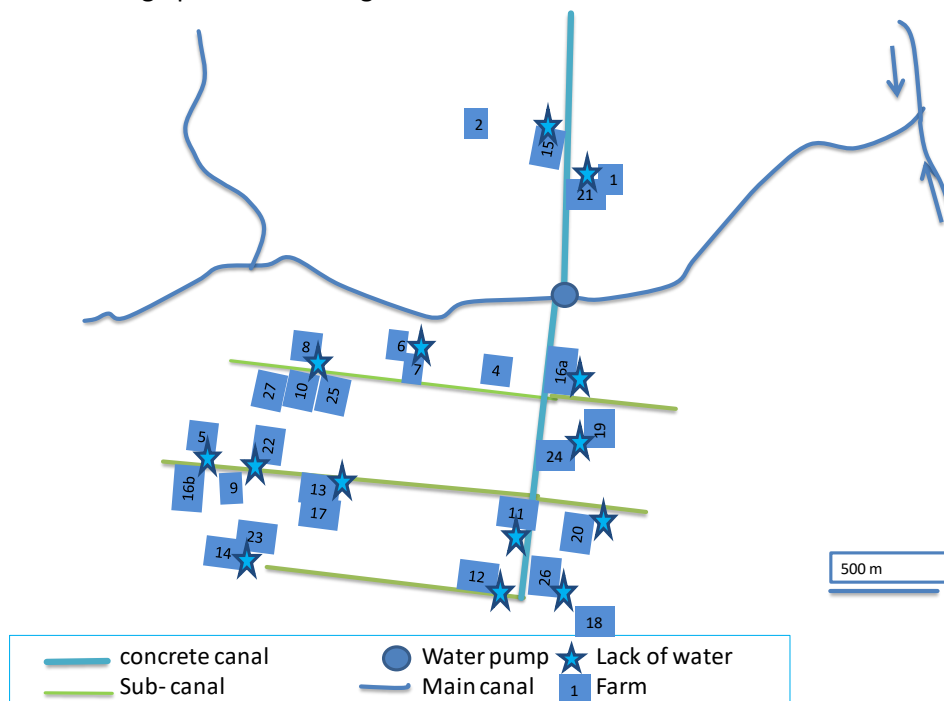


Figure 80: Map of lack of water issue location - Bang Pla Ra

ii. Farm level

The farmers' points of view vary but mainly they think there is a problem linked to the water quantity. Indeed, 12 out of 27 said there was a lack of water and 5 out of 27 said usually there was a problem but not this year thanks to Huay Samong Dam (4) and because the rain came early (2). Additionally, 7 out of 27 face the problem but not every year and 2 out of 27 answered no. In total 25 farmers face sometimes or regularly the lack of water. According to the interviews, the lack of water is from December to June but mainly in April (22 out of 25) and March (19 out of 25). 22 of them do not know why there is a problem. Only one farmer answered that the reason was the farmers pump at the same time. In terms of impacts, only four farmers said the lack of water does not impact their production while 10 answer yes, 6 out of 25 answered that it depends and 5 out of 25 farmers answer "not really". Eventually the lack of water affects the production (fish die and loss of profit) for 8 of them. 2 others stop the cycle or modify the management of the pond.

b) Salinity

i. Tambon level

According to the president of the TAO as said before, the salinity level is linked to the water quantity. It impacts more the rice producers than the dish and shrimp producers. According to the president of the SML group, salinity issue occurs every year in March. The farmers do not use water at that time. According to him there might be conflicts between rice producers and fish and shrimp producers about closing the main gate.

