The Development of an Irrigation System in the Villages of Nong Din Dam and Charoen Chai

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Executive Summary

Subsistence farmers in semi arid regions of Northeastern Thailand face many risks. Anything from personal illness to inclement weather can send the farmers into debt. This project will assess the water requirements for farming in Nong Din Dam and Charoen Chai, and develop a suitable plan for an irrigation system to meet those requirements, thus enabling the farmers to increase their crop yields. An irrigation system could increase crop yields, reduce the risk of crop failure, and possibly allow for the addition of a second harvest each year. The extra income generated by irrigation to their crops would help the farmers rise above subsistence farming by providing economic stability. Our team will analyze the conditions in the villages, including field conditions and crops to assess the situation and determine which irrigation system best suits the needs of the villagers. We will also provide recommendations for a plan for fairly distributing water from the system, as well as maintaining it, both to be overseen by an organization cooperatively run by the farmers.

Nong Din Dam and Charoen Chai are located in Ubon Ratchathani province, within the sub-district of Nam Khun in Northeastern Thailand. They are 98 kilometers from Ubon City and 600 km northeast of Bangkok. Slightly more than half their populations are Catholic, while the rest are Buddhists. Since Catholics are seen as outsiders in Thailand, a Catholic majority is extremely uncommon in Thailand. There is currently a church in the villages, which sponsors the Nong Din Dam and Charoen Chai Rural Development Program, which attempts to assist the villagers in various ways.

Ubon Ratchathani is both Thailand's easternmost province and the Northeast's most populated province, with a population exceeding 1.5 million (Cummings 554). It covers fifteen thousand square kilometers and has a great deal of arable land. Though Ubon is located on the Khorat Plateau, which is prone to extreme cycles of dryness and flooding, causing conditions similar to the "African savannah" (Fukui 19), it is still an important source of food for the people of the Northeast.

The region's importance as a major supplier of food does not isolate them for the trends of the national economy. The recent downturn of the Thai economy has affected the farmers even though they are located in a remote part of the country. The devaluation of the Baht has made it increasingly difficult for farmers to turn a profit.

This is only one of the many problems the farmers of Nong Dim Dam and Charoen Chai face everyday. The farmers are dealing with a wide variety of other problems including: inconsistent rainfall during the growing season, poor soil that lacks water and nutrient retention capabilities due to its sandy composition, low water table, and decreasing income due to extreme drops in the price of rice (Lutzky 21). As there is insufficient rain during the dry season, from November to April, they are currently limited to growing during the rainy season that extends from May to October. They grow sticky rice for personal consumption, and sell cassava, corn and jute to earn money for necessities they cannot produce themselves. This practice earns the villagers an average 10,000 Baht per year, or $253 a year.

There are a number of different irrigation systems. The decision of which system to use will depend on a number of factors including: the requirements of the farmers, crops grown, field size, capacity, water requirements for specific crops, the availability of water, the terrain surrounding Nong Din Dam and Charoen Chai, and the budget and organization of the villagers. The paper will assess these factors and the effects they will have on both the feasibility and creation of the chosen irrigation system.

To accomplish our task, our group will first identify a source of water for the irrigation system. No irrigation system can be effective with out an adequate source of water. We are not likely to find accessible ground water, such as lakes streams or ponds, due to the geographic location of the village. Likewise, the villages' locations atop a plateau substantially decrease the probability of large bodies of water naturally occurring within a reasonable proximity of the villages. Alternative methods to collect water may need to be devised to provide water to the irrigation system.

Our group will also assess the water requirements for each type of crop to determine water requirements for each field. With GIS mapping, we will construct a detailed map of field locations, elevation and water demand. Possibly utilizing water deficit planning, our group will review the critical volume of water required to make the system cost effective, and determine the feasibility of an irrigation system.

If we determine an irrigation system is feasible for the villages of Nong Din Dam and Charoen Chai, our group will make recommendations for an irrigation system and develop a system for maintenance and water distribution. It

is our hope that, once this irrigation system is implemented, it will be a major step for the villagers in their quest to move beyond subsistence farming.

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1 Introduction

Despite the recent shift in the world's economy towards industrialization, agriculture remains an economic staple in many countries. Farmers constitute a significant percentage of the population of many developing nations, and of these, many are subsistence farmers, growing just enough to feed themselves and their families, with little or no surplus. The dangers of farming at this level are immediately apparent. Given a poor growing season, farmers may find themselves unable feed their families without purchasing food they cannot afford, thus going into debt. They operate at the subsistence level because of scarcity of arable land, poor soil quality, or insufficient access to water and fertilizers.

Among the nations in Southeast Asia, Thailand has actually experienced an encouraging growth rate in agricultural output, increasing almost 2% per year during the 1950s, 5.4% per year from 1958 to 1973, and 3.9% per year from 1973 to 1984 (Heenan 199). This growth was largely due to the increase in the amount of arable land, which increased from 10 million acres in 1850 to nearly 150 million acres in the 1980s (Phongpaichit 3). Despite this growth in national farm output and agricultural land, most farms in the northeast received few benefits, due mostly to poor soil quality and erratic rainfall.

