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A CONCEPTUAL FRAMEWORK FOR EVALUATING THAILAND'S SMALL SCALE
IRRIGATION PROJECTS DESIGNED TO PROVIDE BASIC WATER NEEDS

Delane Welsch
Professor of Agricultural and Applied Economics
University of Minnesota

K. William Easter
Professor of Agricultural and Applied Economics
University of Minnesota

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Introduction

Irrigation has received a great deal of attention by developing countries and international funding agencies for nearly the entire period since World War II. From the mid-50's to the mid-70's the focus was on large scale projects. Since then attention seems to have shifted to improving the operation and utilization of existing large irrigation projects and to constructing small scale projects. For example, about 20 to 25 percent of the irrigation investment in Asia is planned for improving old projects (Rosegrant, 1981). Accompanying this shift has been a refocus on the problems of small or disadvantaged farmers and to meeting the "basic needs" of the rural population.

The Thai Situation

The Government of Thailand and the external funding agencies that have been providing assistance for irrigation development have generally followed the patterns described above. Several Thai irrigation development activities are of special interest to this paper. The first is the "small tank" development program. "Small tanks" are reservoirs, constructed on natural drainage ways, that collect and hold the runoff of rainfall from the particular watershed on which they are located. "Small" is not precisely defined by Thai authorities. In this paper we will define small as storage capacity of 5 million M³ or less. It has been estimated that over 550 tanks have already been constructed in Northeast Thailand during the past decade, and an additional 800 or more are planned for construction in the next few years. During

1978-79, 363 small tanks were constructed with a total capacity of slightly over 100 million M³.

The second aspect of Thai irrigation of interest to this paper are the small scale pumping projects of the National Electricity Authority (NEA). These schemes involve using electric pumps to pump water from large rivers. Five hundred hectares of irrigated land in the wet season is the average size of these NEA schemes. NEA provides lined main canals while the farmers install the tertiary canals. Except for the pump operation these projects are operated and maintained by the farmers. Farmers obtain water upon demand from the pump operator and pay only a charge for the power costs of pumping.

The third activity of concern is the newly emphasized Thai government objective, imposed on small scale irrigation projects, of meeting "basic water needs". In this case, "basic water needs" are defined as:

- 1) Water for household members (including drinking, bathing, washing clothing, etc.)
- 2) Water for animals owned by the household (e.g., draft animals)
- 3) Water for raising fish (fresh-water pond culture)
- 4) Water for dry season irrigation of crops (chiefly small plots of vegetables, corn, groundnut, or melons)
- 5) Water for wet season irrigation of crops (primarily for starting a rice seedling nursery before the onset of the regular wet season monsoon rains)

Objectives of this Paper

A number of questions for Thai irrigation policy makers, development project planners, external funding agencies, and development strategists in general arise out of the situation described above. Two such questions are basic to the evaluation of this small scale irrigation development. First, is it possible to empirically measure the contribution of a small irrigation system (tank or pump scheme) to meeting the basic water needs of the rural people in the project service area? If the answer to the first question is yes, then the second question is: what are the net returns to small systems (tanks and pumps) from each of the five basic water requirements?

Answering these two questions is beyond the scope of this paper. What we shall do is argue that the interactions among the five uses is such that a farming system's model provides the best, and perhaps the only, analytical model for measuring the costs and returns of the five uses. We shall then sketch the model that we and our Thai colleagues are using in Northeastern Thailand to measure net benefits from the five uses on a sample of small tanks and NEA pumping schemes.

The Model

The household is the central core of the farming systems that prevail in Northeastern Thailand. The household's decision framework involves three principle functions: (1) a household consumption function, (2) a labor supply function, and (3) a savings/investment function. These three functions interact both with the livestock and cropping systems within the household and the market economy. For example,

family labor may be allocated internally to the household, crop and livestock activities, or to off-farm work. Outside labor can also be brought in for crop and livestock production activities. Transplanting and harvesting labor for rice are examples of the two-way labor flows typical in Northeastern Thailand.