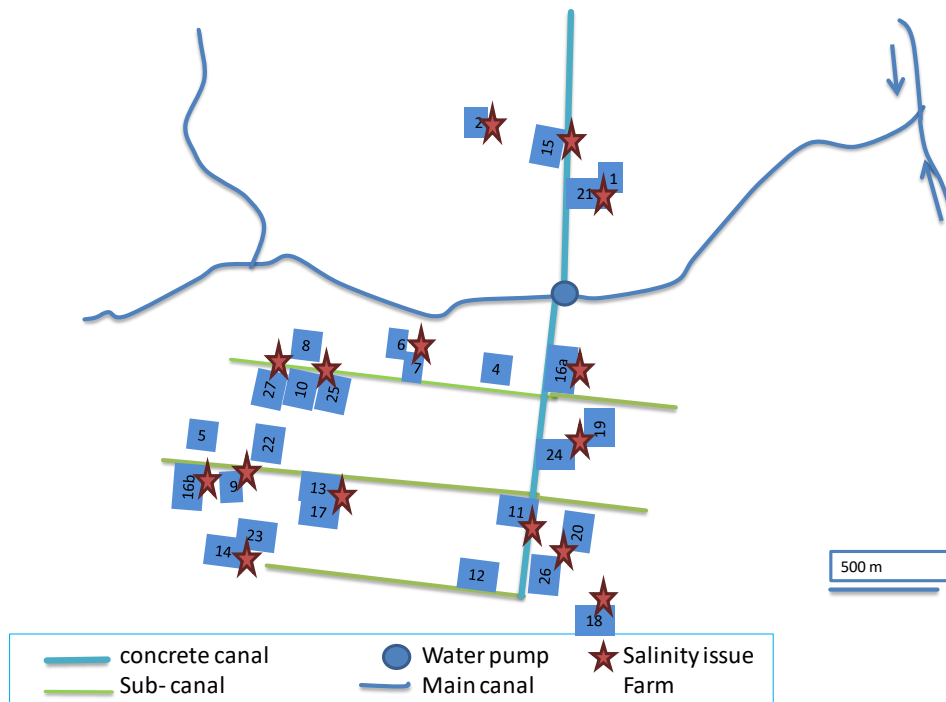


Figure 81: Map of salinity issue location - Bang Pla Ra

ii. Farm level

14 out of 27 farmers face every year the salinity issue while 6 out of 27 do not face it every year and 4 out of 27 farmers mentioned that usually there is an issue but not this year thanks to Huay Samong Dam. Actually, 24 farmers face regularly or sometimes the problem. According to the interviews this happens from January to June but mainly in April (21 out of 23). 12 of them do not know why there is a problem. According to the farmers, only 3 of them are really impacted by the problem and they have to harvest in advance to prevent the fish to die so the size and weight are less important so are the incomes. 10 farmers just stop pumping. They do not have the tools to measure the salinity level. One farmer mentioned that he tastes it to know if it is salted.

c) Flood

i. Tambon level

According to the president of the TAO, the floods do not occur every year. They faced the big ones in 2011. According to the president of SML group, the floods do not happen every year but mainly in September and October.

ii. Farm level

The farmers do not face flood every year. 23 of them mentioned that they pay in order to build a dyke. The others add net to their pond to prevent the animals to escape. According to a farmer, if they do not that, the fishes escape and everybody could pick them up. The floods are quite well managed within the area thanks to the dykes.

d) Pollution

i. Tambon level

According to the president of the TAO, the water within the area is not really polluted but sometimes, the palm tree farm located in Bang Ducha release wasted water and the fishes might die in Bang Pla RA; He does not really know why the water is wasted might be chemicals. For the president of SML group there is no pollution issue within the area.

ii. Farm level

23 farmers think there is no pollution issue and 4 of them already face it saying that it because of the palm tree farm. This issue is minor compared to the others.

5) Solutions

As discussed before, the lack of water is mainly linked to the salinity issue. In order to prevent salinity issue from the river, the gates at the river are closed. But doing so the quantity decreases, thus the solution would be to open again the gate when the lack of water is too important. Or in our study-case, release water from the storage canal as seen before.

In terms of flood, within the village 6, the community builds dikes surrounding the ponds. The farmers pay according to their area between 3000 and 5000 THB.

6) Evolution within the past 15 years

a) Water quantity

According to the president of the TAO, rice production does not require a lot of water compared to fish and shrimp production and as the fish and shrimp production has increased over the past 15 years, the quantity has decreased as well. To the president of SML group, the quantity has increased because of the management.

For 13 out 27 farmers the quantity has decreased and 6 out 27 farmers said it has increased thanks to Huay Samong dam and the rain. 7 farmers said the quantity has been stable over the past years. And the last one mentioned it was going up and down.

b) Water quality

To the president of the TAO, the quantity remains the same as before because it the same activities and same way to produce. For the president of SML group, the quality has been increasing because before the land was dedicated to rice production which uses a lot of chemicals while fish and shrimp production do not use such a product.

For the farmers interviewed, the quality has increased for 5 of them and decreased for 13 of them. 8 out 27 farmers think the water quality has been stable and one famer said it was going up and down



Figure 82: Picture of drained out water - Bang Pla Ra

through the years.

Some of them mentioned that the quality was decreasing because of the chemicals used in rice production (2) and four others said that the fish production released wasted water within the area (picture – color of water).

c) Salinity

In terms of salinity, for both the president of the TAO and SML group, the salinity is linked to quantity. However, the president of the TAO said it has increased while the president of SML group said it has decreased as the quantity has increased.