The villages of Nong Din Dam and Charoen Chai, located in Ubon Ratchathani province, about 98 kilometers from Ubon City in Northeast Thailand, rely on subsistence farming . The average income in the villages is a paltry 10,000 baht (about U.S. $253) per year. The "Nong Din Dam and Charoen Chai Rural Development Program," established by the Mother of Peace Parish, has attempted to augment the villagers' income by teaching the women baking, sewing,

handicraft, needlecraft, and through a “savings mobilization project,” allowing villagers to earn interest on their savings, by helping the villagers to raise cows.

Though these efforts are well-intentioned, they do not address the major problems of poor soil quality and unpredictable rainfall, which are keeping the crop yields at a subsistence level. Without a reliable source of water, there is no way that the farmers can advance to profitable farming status. The lack of cooperation and trust present in the villages, as well as their limited economic resources, has previously prevented an irrigation system from being developed.

This project will assess the water requirements for farming in Nong Din Dam and Charoen Chai, and develop a suitable plan for an irrigation system to meet those requirements, thus enabling the farmers to increase their crop yields. We will also provide recommendations for a plan for fairly distributing water from the system, as well as maintaining it, both to be overseen by an organization cooperatively run by the farmers. This irrigation system will provide the farmers with a reliable source of water, enabling them to increase their crop yields through a second growing season, and thus allowing them to rise above the level of subsistence farming.

2 Background

Agriculture has long been a staple of Thailand's economy. Specifically, much of the nation must rely on subsistence farming, or growing only enough to feed one's family. A lack of a reliable water source is preventing the villagers in Nong Din Dam and Charoen Chai from moving beyond the subsistence level. This section will first present information regarding the two villages, including programs that our sponsor has started. Since the large Catholic population of these two villages may also have a substantial impact on our project, we present information on Catholicism in Thailand and, more specifically, how Catholics are perceived by other Thais.

Since we do have such limited information on the two villages, we must use information on the general area, Ubon Ratchathani, to interpolate to Nong Din Dam and Charoen Chai. After surveying the situation Ubon Ratchathani, we then move on to the national agricultural economy of Thailand, which has a significant impact on the villagers' lives. After delving into the broader national issue, we then concentrate on the agriculture in Ubon Ratchathani, including growing season, common crops, and problems facing the farmers.

Our project addresses perhaps the most critical problem of a lack of a reliable water source through the implementation of an irrigation system in the villages. Since recommending a system requires a thorough understanding of various facets of irrigation, we then present background on different types of irrigation systems, factors relating to the choice of such a system, and issues of farmer management of the system. Finally, since the construction and maintenance of an irrigation system is such a large task, an irrigation cooperative

may be appropriate and, to this end, we present some basic cooperative principles. This information should provide a solid basis for making a recommendation to the villagers of Nong Din Dam and Charoen Chai.

2.1 The Ubon Villages

The culture and demographic makeup of the villages we will be working with are very important factors in shaping this project. The following section will present background on Nong Din Dam and Charoen Chai, as well as information on how religious differences may affect our project.

2.1.1 Nong Din Dam and Charoen Chai

The villages of Nong Din Dam and Charoen Chai are located in the province of Ubon Ratchathani (in the subdistrict of Nam Khun), approximately 98 kilometers from Ubon City. The majority of villagers are subsistence farmers, concentrating mostly on sticky rice, while growing a small amount of jute and cassava. Steeped in poverty, the average per capita income in the two villages is a paltry 10,000 baht ($253 U.S.). The villages make up the Mother of Peace Parish, and slightly more than half the inhabitants are Catholic.

The church has formed the "Nong Din Dam and Charoen Chai Rural Development Program," which has implemented several programs to supplement the villagers' farming income. In a savings mobilization program started by one of the sisters in the parish, farmers pool their income and allow others to take loans from the pool, to be paid back with interest. In addition, the church has begun to teach the women of the villages sewing, handicraft, and needlecraft, which produces goods to be sold at market for additional income. With the help of the program, many of the villagers are now also raising cows. Since these

programs are run by the Catholic Church, it is unclear to what degree, if any, the Buddhists in the village are involved.

2.1.2 Subsistence Farming

The farmers in Nong Din Dam and Charoen Chai can be described as subsistence farmers, meaning they grow just enough food to feed themselves and their families. In years where there is a surplus it is usually traded or sold for a profit. There are limiting factors that keep them at the subsistence level including lack of technology such as irrigation and tractors, and the poor quality of the soil which limits the types and yields of their crops (Wikipedia).