The cropping system and the livestock system are the other two principle components of a typical farming system model. These have the usual interactions with each other. Examples are crops providing feed for livestock and food for the household and livestock providing power and fertility to crops and food to the household. Both are interconnected with exogenous systems when products are sold in the outside market, or non-farm inputs are purchased.

The modification in the typical model that we have made is adding a water supply system to the farming system model. The water supply model interconnects with the household, cropping, and livestock systems. The new supply of water will affect the household labor supply by releasing time from water related activities. During the dry season families no longer have to go 5 km to obtain water. Less time is required to collect water for domestic uses, and to drive livestock to water. The increased supply of water will likely increase water consumption and possibly change the household consumption patterns. Both livestock and crop production will be affected directly by the new water supply. The biggest change could occur in the dry season as vegetable gardens and other dry season crops become possible. Fish products will increase the protein consumption for many families served by a tank project. The fish, if sold, will also provide a new source of income for the lower income segments of society.

In societies where fish are not as readily used in the diet the fish may be harvested by a select few. For example, for many of the tanks in South India the fish are sold to commercial dealers who harvest the fish for sale in the larger cities. For the smaller tanks the earnings are generally used by the villagers for maintaining the irrigation systems. For the large tanks operated by the public works department some of the earnings go back to the government.

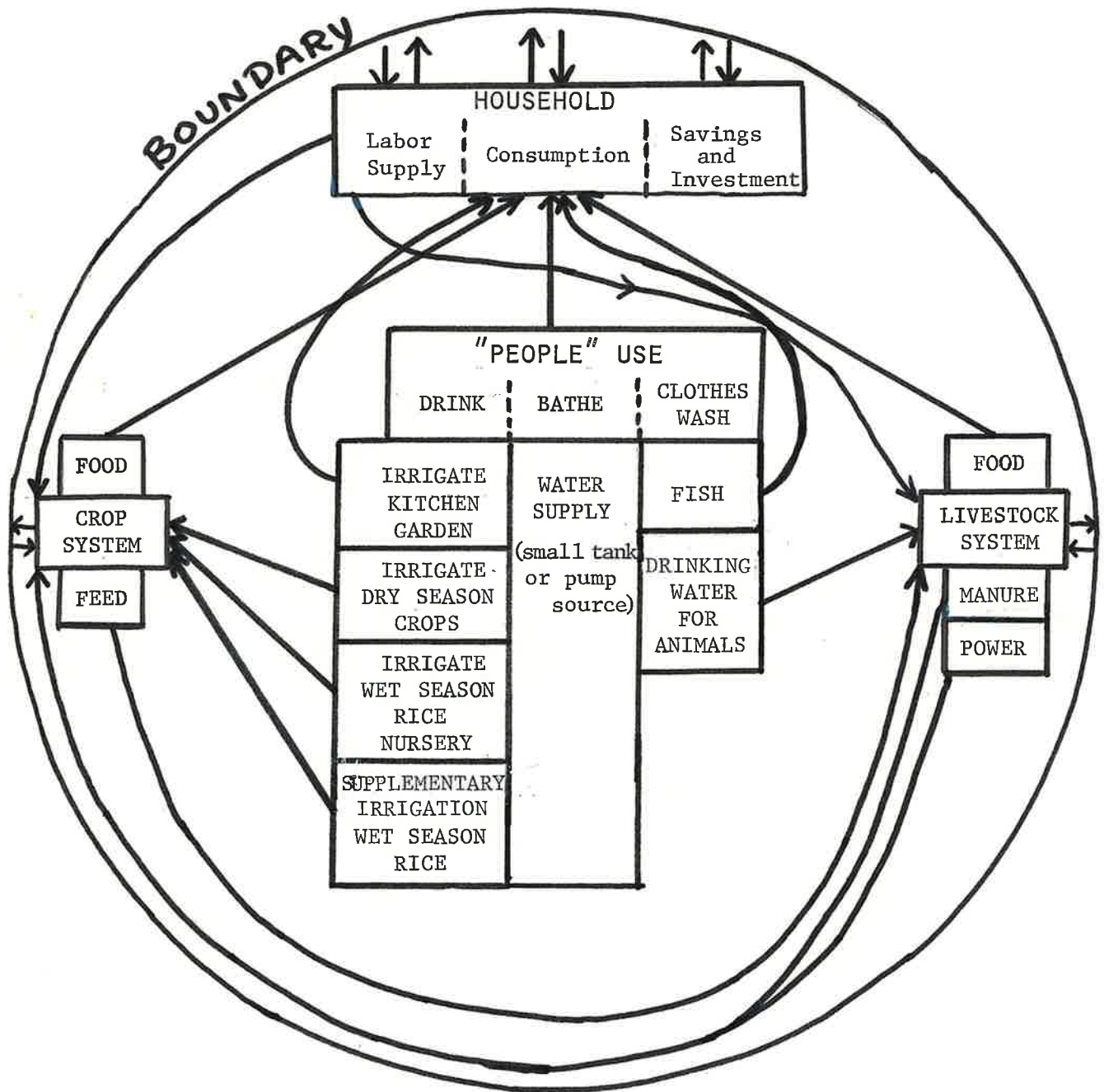
The household savings and investment component as well as the labor supply may have a direct impact on the productivity of the irrigation system. If farmers do not invest in tertiary canals and help maintain the irrigation system crop production will not reach its full potential. On the other hand, the release of household labor from domestic water collecting activities may make labor available for irrigation related activities. How rapidly such labor use changes might occur is an open question.