For the farmers, 11 of them think the salinity has increased while 11 pretend it has decreased thanks to Huay Samong dam (8 out 11). Four of the farmers interviewed said the salinity has been stable over the past 15 years and one said it was going up and down.

IV. Evolution within the next 15 years

1) Farmer's project – farm level

Within our study area in Bang Pla Ra, 19 out 27 do not have plans. Some explain that everything is uncertain so they cannot make plan (2 farmers) and some others mentioned the lack of savings. Two farmers want to increase their shrimp production instead of fish one. Two farmers would like to expand their land. And two others would like to hire more labor. At farm level, six farmers think their kids will take over. In 17 cases, it is not sure. It will depend if they find another job or not. One farmer said that she has only one son so he has to take over the family business. In most of cases, the kids are still young; the parents cannot predict what they will do.

2) Scenario outline – tambon level

a) Water quantity

In the president of the TAO's point of view, as they use the same natural resources the quantity will be stable. The president of SML group thinks the quantity will increase thanks to Huay Samong dam. Most of the farmers follow the idea. Indeed, 16 out 27 farmers think the water quantity will increase and it will be thanks to Huay Samong dam for 14 farmers. Three farmers said the water will be stable because it will be the same activity within the area. Eventually, people are positive according to the water quantity evolution.

b) Salinity

For 20 farmers the salinity issue will decrease and for 17 of them it will be thanks to Huay Samong Dam. The three other mention the importance of the weather (rain). Only one said it will increase because it is linked to the quantity of water. Both presidents (of TAO and SML group) think the salinity will decrease thanks to the dam.

c) Water quality

14 out 27 farmers think the water quality will increase. 12 of them think it will be thanks to Huay Samong Dam. For others, it will be because there is no factory releasing wasted water around. For two farmers agriculture is one of the reason of the decrease of quality both rice and fish and shrimp production. Only one farmer mentioned factory as a problem within the area, without

pointing one specific factory. For the president of the TAO, the quality will be stable while the president of SML group does not know as there has never been a real problem of pollution.

d) Farming activity

The majority of the farmers (24 out 27) think the fish and shrimp production will remain the main farming activity within the area. For 8 of them, the rice production will decrease while the fish and shrimp production increase. The main reason is that it is hard to shift from pond to other production. In terms of number of farmers, 10 farmers think the number will increase because it is a money-making activity. Regarding to the new generation involvement into farming activity the opinions vary. Indeed, the president of the TAO thinks even though the new generation has a different occupation they will take over eventually. The president of SML group thinks that it is their duty to study first. For the farmers, only three of them think that the new generation will take over for sure. But for 15 out 27 farmers it will depend. First it will depend if they study, it will also depend whether the family owns the land. For 8 out 27 farmers, the new generation will find another occupation mainly because it would be more stable than farming business which is also tiring. Regarding to the family typology, we notice that the new generation is indeed studying higher and work in factory or company. Eventually they might come back as suggested three farmers.

Chapter 4: Comparison

I. Farming typology

To summarize, the three study areas present different farming activities. Dong Khrathong Yam produces rice while Bang Taen produces also rice (80%) but also shrimp, fish and orchard. Eventually, Bang Pla Ra produces fish and shrimp. From the data collection we notice that from these differences in terms of activities, the tambon present differences in terms of farm typology. First, we present the typology in rice production that we can meet in Dong Khrathong Yam (annex n°) and Bang Taen (annex n°).

1) Rice farm typology

We identified four main types in rice production that you can find in the next table. In order to do so, we gather in one group the farms which invested in machines (tractor or harvest machine). Most of these farms are also large-scale rice production farms. Indeed, investing into such machines requires more than 1 million baths and only a large production may pay off such expenses and makes it profitable. In Dong Khrathong Yam the average size of this type is 81 rai and concerns 11 farms while in Bang Taen the average size is 105 rai for 5 farms. The second type gathers the farms which have not invested in machine and have to hire operator. They also hire labor to sow and spray chemicals. The third type gathers farms which have started diversifying their production by introducing other types of production. In Dong Khrathong Yam a few farm have developped such activities but three have started fish production and some others would like to develop orchard and vegetables in the future. In Bang Taen, more farmers have diversified, in particular shrimp production beside rice production. Nevertheless, in Bang Taen we did not meet farmer producing only ine crop of rice, only in Dong Khrathong Yam and they represent the type 4.