We must seriously consider that we are dealing with subsistence farmers when evaluating any recommendation for change of traditional methods. There is a substantial risk associated with a bad year. In the case of a catastrophe such as a crop failure or a natural disaster the farmer will not be able to feed his or her family, and may have to sell assets including land to do so (Scott 2). An irrigation system in Nong Din Dam and Charoen Chai would be an essential component to mitigation of these risks and the first step in a move away from subsistence farming.

2.1.3 Catholicism in Thailand

The sizable Catholic population in Nong Din Dam and Charoen Chai is atypical of most Thai villages. It is necessary to examine the role of Catholic Church in Thailand, as well as the general attitude of Thais toward the Catholic faith to determine the effect this religious difference will have on our project.

Thailand's population is predominantly Buddhist, about ninety-five percent. Of the remaining five percent, Muslims make up the largest minority

(Niphon). There are only an estimated 250,000 Catholics in the nation (about 0.4% of the total population), which is small even compared to the other minorities. In Ubon Ratchathani province, there are 24,967 Catholics, making up only 0.32% of the population, despite the presence of a Catholic Diocese (Cheney).

Although the people of Thailand are generally accepting, the Catholics in Thailand are still seen as foreigners for several reasons. One of these is due to their obvious minority. Most of the Catholic parishioners in Thailand are not generally native Thais. The majority come to Thailand from neighboring countries, predominantly Laos, which is a close neighbor to the Ubon region. Thai people also see Catholicism as foreign because many Catholics came to Thailand from previously colonized nations, adding to the stigma of Catholicism (Niphon). Although these are general trends of the relationship between Catholics and Thais, the nature of the relationship between the Catholics and the Buddhists in Nong Din Dam and Charoen Chai is still unclear to us.

2.2 Ubon Ratchathani

The villages of concern in this project are located in the province of Ubon Ratchathani. Situated along the borders of Laos and Cambodia, and with a population exceeding 1.5 million, Ubon Ratchathani is both Thailand's easternmost province and the Northeast's most populated province (Cummings 554). Covering fifteen thousand square kilometers, much of which is arable land, the area of Ubon is an important supplier of food for the Northeast's large population (Lutzky 15). Linking Ubon Ratchathani to Bangkok, the Mittaphap

Highway, or Friendship Highway, runs 629 km. Any goods that flow out of Ubon travel along this highway or through Thailand's complex rail system to Bangkok.

Figure 1. Map of Thailand (Central Intelligence Agency)

Unlike most other parts of Thailand, the Khorat Plateau, upon which Ubon is located, cycles through extremes of dryness and flooding, producing arid

conditions similar to the “African savannah” (Fukui 19). This has severely hindered the agricultural development in the region.

Figure 2. Map of Ubon Ratchathani Province (MSN Learning & Research)

2.3 Agricultural Economy of Thailand

It is important to understand that, while the farmers in Ubon Ratchathani are largely isolated from the rest of the nation, they are still affected by the larger national economy. Bordered by Myanmar, Malaysia, Laos, and Cambodia, the Kingdom of Thailand covers 514,000 square kilometers and consists of four distinct regions: the North, the Northeast, the Central, and the South, each with distinct demographics, climate, and geology. As of July 2003, Thailand had a population of 64 million (est.), making it one of the world’s twenty most populous countries, despite its modest size (Central Intelligence Agency). In the decade before 1995, Thailand enjoyed its greatest productivity and growth. In the following years there was a severe economic downturn leading to the devaluation of the Baht and a national recession. The downturn resulted from infrastructure problems, banking problems, lack of skilled labor, and mounting problems with

economic inequality. In response, the Thai government enacted strong measures to help restore the economy to its previous state (Fryer 1).

Despite industrialization in recent years, Thailand remains a heavily agricultural nation. However, while agriculture accounts for 40% of Thailand's workforce (Fryer 1), it makes up only 8% of all exports (US 2003 Economic Summary). Because of this disparity, food surpluses, which are generally a rarity in developing nations, are a common occurrence in Thailand. Thailand's high proportion of land owners to non-land owners is also uncommon in the developing world. This low rate of tenancy, combined with Thailand's generally large farms (by Asian standards) has led to a higher standard of living in Thailand than in other developing nations. For instance, the government privatized many businesses that were formerly government-owned. In addition, the banking and financial systems were restructured (Fryer 1).

The Thai village economy has existed for hundreds of years and, like the national economy, relies heavily on agriculture, and is often referred to as an "arm's length economy," which reflects the small scale of farming in Northeast Thailand. Most farmers in the region sell their goods to middle men, who are in turn sell to wholesalers or other types of markets. This system implies an open market where buyers and sellers can switch to whoever gives them the best price, often in an informal auction format (Warr 81).

