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## Potential and constraints for intensive land use with pond irrigation in north-east Thailand

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### **Introduction**

Forests covered 57% of Thailand's land area during 1960s compared to 25% at present. Thus, the country has lost more than 30% of its forest cover during the last forty years. In the North-east Thailand, forests in uplands have been converted for agricultural land use on a large scale. Sugarcane and cassava are the major upland crops. Area under sugarcane, in particular, has been expanding since last fifteen years, because it provides higher and more stable income than any other crop. However, continued cultivation of sugarcane may lead to heavy soil erosion and depletion of soil fertility. Lately, the Thai government and various NGOs have begun to promote new

farming systems, such as integrated/mixed farming of vegetable, fruit and tree crops. Such systems are environmentally sound and also give farmers more independence from agribusiness companies. However, it is not so easy for farmers to make a transition to such new farming systems under the conditions of highly erratic rainfall, insufficient water resources and sandy soils, that are typical of North-east Thailand. In this paper, I will assess the potential and constraints for development of intensive cultivation of vegetable and fruit crops irrigated by ponds, using a case study of a typical village of the North-east Thailand.

### **Study area**

The Korat Basin, particularly the area covered in Khon Kaen province, is characterized by a gently rolling topography with an average elevation of 200 m. There are two types of paddy fields: paddy fields on sloping land/upper slopes and paddy fields on lower slopes/riverside, existing side-by-side in mini-watersheds. Upper paddy fields are generally characterized by sandy soil and lower water retention capacity compared to lower paddy fields characterized by clayey soil and higher water retention capacity. The difference in elevation of the two types of paddy fields is often only a few meters. However, even such a minor difference may have significant implications from the point of resource use practices adopted by farmers.

Nong Saeng village is located 45 km south of Khon Kaen City. The village exhibits topography typical of the area as explained above (Figure 1). Figure 2 shows a map of Nong Saeng district, which consists of six villages. Nong Saeng village is the oldest village located in the center of the district. The village was founded in 1931 with only 8 households. As at present, this village comprises 207 households and 990 inhabitants. Much of the uplands had a dense forest cover. Farmers converted forests for agricultural land use for a long time without any legal permission. The government granted legal sanction to such agricultural land use only recently. Further, farmers enjoy a privilege of cultivation without paying any tax and many farm activities are supported by the government as part of its commitment for rural development. Pond construction is one of the farm activities supported by the government. There are more farm

ponds in Nong Saeng village than in most other villages in the region. A problem faced by the farmers is: how to use ponds such that productivity and sustainability of their farming systems are improved.



Figure 1. Location of the research site

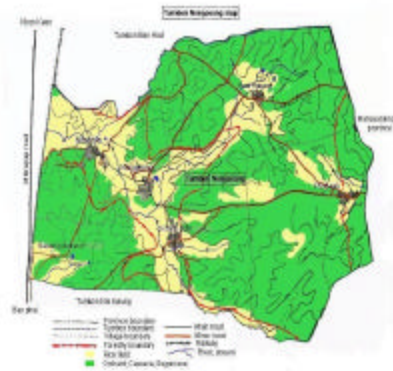


Figure 2. Land use in the research site

In the late 1990s, several government agencies, including Agriculture Land Reform Office and Land Development Division, provided support towards pond construction in Nong Saeng village. About 75% households of the village have one or more ponds. About 60% of these farmers got full support for pond construction compared to 40% farmers who received only a partial support. A survey of 55 families/holdings (which is equivalent to 1/3<sup>rd</sup> of farmers who have ponds in Nong Saeng village) was undertaken to understand structure and function of current farming systems and pond use.

**Labor and land**

About 60% of the surveyed families comprised 4-5 members and can be classified as nuclear families. In 60% of the surveyed families, two members per family were found to be actively engaged in agriculture (Table 1). In 50% of the surveyed households at least one member had off-farm employment in places far away from home, such as in Bangkok or Taiwan. Remittances were used to meet the

expenditure required for agricultural operations as well as other activities.