Large-scale rice production Machine	Important use of External labor	Diversification	Nabee production
<ul style="list-style-type: none"> • Machines (tractor/ harvest machine) • large area 	<ul style="list-style-type: none"> • labor: operator • sowing or/and spraying 	<ul style="list-style-type: none"> • <u>rice production</u> • <u>other production</u>: fish pond, bamboos, organic rice 	<ul style="list-style-type: none"> • <u>1 crop - lack of water</u> • labor: operator only

Table 9: rice farm typology

We assumed that the types 1 and 3 were the more sustainable facing the price variability of the rice. The first one is independent from operator and can absorb the low price with the large-scale production. The third one insure diversified products and various incomes to face to economic problem. By discussing with the farmers of Dong Khrathong Yam, they agree to say the more sustainable type for the future is the number three and they would like to tend to it.

2) Fish and shrimp farm typology

In this part, we present the typology we identify in Bang Pla Ra. For more details, read annex n°5. The characterization was not easy because there is a few difference between all farms. Indeed, they all produce at least one mixed pond of fish and shrimp and most of them hire labor to harvest shrimp and the middleman harvest fish with his/ her team. However, we determine one main type: the farms which produce 100% fish and shrimp mixed pond. Some of them have invested in materials such as net, then they do not hire labor to harvest (type 2) and we classify in a third type the farmers who produce different type of pond: mixed or not mixed.

100% F/S	No labor	Diversification
<ul style="list-style-type: none"> • F/S pond • labor for harvesting and apply products 	<ul style="list-style-type: none"> • investment in net 	<ul style="list-style-type: none"> • F/S pond • Fish or shrimp pond only • Orchard

Table 10: Fish and shrimp farm typology

II. Reasons for using external labor force

We try to understand why the farmers hire labor for each type (table n° for rice production and table n° for fish and shrimp production). In the first type, the reason is the large area. Indeed, in order to finish the tasks in time, the farmer may need help from labor as the land is too big. For the second type, many reasons may explain why they hire labor. The first factor is the age, then they may have other occupation, or there is only one farmer working in the farm. The land size might be a reason as well.

Large-scale rice production	100% external labor	Diversification
<ul style="list-style-type: none"> • large area of production 	<ul style="list-style-type: none"> • Age • other occupation • land size • 1 farmer 	<ul style="list-style-type: none"> • take care of the shrimp pond and other activities

Table 11: Reasons for using external labor force - rice production

For fish and shrimp production, they hire labor mainly for harvesting because they do not have the tools.

III. Economics part

As we see in the previous part, the profit varies from a production to another. The following table present the profits from rice, shrimp and mixed fish and shrimp production per year. We can see that the difference is huge between rice production and shrimp production. We also notice the difference between shrimp only and fish and shrimp production and we may wonder why the farmers do not produce only shrimp though. It is important to remind that these figures are an average from the data collection and as we will discuss in a next part, these results may be not always accurate.

Rice production	Shrimp	Fish and Shrimp
4400 THB	36000 THB	12000 THB

Table 12: Prices variability between farming activities

But they show how different are the farming activities in terms of profit. We try to show with the next figure what area is necessary in order to get the same profit. One saure representing one unit (a it happens one rai here). We can observe that the rice production requires 8 times an area compared to the shrimp production. However, the shrimp production is a risky production. So even though the profit is high it may be very low. We met farmers whom shrimp cycles die very often.

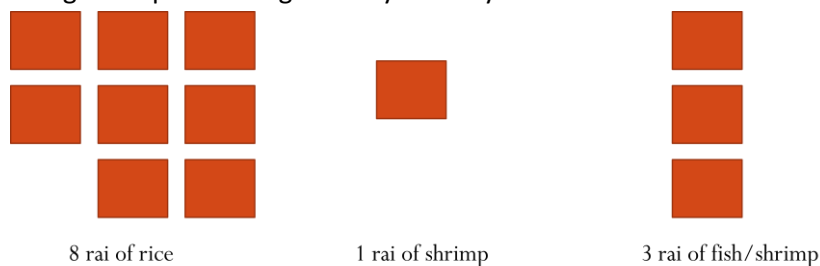


Figure 83: Land size required to get the same profit per activity

IV. Farm characteristics

In this part, we compare the three tambon. First we can see that the rice farmers in Dong Khrathong Yam are older than the fish and shrimp producers in Bang Pla Ra. Indeed, the farmers interviewed in Bang Pla Ra are quite young. They took over their parents within the past 15 years. According to the farmers, the profitability of the activity determines whether the new generation wants to take over or not. In fish and shrimp production case, the young people become farmer because is profitable, in rice production, most of them go to study and work either in company or factory. We also notice that the land size is higher in rice production than in fish and shrimp production. We just saw that fish and shrimp farm require smaller area to get a similar profit with rice production. Moreover, in Bang Pla Ra and in particular Nikom Phattana village, the area is full of ponds. If the farmers want to develop their production they have to expand it in other tambon or province. But most of the farmers producer nearby their farms in order to watch over and look after the animals to prevent the thieves and diseases.