2.4 Agriculture in Ubon Ratchathani

Understanding some basics behind the agriculture in northeast Thailand and some of the problems plaguing the farmers will be vital to the success of our project. There are two distinct seasons, a rainy season that extends from May to

October and a dry season from November to April, with a mean annual rainfall in the region of 1600 mm (Lutzky 17). Crops are planted around the third week of July, and are harvested in November. The main crops in the villages include rice, corn, jute, and cassava. The villages grow two types of rice: glutinous (sticky) and non-glutinous (non-sticky) rice. The sticky variety is grown for personal consumption, while non-sticky rice is mainly produced for sale (Lutzky 18).

Chemical fertilizer is applied to over 90% of the rice grown in the area, while manure is applied to roughly 85%. Some farmers do use irrigation; however, this is limited due to technological and financial restrictions (Lutzky 19). Most northeastern Thai farmers lack machinery, and generally hire others with machinery to help them with threshing and milling, though they normally harvest by hand (Lutzky 20).

The farmers in the area surrounding Ubon are dealing with a wide variety of problems:

- poor soil that lacks water and nutrient retention capabilities due to its overly sandy composition
- low water table
- environmental damage due to improper fertilizer use, and
- insects and disease
- inconsistent rainfall during the growing season

(Lutzky 21)

2.5 Irrigation

An irrigation system has been identified as a means for the farmers of Nom Ding Dam and Chaoren Chai to mitigate many of the risks associated with

subsistence farming, and perhaps to move beyond subsistence farming altogether. To successfully make recommendations for an irrigation system, however, the group must first gain a through understanding of many different facets of irrigation. The following sections detail the different types of irrigation systems, factors that go into choosing them, information regarding water sources and cost, the concept of water deficit irrigation, and concepts for farmer-managed irrigation systems.

2.5.1 Types of Irrigation Systems

There are several available systems of irrigation to be considered for use in Nong Din Dam and Charoen Chai. We must examine these different types to form a basis for our recommendation. The following section examines three major types of irrigation systems: sprinkler irrigation, drip irrigation and gravity irrigation.

2.5.1.1 Sprinkler Irrigation

This system, an example of which can be seen below, has gained popularity over the years due to it ease in operation and its use of light and inexpensive aluminum piping. The main elements of a sprinkler system are the source of water, the main pipeline, the sub main pipelines, the sprinkler laterals, and the sprinklers. Gravity fed lines or a pumping system force water through the system and onto the fields. The main pipeline of this system brings water from the source to the fields; these pipes are generally made of either PVC or aluminum. The sub main pipes branch off the main pipe and deliver the water to the individual fields, often running along the boundaries of the fields supplying the water to the sprinkler laterals. The sprinkler laterals supply the water from the

pipes to the actual sprinklers, which spray the irrigated water over the desired area. As pumps are often expensive, there is significant cost associated with the equipment used in this type of operation. Construction of this system is fairly simple, however (Finkel 193).

Figure 3. Sprinkler Irrigation System (CA Dept. of Water Resources)

2.5.1.2 Drip Irrigation

Drip irrigation is similar to sprinkler irrigation in that pumps or gravity deliver water to the fields in the same way. When the water reaches the fields, however, it is not sprinkled over the crops, but a system of porous pipes is used. The pipes rest on the ground, as seen below, and supply water to the soil at a slower rate than that of sprinklers. The porous pipes deliver water directly to the base of the plants, reducing the losses to evaporation, and thus making this system more efficient. The pumping equipment that may be necessary to move the water in this system is also expensive but, again, construction is not difficult (Finkel 247).

Figure 4. Drip Irrigation System (USDA)

2.5.1.3 Gravity Irrigation

Gravity irrigation is another major type of water delivery. This system also uses a main water source but uses gravity rather then a pump to move the water. Furrows or canals, similar to the one seen below, are often used as a way of delivering water to the fields, but farmers can use different types of piping as an alternative. This system is labor intensive because the furrows and canals need to be built and maintained, but is inexpensive due to the lack of pumping equipment. An added consideration with gravity irrigation, however, is the topography of the land due, to its reliance on gravity. This system works best on level or moderate slopes (Finkel 349).

Figure 5. Gravity Irrigation (San Joaquin Geological Society)

2.5.2 Water Deficit Irrigation

Most irrigation systems assume a near infinite water source. When irrigating in semi-arid regions, this is not a viable assumption. A water deficit model recognizes a limited water supply and adjusts to meet those considerations. Water deficit irrigation, simply put, is under-watering a plant to maximize water dispersal among a larger number of plants (Gorantiwar). Gorantiwar and Smout define the purpose of under-irrigation as "to spread available water over a large area, thereby increasing the total use of water or energy per unit irrigated." Both energy and water use will need to be minimized for an irrigation system in Charoen Chai and Nong Din Dam, due to a lack of funds and the scarcity of water. Under-irrigating crops will not yield harvests of a superior quality; in fact, the harvested fruits will be small and underdeveloped. By tight management of water, however, the process can increase the volume/mass of a harvest by up to 40% (Gorantiwar).