Table 1. Involvement in agriculture and other activities in relation to family size

Family size	Number of members engaged in agriculture					Total number of sampled households	Number of families with members in off-farm employment away from home
	-	1	2	3	4		
< 3	2	1	2	2	-	7	2
4	3	1	13	2	-	19	6
5	1	2	9	-	-	12	18
6	-	1	4	1	2	7	3
>7	-	3	5	1	1	10	7
Total	6	8	33	5	3	55	26

**Source:** Survey during January – June 2003.

Average farm size in the village is 40 *rai* (1 *rai* = 0.16 ha), which is 1.6 times larger than the average for the North-east Thailand. Every farmer has both lowland fields where paddy is grown and upland area where cash crops are grown, the former being much smaller in area than the latter. Farm size is not related to number of family members actively engaged in agriculture, because there is considerable mutual aid among households due to kinship and community relationships.

### Use of pond water

Ponds provided at no cost by the government are usually located in the upper paddy region (Figure 3). On average, they measure 40 m in length, 30 m in width and 3 m in depth. Ponds built at the farmer's own expenses are usually located in lower paddy region, and are smaller than the ponds provided by the government. Figure

4 shows different uses of these ponds. All but one farmer use ponds for fish raising. About 85% farmers use ponds for paddy seedbeds or transplanting, 70% for cattle raising, 60% for vegetable cultivation and 50% for fruit production. Figure 4 also shows farm households earning more than Bhat 5,000 (approximately US \$ 125) as gross income from sale of products produced using pond water. About 30% of families earned gross income over Bhat 5,000 from cattle raising compared to 10% earning such income from fish culture or paddy/vegetables/fruits production. Apparently, ponds are currently used more for agricultural production for local consumption rather than for marketing.

Gvm: pond provided by government at no cost  
 Own: pond constructed by owner at own cost

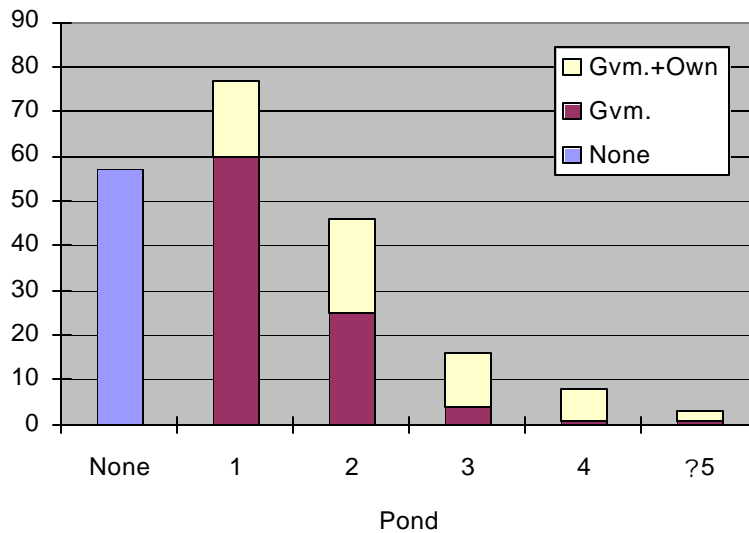


Figure 3. Distribution of farm households based on number of fish ponds per household