Criteria	Dong Khrathong Yam	Bang Taen	Bang Pla Ra
Average age	55	51	47
Land size (rai)	61	55	28
Main land status	Mixed/rented	Mixed/rented	Owned
Renting rate (average THB/year)	1300 THB/rai	1000 – 2000 THB/rai	1000 -2000 THB/rai

Table 13: Farm characteristics per tambon

We may also compare the areas regarding to the land status. Indeed, in rice production the land status is mixed but with a leasing trend whil in fish and shrimp production the land is mainly owned. Even in Bang Taen we see the difference between rice producer only and mixed rice and shrimp producer. The mixed farms rent land for the rice and produce the ponds on owned land. This may be explained because as the aquaculture production requires certain investments, the farmers do so on land they own. In terms of renting rate, there is a few difference between the area.

V. Water management

The following table summarize the water management in each tambon and water issues. Sometimes a problem does not appear like this because farmers have found solution to adapt their production to the water issues. However, it would be interesting to assess what the impacts in term of economic loss due to water issue is. The issues depend on the area but also on the activity. Indeed, in terms of salinity, the rice production may be destroy by the brakish water while the shrimp production is helped by the salinity. It is a dilemma for the water manager to deal with both activity when they take decision about closing water gate. On one hand the lack of water due to the gate closes will impact all produciton but on the other hand salinity might impact rice producer. It is why it is important to gather the stakeholders and take fare decisions or the least negative on the productions.

Water issues	Dong Khrathong Yam	Bang Taen	Bang Pla Ra
Lack of water			
-period	December – January		
-causes	<i>Over pumping</i>		
-impact	Decrease of yield		
Salinity			
-period	March - April	March - April	March - April
-causes	<i>Over water pumping from the river</i>	<i>Over water pumping from the river</i>	<i>Over water pumping from the river</i>
-impact	Delay the next crop Decrease of yield	Delay the next crop Decrease of yield Water gate close= lack of water	(Only on Fish) decrease of growth and Water gate close= lack of water
Pollution			
-period	September		Throughout the year
-causes	<i>Factories upstream</i> <i>Chemicals</i>		<i>Palm Tree</i>
-impact	Not really = no cropping		Animals die or limitation of growth
Flood			
-period	September – October	September – October	September – October
-impact	Limited = no cropping	Limited = no cropping	Limited=dykes + net

Table 14: Water management per tambon

Discussion

The results we have presented may be discussed on some points.

Methodology

First I would point the change in translator which impact on the homogeneity of the data collection and may lead to a loss of accuracy while translating from Thai to English. It is certain that speaking Thai would have facilitate the analisys and give more strenght to the solociology study. This lack of homogeneity and strictness has led to question the accuracy of the data because of the change in terms of vocabulary and a trend to summarize the answers instead of translating verbatim.

The evolution of the questionnaire at the beginning of the data collection may have missed some informations in the first area such as the economic data.

Eventually, it would have been interested to get more interview in order to lead a statistic study and get significantly quantitative results.

Results

Intrinsic factors

Some discussion factors have to point the cultural aspect and the study place because some results are influenced by intrinsic factors to the Thai culture or at least to the Thai agricultural sector organization. First, Thai farmers are not obliged to write down their expenses and incomes in a ledger book. This aspect has led to a lack of accuracy of the economic data collection. Indeed, when the farmers were asked to give us the amount of the costs of production they did not remember well. This has been obvious when we presented the results of the study to the farmers. They commented a lot the economic part pointing some mistake in the data as mentioned in the results part. Another typical Thai aspect is the principal of "loosing face". This principal leads Thai person to not mention they have lost money or failed in some activities. We can wonder if the collected economic data may have been biased by this aspect especially when the farmers were two or three during interviews. The last aspect is the "positive" attitude they adopted even though the farmers have to face different issue. Many of them mentioned "Su Su" which represents the fact to remain positive and strong no matter what happens.

Farming production

As we saw, Red Bull supports the organic farming initiative. However, regarding to the total production 147,8 T sold and the RED BULL® policy to buy 1T/m during 8 months which equals 8T in total. The outlet is not that secure. Nevertheless, the organic group is still in discussion with Red Bull® in order to get better prices.