2.5.3 Water Sources

Farmers can use a number of water sources to obtain water for irrigation. These sources include the ocean, rivers, streams, springs, lakes, purchased water, wells, and rainfall (Hackelman 1-7). Unfortunately, due to the limited budgets of the farmers and the geographic location and terrain, the majority of these sources will not be feasible. We are not likely to find accessible ground water, such as lakes, streams or ponds, due to the geographic location of the village. Farmers could purchase water, but its cost is prohibitive. There is a significant amount of precipitation. Eighty-eight percent of the average rainfall, however, occurs between May and October (Lutzky 17). To utilize this source of water we would

have to devise a system to collect and store surplus rain during the rainy season for use during the rest of the year.

2.5.4 Cost

To evaluate and compare the costs associated with each irrigation system we must take both the initial investment and the long term costs into consideration. The initial investment is relatively easy to assess. All expenditure associated with the purchase of components, materials, and the construction of the system make up the initial investment. Long-term costs can be broken up in to two groupings, "fixed" and "variable" costs (Roth 103). Fixed costs accumulate regardless of whether or not the system is in use. Depreciation, taxes and insurance are examples of these. They are also known as "the cost of owning a system" (Roth 104). "Variable or operating" costs are expenses that occur due to the use of the system, and include repairs/maintenance, fuel, oil, and labor (Roth 105).

2.5.5 Factors Affecting the Choice of an Irrigation System

When planning the implementation of an irrigation system it is necessary to consider many factors. Several of these include the water source, topography, climate, soil types and crops.

Several factors affect the effectiveness of a water source, including:

- elevation
- size
- acceptable flow rate
- distance from fields (affects the need for a pump), and
- water quality (presence of chemical sediments).

The topography of the region (the slope of the terrain) can be a limiting factor in choosing an irrigation system. Farmers can use all systems on minimal to moderate slopes, but can only use drip irrigation on steep slopes. The uniformity of the slope can affect the flow of water in all types of systems but is generally not a problem for the three predominant irrigation systems discussed earlier (Finkel 37).

We must also consider the climate of the irrigated region when evaluating the choice of an irrigation system. Sprinkler systems are not suited for windy conditions, as wind can greatly disrupt the uniformity of the system and increase evaporation substantially. The temperature and humidity greatly affect the efficiency of a sprinkler system by aiding evaporation. In the case of high temperatures and low humidity, it is best to use drip or gravity irrigation (Finkel 39).

Soil in the irrigated region is also an important consideration, as it can affect the watering method. Soils with high moisture capacity require water less often but require more water each individual watering. Soils with low moisture capacity need water more frequently and cause increased losses due to runoff (Finkel 39).

The type of crop being grown also has significant importance when considering an irrigation system. All types of irrigation are suitable for row crops. Gravity irrigation is best for closely spaced crops and orchards (Finkel 42).

2.5.6 Planning for Farmer Control and Maintenance

According to Yoder and Thurston, when designing an irrigation system to be run and maintained by farmers, there are five main elements of a successful

design process. The design process should: "1): be policy-driven, 2) be field-based, 3) have farmer participation, 4) include procedures for learning from experience, and 5) incorporate local logic, knowledge, and experience" (Yoder 10).

Any successful irrigation design project must state clear policies that should support farmer management and involvement. Though these policies must be clear, they must also be flexible and able to adapt to the farmers' needs. This often causes problems when government organizations are involved, as their budgeting rules are often very strict, and can cause significant delays. Government policy should also support farmer ownership of water supplies and the irrigation infrastructure (Yoder 10).

To properly facilitate the design of a system, engineers of the system must spend significant time in the field. This is essential to ensure the proper amount of farmer involvement in the design. Engineers in the field can actually see the physical location where their system will be implemented, as well as interact with the farmers to incorporate suggestions. Though detailed blueprints are often difficult to make in the field, many irrigation projects do not require such detail. These often must be adjusted during the final construction phase anyways, and actually are not required for all but the most complex systems (Yoder 10-11).

If the system is to be owned and operated by farmers, their participation in the entire design process is crucial to the success of the project. Engineers must present a positive attitude toward and maintain healthy relationships with the farmers. In addition, it is vital that they meet with farmers often to keep them informed of the progress of the project and any delays or changes. They must

remain informed of the costs of the project and understand what they will be responsible for. In large projects such as irrigation construction, it is common for farmers to form farmer groups, either formally or informally, to encourage participation in the design process (Yoder 11).

While it is apparent that the engineers designing a system must provide training to the farmers responsible for managing it, farmers also play a key role in providing information to the engineers. The farmers have the advantage of having observed the fields for many previous years, while the engineers can only observe them for a short time. To gain as thorough an understanding as possible of the fields, engineers must visit the field on multiple occasions, and communicate openly with the farmers to identify issues they may encounter (Yoder 12).