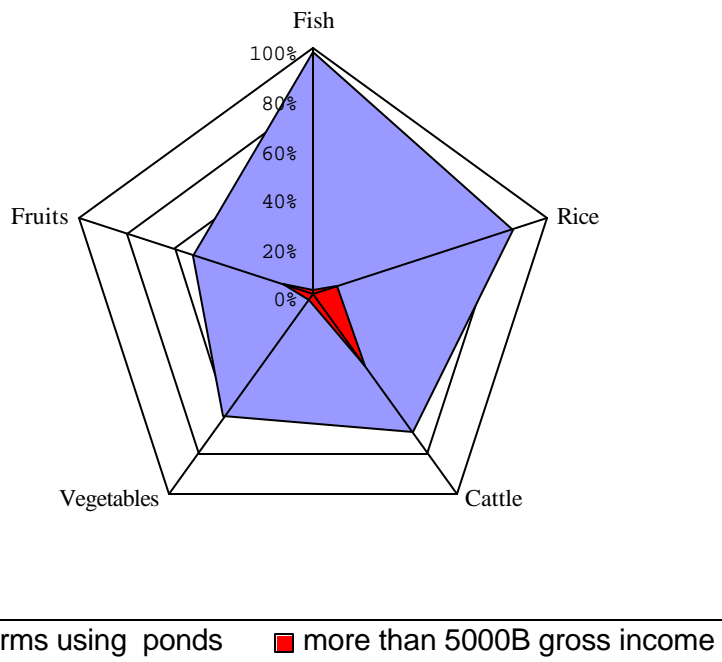


Figure 4. Uses of Farm Ponds and Proportion Generating More Than 5,000B Gross Income (% of farm households).

Figure 5 shows that water depth reaches a level of < 1.5 m by the end of dry season (April). Considering that 1.0-1.5 m depth is necessary for year-round fish culture, the amount of water stored in the ponds is inadequate to meet the irrigation requirements of vegetable or fruit crops.

### Types of farming systems

Most farmers of Nong Saeng village produce sticky rice, which is consumed locally and sugarcane, which is sold for income. Figure 6 shows classification of existing farms based on the primary source of gross income. Sugarcane farming households, defined as households getting more than 80% of their total gross income from sugarcane, make up 56% of sampled households. Farmers would appear to have little motivation to abandon sugarcane, because it provides more stable and higher income compared to other crops.

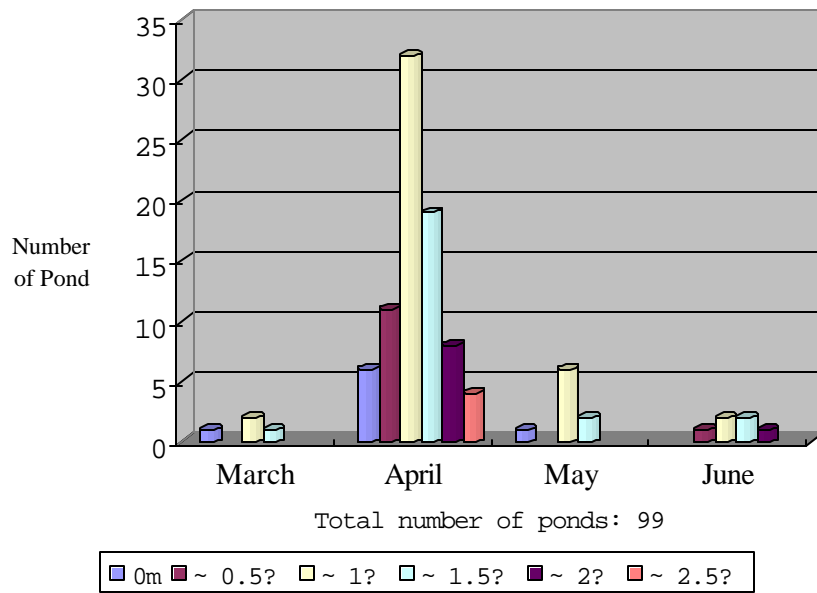


Figure 5. The Depth and Month When Pond Water is Shallowest.