We also saw that the new generation is more interested in working in company instead of doing farming. This situation is quite understandable. Indeed, why struggling with a low profit farming activity while having a stable job will give you stable incomes and better quality of life?

We notice that there is a huge difference between shrimp production profit and fish and shrimp production profit while they are similar. Despite low fish price, the difference explanation is not that obvious. We may assume that for the fish and shrimp production, the farmers focus mainly on fish and not really on shrimp even though these animals lead to a better profit than fish. This has been

confirmed by few farmers telling us that they give food for the fishes and the shrimps just get the rest of the food.

Water issues

We saw that there are some water issues. But as we also saw, some adaptation at farm level or collective level have been made and this leads to questions whether there is a problem as the farmers are quite positive about the problems. For example, some shrimp farmers said there was no salinity issue. But as the salinity is not a problem for shrimp production, we can wonder whether there is salinity indeed but there is no impact on the production. This would make sense when we see that some rice farmers sharing the canal with shrimp farmers mentioned salinity issue. We can assume that in fine there is some issues or at least the problems exist but are seen differently according to the production.

Scenarios

The data collection skims over the scenarios construction but will help to the reflection about them. Especially the part on the public project might help the reflection.

Conclusion

We saw through the study how three main factors: family organizations, access to the market and outlet and water management influence the farming activities within Bnag Phluang area. The three tambon present different activities: mainly rice production and fish and shrimp production.

First, we saw that water management has led to the development of farming activities development: second rice crop and fish and shrimp ponds expansion in Prachinburi Province within the past 15 years. Nowadays, this activities present differences in terms of water demand and profitability. We assessed that rice production is the least profitable activity regarding to the area necessary to get a similar profit than shrimp production. However, among the rice production we identify some rice farm types which might be sustainable such as the large-scale farm and the diversification ones. The first one increases the profit thanks to an economy of scale and the second varies the incomes from different production. The profitability of the activity leads also to the possibility of investment and thus a possible increase of the profit. However, we saw that water management may be an obstacle to the development of certain production: orchard facing flood, lack of water impacting fish production etc. it is why it is important to develop an efficient irrigation system. Facing the current water issues, the farmers have developed some adaptations and solutions but we may wonder whether there is still a lack of profit despite these adaptations. Some collective and public projects have been led such as Huay Samong Dam which allows pushing away brackish water when releasing water around February. The water management is thus a key element in the farming development. Moreover, the profitability of the system and its sustainability (in terms of economics and water availability) will determine whether the new generation of farmers will take over the family business. Indeed, the agricultural sector must be stable and profitable in order to take over otherwise they will choose other employment. The profitability and the training in farming innovation might lead the farmers to invest and develop different techniques less tiring which might encourage the new generation to take over.

Besides the profitability and water management, the new generation involvement is the third key element necessary to the sustainability of the agricultural sector. It is on these aspects that the public policies must reflect and coordinate their projects in order to be as efficient as possible. It will be important to define the scenarios for the next 15 years according to the data collection.

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ANNEXS

ANNEX 1: QUESTIONNAIRE

A. Farming activities questions

I. General organization

- 1) How many people live in the farm (family members including you)?
- 2) Who are they? (Sister/brother/wife/children...)
- 3) Could you tell their age (including yours)?
- 4) How many of them work with you?
- 5) What about the others members: do they work?
 - a. If yes, what is their job?
 - b. Do they bring back money?
- 6) Do you have children who live elsewhere?
 - a. Do they work?
 - b. What job?
- 7) What is your education level?
- 8) Have you always been farmers?
If not what did you do before
When have you started doing farming?
Why this change?
- 9) Land: What is size of your production area? (*show plot on the map and table*)
 - a. What surface area do you own?
 - b. What surface area do you rent-in?
 - c. From whom? How much?
 - d. What area do you rent-out?
- 10) What were your farming activities last year (59)?
 - a. What species/varieties?
 - b. Describe the production cycle over the year?
Rice /Fish/Shrimp production cycle/ number of harvests etc.
 - c. Why did you choose these activities
- 11) Have you invested in any machines (including machine for water purpose)?
 - a. If yes, what machines? Harvest/tractor/tiller/
 - b. How much did you invest? (especially the cost of a water pump)
- 12) Do you hire labor?
 - a. For what purpose? Plowing/ sowing
seed/chemicals/Fertilizers/harvest
 - b. How much do you pay them for each purpose?
 - c. Are they temporary workers? Permanent ones?
 - d. Did you hire labor 15 y ago? How has it developed over the past 15 years? Why did you start hiring labor?
- 13) Do you (and other farmer) have others occupations? (*different from farming*)
 - a. If yes, are they permanent? Temporary? Why?