An aspect of the design process that engineers often overlook is to identify the objectives of the farmers. The engineers' criteria for a good design may not always match up with the farmers', and this must be determined at an early stage. In addition, engineers should establish a simple and effective forum to communicate design ideas to the farmers. Yoder and Thurston suggest bringing farmers onsite and marking off areas with stakes and strings, instead of discussing abstract design ideas in a large meeting. Another effective means of communicating design plans is for engineers to build three-dimensional models of the proposed structures. If feasible, it is also recommended to take the farmers off-site to locations where similar systems have been implemented. This accomplishes two important tasks. It allows the farmers to actually see a system in operation. More importantly, though, they can discuss the management issues of the system with other farmers (Yoder 12).

2.6 Cooperative Principles

Due to the substantial cost of undertaking an irrigation project, it will be necessary for the villages to act cooperatively by pooling resources and sharing the responsibilities for maintenance of the system. According to the International Co-operative Alliance (ICA), a cooperative is "an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly-owned and democratically-controlled enterprise" (p. 2). The organization also identified seven principles which embody the spirit of cooperatives. Any organization, whether formal or informal, that is formed in relation to this irrigation project, should adhere to these principles:

- Membership in a cooperative should be voluntary and open to anybody willing to use its services.
- Cooperatives must be democratically controlled by their members, and those serving as elected representatives of the cooperative are accountable to its members.
- Members must do business with the cooperative in order for it to be successful, and may be rewarded in various forms for the amount of such business.
- Cooperatives must remain autonomous, and any agreements they enter into must retain that autonomy.
- Cooperatives should provide education and training to members, representatives, and employees.
- Cooperation among cooperatives is encouraged to serve the cooperative movement.

- The final principle reads: “Co-operatives work for the sustainable development of their communities through policies approved by their members” (International Co-operative Alliance 2-3).

By adhering to these principles in the formation of a cooperative for management of the irrigation system, we will ensure fairness and equity to all who choose to participate.

3 Methodology

This project will assess the water requirements for farming in Nong Din Dam and Charoen Chai, and develop a suitable plan for an irrigation system to meet those needs, thus enabling the farmers to increase their crop yields.

The project will take place between January 9, 2004, and March 5, 2004, though we expect that the final construction of our recommended irrigation system will take considerably longer. It is important to focus the project to a specific location and thus, we will include only the fields in the villages of Nong Din Dam and Charoen Chai.

The team plans to fulfill the goal of the project by carrying out the following steps:

1. identify the water requirements of the villagers
2. identify sources of water for the irrigation system
3. design a plan for a suitable irrigation system
    i. assess the impact of the terrain on the irrigation system
4. develop a cooperative water management plan.

3.1 Identify Water Requirements

To determine the feasibility and complexity of the proposed irrigation system, we will first need to identify the water requirements of the villagers. This will involve taking detailed measurements of the fields of the farmers who wish to participate in the project. We will need to determine the total land area we will need to irrigate. In addition to this, we will map out the crops that are grown on each field, and the typical water requirements for each crop. The water requirements for each crop will be determined through reference sources and interviews with the villagers. With this combined information, we can determine the total amount of water required for crops for the village. We will then determine the minimum rainfall the farmers can expect in a given year, by looking at rainfall data for the area, and also from the farmer's knowledge of yearly rainfall. Subtracting this number from the total water requirements of the villagers will yield the amount of water the irrigation system must provide in a year.

At this stage, if maps of the villages are unavailable (which we expect they won't be), we plan to map the fields ourselves using a GPS system along with field observations and measurements. While the GPS technology is inexact, it is inexpensive and we expect that the error will not throw off our data significantly. To generate these maps, we will use GIS mapping technology with MapInfo software.

This stage of our project will likely involve interviews with the farmers, which brings the communication issue into play. We are uncertain how we will

communicate with the villagers. At this point, we plan on the availability of one of our sponsors, either Sr. Lita or Ms. Cipriano, to interpret for us.

As these data are crucial for our project to proceed, it should be gathered as soon as possible. We plan to have it completed within the first two weeks of the project period.

3.2 Identify Water Sources

Another step in determining the feasibility of the project overall is identifying sources of water for the irrigation system. We will locate sources of water through interviews with the villagers and through analysis of maps of the area, if available.

Along with consideration of static water sources such as ponds and reservoirs, we must also consider the amount of rainfall the area receives. It may be possible to incorporate a rain collection system into the irrigation system, to save rain for later use. Indeed, if there are no surface bodies of water in the area, the system may need to rely entirely on this rainfall collection system.

These data are also crucial to our project, and should be collected concurrently with the data from Objective #1. This should also be completed within the first two weeks of the project period.

3.3 Develop a Plan for an Irrigation System

After collecting the previously mentioned data, we will be in a position to analyze this data and use it to recommend a suitable irrigation method to meet the requirements of the farmers. In addition to consulting our own data, it will be important to gather opinions and view from the villagers at this stage. Since they

will be responsible for maintaining the system, it is important that we take their input into consideration when making our proposal.