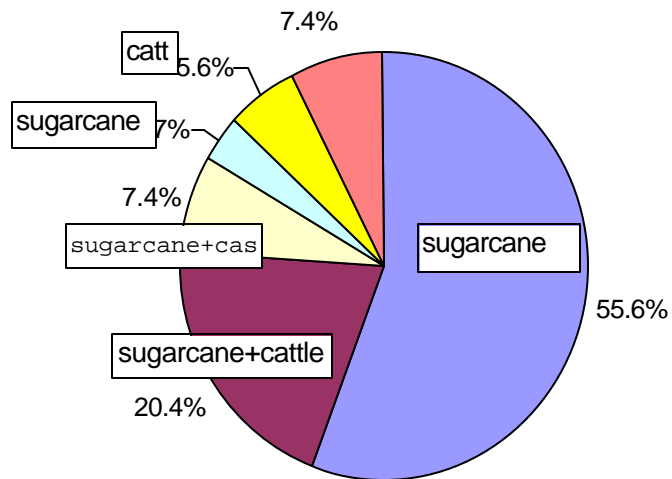


Figure 6. Ratio of Farms by Farming Types

Paddy is grown for home consumption using family labor, supplemented with some hired labor for transplanting and harvesting. Sugarcane production is more dependent on labor from outside than paddy production. Ploughing and transplanting of sugarcane are usually contracted out to large farmers who own power tillers (Table 2). Many farmers sell their sugarcane to large farmers before harvest. In such cases, large farmers have to arrange labor for harvesting. Such an arrangement is referred to as Green Sale Contract.

Table 2. Area cultivated and sources of labor used by six randomly selected farmers in village Nong Saeng, Thailand

Parameter	Farmer's number					
	1	2	3	4	5	6
Planted area ( <i>rai</i> )	10	12	12	30	30	41
Plowing	F	C	C	C	C	C
Transplant	F+H	C	H	C	F	H
1 <sup>st</sup> fertilizer application	F	F	F	F	F	F
2 <sup>nd</sup> fertilizer application	F	F	F	F	-	F
Weeding	F	F	F	F	F+H	F+H
Harvesting	GS	GS	C	GS	GS	GS

F, family labor; H, hired labor; C, contract working; GS, green sale; \*1 *Rai* = 0.16 ha

Dependence on external inputs drives many farmers into debt. Only 5 % farmers were completely debt-free compared to 95% farmers who had taken loan from the Bank of Agriculture and Agricultural Cooperative (BAAC), the Sugarcane Cooperative, the Village Fund or other sources. As many as 50% of farmers had drawn loans of Bhat 50,000 or more (Table 3). The borrowed money was spent mostly to cover expenses required for growing sugarcane. Sugarcane is more profitable and also requires higher investments compared to other crops. Loans usually have to be paid back within one year, but this is virtually impossible for many farmers. The majority is forced to borrow money again at even higher interest rates to pay off old debts. Often family members are obliged to find work far away in Bangkok or Taiwan.



Table 3. Classification of sampled families based on the amount of debt

<b>Total amount of debt (<i>Baht</i>)</b>	<b>Number of families</b>
Nil	3
<10,000	5
10,000 - 50,000	20
50,000 - 100,000	22
>100,000	5

**Source:** Survey during January – June, 2003

Only a few farmers have diversified into production of vegetables or fruits for sale (Table 4). Why have these farmers diversified? To answer this question, we need to examine the characteristics of farms and families of such farmers. Farms which have diversified into vegetables and fruits have more persons aged 60 years or less working in agriculture more than 6 months a year. Further, such farms have larger number of ponds, because vegetable production is more labor intensive and needs supplemental water throughout the crop period. Hence, it will be essential to establish critical amounts of labor and water resources if other farms were to diversify. We may hypothesize that diversification into these new crops may be limited more by inadequate water resources than by labor. Technology development efforts need to be focused on improvement in the present water collection, storage and utilization practices.

The marketing channels shown in Table 4 can be classified into three types: direct sale, sale to a shipper (a merchant who buys product from farmers and sells it to wholesalers in market), and sale through a farmers' group. These different marketing channels represent three different types of human networks. In concrete terms, farmer 'A' listed in Table 4 who sells products through a human network that connects her directly with consumers and retailers as established by her mother over past thirty years or so represents the first type of network. Linkages of farmers 'B' and 'C' to the market through a shipper, who happens to be their relative, represent the second type of network. The shipper recommends to farmers which

Table 4. Resources, income and marketing channels related to farmers who have adopted cultivation of vegetables and fruits

Farmer type	Agricultural labors	Cultivated land ( <i>rati</i> )		No. of pond	Gross income from sale ( <i>Bhat</i> )		Marketing		
		Paddy	Upland		Paddy	Sugarcane Vegetables Fruits			
A	4	15	38	5	875	70,000	63,400	23,520	Direct sale
B	4	17	49	4	-	147,000	1,680	1,000	Shipper (Veg)
C	3	13	47	5	6,090	176,250	12,350	2,600	Shipper (Veg)
D	2	10	15	3	1,375	34,500	-	30,000	Farmer group
E	3	10	20	3	-	30,000	-	50,000	Farmer group