II. Economic issue

- 1) What is your annual production?
 - a. Growth rate/ yields
- 2) What are the production uses/outlets? (*sales / Home consumption / other*)
 - a. If sales: precise (*to what and how (contract/wholesale/tourists etc.)*)
 - b. If it is others : precise
- 3) What are your (farming) ANNUAL NET incomes? The others? (*Amount of the last sale for example?*)
- 4) What are your costs of production?
- 5) Is your farming activity profitable/money-making? (profitability/ha on a 1 to 5 scale)
- 6) How has your activity developed over the past 15 years (since 2545)?
In terms of equipment/land/activities/varieties etc..
 - a. Did your activity change?
 - b. If yes, what were the important changes? Why? (dates!)
 - c. If not, was it the same production techniques? With the same varieties?
- 7) *For Fish/shrimp only:*
 - a. *What is the distribution channel? Market? Sell etc.*
 - b. *What investment did you make for F/S production?*
 - c. *How do you manage it during the flood? Do you build dike to keep fishes inside pounds?*

B. Water management questions

I. Technical issue

- 1) Do you irrigate the total area?
- 2) Do you have any water reservoirs? (*what volume?*)
- 3) What quantity of water do you use by year? (*it is difficult to estimate but try*)
 - a. With a pump : water flow/ length of time
 - b. With a pond : part of it used / volume
- 4) Could you describe your water uses over the year? (*Schedule month by month) when you need the most and the least*).
- 5) When is the lack of water most important? (farm level)
 - a. Is it every year?
 - b. Does it impact your production?
 - c. How do you manage or adapt your production?
- 6) Is there a salinity issue? (farm level)
 - a. When exactly?
 - b. Is it every year?
 - c. How do you manage or adapt your production?
- 7) Is there any problem of pollution? (farm level)
 - a. If yes, do you know the origin?
 - b. Have you ever reported it? To who?
- 8) Have you noticed any changes over the past 15 years? (farm level)
 - a. Quantity : stable/less/more
 - b. Quality : stable/decrease/increase
 - c. Salinity

II. When you have any problems (pollution, conflicts, water scarcity...) do you report them?

- 1) If yes, who do you report it to?
- 2) Do you get solution/consideration?

III. Farmers collective

- 1) Do all the farmers of the Tambon have enough water over the year?
 - a. If not, when is the lack important?
 - b. How is it managed?
- 2) Which WUG are you part of?
- 3) How is the water management organized within the Tambon or your WUG?
(Zone/water uses/pumping/opening Watergate etc.) Who is in charge?
- 4) Are you satisfied of the water management operated by the group?
- 5) Are there collective initiatives planned in the future with the others farmers?
(production/water)