3.3.1 Assess Terrain Impact

As par of developing a plan for an irrigation system, we will assess the impact of the terrain on a possible irrigation system. This is necessary to determine which types of irrigation systems, if any, would be appropriate, as relative elevation can have a significant impact on the performance of the system.

To accomplish this, we will search for elevation maps of the area. If we are unable to locate these, we will map the area ourselves, using either a GPS system, an altimeter, or an eye level. This will be the final phase of information-gathering before the actual design process begins because it plays such an important role in the design of the system. This data should be collected by the end of the third week of the project period.

3.4 Develop a Cooperative Water Management Plan

Finally, after carefully analyzing our data and recommending an irrigation system, we will recommend a system for distributing the water and maintaining the system, using accepted cooperative principles. We will collect data from other villages with community-managed irrigation systems to determine common and acceptable methods for such management. In addition, we will interview farmers in the villages to gather their views and suggestions on this management system.

Again, this presents us with a communication issue. It will be imperative that we are able to communicate with farmers in other irrigation cooperatives as well as those in Nong Din Dam and Charoen Chai. While we hope to rely on Sr. Lita and Ms. Cipriano to interpret in the two villages, we may need to hire a third-

party interpreter for communication when we visit other irrigation cooperatives. We plan for this work to be ongoing throught the term. We will interview the villagers within the first few weeks but the visits to other farms and expert interviews could take place at anytime during the project period.

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Appendix B. Traditional Northeastern Thai Villages

Households are considered a major subdivision of Northeastern Thai villages. The inhabitants of these villages distinguish themselves from other Thai by centering a portion of their Buddhist ceremonies within the household unit. Specific to Northeastern Thai households is a sleeping room, which houses a Buddha statue for religious and ceremonial purposes (Tannenbaum 142).

Thai villages cluster around a nuclear population that lives in the village proper. Each village has a guardian spirit, which the Thai believe descends from the ancestral line of the village. Providing religious autonomy, the temple is the central meeting place in nearly all Northeastern Thai villages. Because of this autonomy, many Northeastern Thais view communities lacking a temple as temporary settlements, not true villages. Periodically, the inhabitants hold ceremonies on the grounds of the temple to conciliate the ancestral spirits whom guard the village (Tannenbaum 151).

While Thais use the village's autonomy to support their own civil and moral code, Thai villages do not exist in isolation. They share relations by marriage, business deals, common interests and simple friendly knowledge of one another. Inhabitants often extend invitations to surrounding villages requesting the residents to attend their temple ceremonies and festivals. If two Northern Thai villages are within a close proximity of one another, they may even worship the same territorial spirit, which may or may not have ancestral heritage to both communities (Tannenbaum 150).

Appendix C. Cooperative Agencies in Thailand

The Thai government is extremely supportive of cooperatives, and has formed a variety of agencies in Thailand with the purpose of promoting and assisting in the formation and operation of cooperatives. Some of these provide monetary support while others simply provide the support and backing of a major organization.

Cooperatives Promotion Department

The Cooperative Promotion Department (CPD) provides seven major services: (1) promotion of cooperative principles to the general public, (2) education and training for staff, members, and officers of cooperatives, (3) assistance with formation of multi-purpose cooperatives and loans to support them, (4) promotion of new agricultural technologies to help increase productivity, (5) allocation of land to small farmers and assistance with Land Settlement Co-ops, (6) maintenance of public works such as irrigation, and (7) promotion of involvement of cooperatives in community development. The agency's resources are quite expansive, including 7,200 employees in 73 provincial offices, 751 district cooperative offices, and other field units, and an annual budget (as of 1996) of 3.15 billion baht (approximately $79 million U.S.) (Soedjono 119-121). The farmers in the two villages we are dealing with may be able to utilize the training and other services provided by this agency.

Cooperative Audit Department

The Cooperative Audit Department (CAD) operates as the sole agency responsible for auditing cooperatives; auditing 90% of cooperatives and 60% of

farmer associations annually. The purpose of the organization is to prevent fraud by the management of cooperatives and to ensure that proper and accurate bookkeeping practices are followed. To achieve these goals, the agency provides annual audits as well as spot-checks of bookkeeping. The agency also provides training to employees and officers of cooperatives on proper bookkeeping procedures and provides other relevant financial advice to cooperatives and their members. The organization employs 1,700 Thais, and has an infrastructure consisting of a main headquarters, regional and provincial auditing centers (Soedjono 121-124). Again, it will be important for any new cooperatives to avail themselves of the training services provided by the Cooperative Audit Department.