**Source:** Survey January - June 2003; 'A', 'B', 'C', 'D', 'E' are five farmers cultivating vegetables and fruits for sale.

crops they should grow from the point of maximization as well as stability of profits. The shipper also provides them the modern inputs on a credit basis. The third type of human network is represented by farmers 'D' and 'E' who are members of a cooperative organization. This farmers' group provides its members with interest free credit and holds a meeting every month in which farmers can exchange information on how to improve production technologies and insure uniform quality of their products. This cooperative ships mangos to Malaysia as well as throughout Thailand.

These five farmers may be viewed as illustrative examples of establishment and operation of networks entirely through personal human relationships. In these examples, we can see a more fundamental principle at work: farmers can diversify into new cash crops if they are part of a supporting network, whatever kind of human relationship it may be based on. This is because farmers, on their own, have very little information about technologies and marketing related to cash crops.

### **Conclusions**

From the viewpoint of farm management, farmers have to make a series of decisions about crops: what crops to grow, how much land area be allocated to each crop, what production methods to use, and how to market products. Ideally, the decision-making should be based on complete information about available technologies, marketing, inputs and capital. However, it is difficult for farmers to obtain complete information by themselves partly because they lack funds required to get the needed information. Without funds, accessibility to information depends on two factors: (a) farmers' own abilities to seek information; and (b) access to information through social networks based on the human relationships they have built up. We hypothesize that farmers' own abilities to find information will be closely related to their educational levels. Figure 7 shows the educational levels of farmers in Nong Saeng village who are engaged in agriculture for at least 6 months in a year. About 80% of these farmers have primary education. We may hypothesize that such farmers will have only limited ability to seek and process information on their own, and that the domain in which they are capable of making decisions on their own is limited to

management decisions within their respective farms. If this is true, social networks will be decisive for providing farmers with relevant information from outside their farms which is necessary for a better decision-making and success in market.

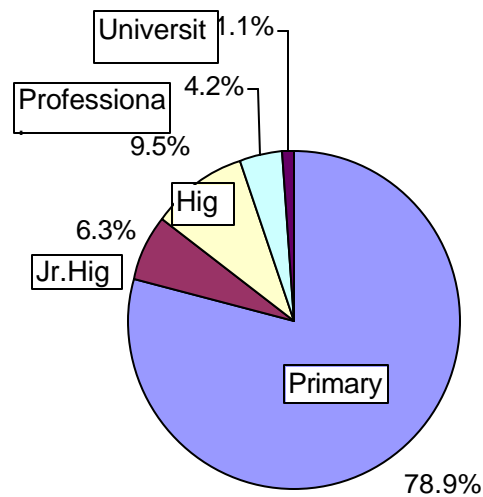


Figure 7. Education level

A farmer has to do everything by himself/herself if he/she wants to sell farm products directly in the market. This is very time consuming in itself, and in addition, sustained effort is required to establish and maintain stable linkages with consumers. It is unlikely that majority of farmers can successfully follow this approach. A cooperative organization may be the most desirable network for farmers to sell their products, because they can obtain more information and can have more bargaining power. However, it is quite difficult to organize farmers and manage an organization without considerable support from agricultural extension or an existing agricultural cooperative. Therefore, linkage with a merchant

(wholesaler or shipper) is the kind of network most often seen in Thailand. The merchant indicates to farmers promising kinds or varieties of vegetables and fruits to produce, and lends them seeds, fertilizers, and even cash directly to procure inputs. In this kind of network, the merchant can be seen as a type of manager who makes strategic decisions, while the farmers are more like laborers in the field. Although this is less profitable than the other two kinds of networks, it is often the only real option for farmers to sell their products when they have no transportation of their own. For farmers to become independent of merchants' control, social networks and cooperative organizations need to be encouraged by the Government apart from providing financial assistance for establishing structures like ponds.