C. Evolution

I. Farm level

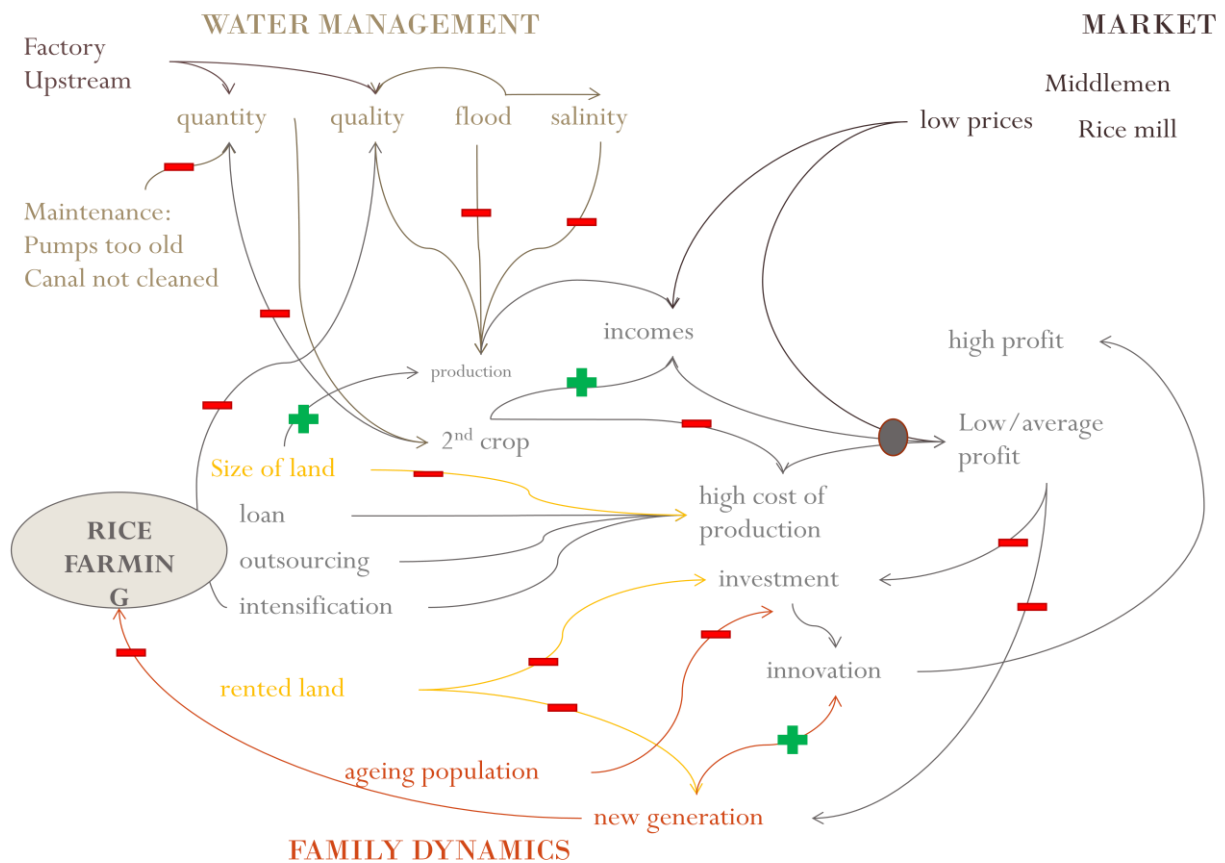
- 1) What could improve your farming activity within 5 years?
- 2) What could negatively impact your activity within 5 years?
- 3) What are your plans for the future? Short term
- 4) (For rice producer only: would you change to F/S production? **why?**)
- 5) *Future/what's next? Long term*
 - a. When do you think you will stop your farming activities?
 - b. Will your children (or someone else) take over you?
 - i. If not, what are you going to do? (*Sell for example /rent etc.*)

II. Tambon scale

- 1) How will progress the quantity of water within the 5 next years? Why?
- 2) How will progress the quality of water within the 5 next years? Why?
- 3) How will progress the salinity of water within the 5 next years? Why?
- 4) How do you see the development/ evolution of agriculture within the Tambon within 10 years? (In the future: how many farmers/size of the farms/kind of activities/New generation and farming etc..)

Do you have any comments to add? Would you like to ask questions?

ANNEX 2: Interrelationship between stakeholders



LEGEND

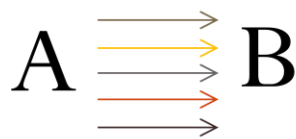
WATER MANAGEMENT Influencing factor= category of key element or issue

quantity

Key element or issue
Each colour corresponds to the same colour category



Central activity



A influences B
Each colour corresponds to the same colour category.



A influences B positively



A influences B negatively



Co- influence of different element over another

ANNEX 3: Typology in Dong Khrathong Yam – Rice production

- to be noted that only 26 farmers appear in the table because one of the farmer's informations were not sufficient enough to identify an accurate type.

Characteristics	Large-scale rice production Machine	Important use of external labor	Diversification	Nabee
Number of farmers	11	10	3	2
Average size	81 rai	45 rai	41 rai	58 rai
% Owned land	50%	43%	27%	87%
% Rented land	50%	57%	63%	13%
Investments	Tractor	No	No	No
Farming activity	Rice 2 crops	Rice 2 crops	Rice 2 crops+others production	Rice 1 crop

ANNEX 4: Typology in Bang Taen – Rice production focus

- to be noted that only 26 farmers appear in the table because one of the farmer's informations were not sufficient enough to identify an accurate type.

Characteristics	Large-scale rice production Machine	Important use of external Labor	Diversification
Number of farmer	5	13	8
Average size	105 rai	34 rai	61 rai
% Owned land	33%	60%	46%
% Rented land	67%	40%	54%
Investments	Tractor	No	variable
Farming activity	diverse - mainly traditional rice	Mainly Rice production (trad+organic)	Normal rice + organic+ Shrimp (18 rai in average)

ANNEX 5: Typology in Bang Pla Ra – Fish and shrimp farming

Characteristics	100% F/S	No external labor	Diversification
Number of farmer	16	5	6
Average size	33	15	25
% Owned land	81	63	100
% Rented land	19	37	0
Farming activity	F/S	F/S	F/S (12 rai in average) + Shrimp (5 rai in average) + Fish ponds (10 rai in average)