Bank for Agriculture and Agricultural Cooperatives

A state bank formed specifically for farmers and agricultural cooperatives, the Bank for Agriculture and Agricultural Cooperatives (BAAC) provides credit to farmers for various farm and farm-related activities. As of 1995, the organization had 80 branches, 285 district offices and 840 field offices, and 11,379 employees. The bank often collaborates with the CAD and CPD, most notably in a program to test new cooperative practices and activities with 6 pilot cooperatives, by collecting and analyzing data from the pilot co-ops to recommend ways to increase productivity. (Soedjono 124)

The BAAC also set up Area Marketing Cooperatives (AMCs), each beginning with 30,000 – 40,000 members and with branches at the district, subdistrict and village level. At the provincial level, the AMCs trade crops for members to maximize their profit, cooperate with government agencies to provide

increased marketing ability, and to help provide new technology to members. At the village level, the AMCs provide village shops which operate in a similar manner to consumer coops, by providing supplied to members (Soedjono 125-126). These AMCs could prove useful to the cooperative between the two villages we are dealing with.

Cooperative League of Thailand

The Cooperative League of Thailand (CLT) is the main cooperative organization in Thailand and, as such, all cooperatives in the nation, regardless of their type, are required to be members. The organization receives most of its funding from members, who are asked (though not required) to pay 5% of their net profit (up to 10,000 baht) to the organization annually. Activities of the organization include training of Boards of Directors, officers and staff, as well as publishing various publications and performing organizational tasks (Soedjono 126-128).

The legal status of a cooperative may be either incorporated or unincorporated. Incorporated cooperatives are those that were formed under special cooperative laws, and are recognized as a legal entity. Unincorporated cooperatives are those simply consisting of a group of people working together without an official charter (Williamson 3).

Appendix D. Cooperatives in Thailand

The first cooperative in Thailand was established in 1916, as a village credit organization. The impoverished farmers, who formed this cooperative, were forced to register under the Civil Association Act because there were no laws in Thailand regarding cooperatives until after 1928. With government cooperation and encouragement, however, cooperatives have grown and thrived. As of 1995, there were 4,880 in Thailand with over 6.5 million members. The six major categories of co-ops in Thailand are: agricultural, land settlement, fisheries, thrift and savings, consumers and service societies (Soedjono 83).

By far the largest group is the agricultural cooperative, consisting of 58% of all cooperatives and of the total membership in the nation. They have been experiencing an astonishing growth rate in recent years, averaging 17% annual asses growth, and 14% annual equity growth. Total assets of agricultural cooperatives in Thailand totaled 22.7 billion baht ($568.8 million U.S.) and total equity was 7.5 billion baht ($187.9 million U.S.) as of the end of fiscal year 1994 (Soedjono 83).

Appendix E. Economic Issues of Cooperatives

When looking at the economics of farming cooperatives there are several factors to be considered. One is the ability of farmers to cooperatively bargain for the goods that they need. Another is the ability of farmers to cooperatively sell the goods that they produce. It is important to take these factors into account when considering the formation of a farming cooperative. The main purpose of most cooperatives is to increase the profit of those involved. To do this there are several simple principles that need to be understood in order to understand the economics of cooperatives. The two major types of cooperatives that are most often used in conjunction are marketing and purchasing cooperatives.

The purchasing cooperative could be used by the farmers outside of Ubon. According to the Cooperative Life website, a purchasing cooperative is used to "purchase products and services in bulk to reduce or share costs." The benefits of cooperative buying come in two major forms. The first is the ability for farmers, especially those with small farms common in northeast Thailand, to pool their resources to buy items that they could not afford individually, such as tractors, plows, and other mechanized farm tools. The use of cooperative bargaining when buying can also help farmers greatly. By buying in bulk, this usually allows the farmers to get a better price per-unit than if they had been buying on their own.

Marketing cooperatives "build markets for members' products and services, improve member bargaining power, facilitate delivery of product to market, and improve product quality" (Cooperative Life). Our current information leads us to believe the village farmers are selling their crops to a middleman, who in turn sells the crops for a profit. The farmers who are not working together are

forced to sell their crops in a market controlled by the buyer. This type of market pressure leads the farmers to compete against each other, resulting in a lower price for their crops. This competition decreases the profits that the farmers could be making, if all of the farmers were working together. It is also important to consider that in order for this type of system to work all farmers in the area must be part of the cooperative: only a few farmers need to abandon the cooperative and undersell their goods, to undercut the entire foundation of the cooperative (Frederick 1-3).

Appendix F. Proposed Schedule

Objective/Task	Budget
Complete Background	
Finalize Methodology	
Meeting with Khun Kavi	
Field Data Collection	
Travel to and from site	$200
Overnight stays	???
Identify Water Needs	
Identify Water Sources	
Detailed Maping	
Water Use Analysis	
Irrigation system design	
Conclusion/Recomendations	
Final Presentation	
Preparation	
Rehearsal	
Actual Presentation	
Final Document	
Printing	
Copies	$35
Delivery	
Toatal Budget	$235