Figure 1 shows a diagram of the farming system model with the four major components: the household, the cropping system, the livestock system, and the new supply of water.

Two system concepts should be pointed out. First, systems are hierarchical in that they are made up of components, and are components of higher systems. Thus, it is proper to speak of household, crop, livestock, and water systems which are components of a farming system, which in turn is a component of a higher system.

Second, when building an analytical model it is necessary to impose a boundary. Variables, parameters, and constants inside the boundary are treated as endogenous to the system and those outside the boundary are treated as exogenous.

FIGURE 1. The Farming System Model



EXOGENOUS SYSTEMS

1. Markets for output.
2. Markets for inputs including labor.
3. Institutions regarding irrigation and farming.
 - a. farmer organizations and government agencies dealing with the farmer.
 - b. national policies and rules regarding rights.
 - c. social customs, values, etc.

These two factors dictate certain measurement realities. First, interactions between endogenous variables tend to be non-cash, whereas interactions between endogenous and exogenous variables tend to be cash transactions. Empirically, the non-cash transactions are difficult to measure because of the difficulty in measuring physical quantities and in assigning prices to the quantities. For example, measuring the allocation of time by the household between leisure and work, and within the work category, among the various production and consumption tasks, is not easy. Of particular concern in estimating costs and returns from newly supplied water is the identification of time allocated to meeting these basic water needs "before" and "after" the project.

Measuring Benefits

There are five basic sources of benefits within the farming system: wet season rice production (WB_t), dry season crop production (DB_t), fish production (FB_t), water for livestock (LB_t) and water for household use (CB_t). Thus the total benefits (B_t) when appropriately discounted are:

$$B_t = WB_t + DB_t + CB_t + LB_t + FB_t$$

Of the potential benefits from the new water supply, irrigation benefits are probably the easiest to measure. For there is a considerable amount of literature and information we can draw on to evaluate irrigation. However, irrigation is a minor function of the very small tank projects. Even for the larger tank irrigation projects, fish benefits are likely to be just as important (Tubpun, 1981).

The benefit measurement for the household and livestock can be approached in the same manner. The benefits would be the time saved in obtaining water during the dry season. The value of the time saved would vary by type of labor. For example, if children are used to drive livestock to water, then their opportunity cost would be used to value the time saved.

Fish benefits depend on several important variables. First is the fish production which varies with species, quantity of water, fish mortality, and food supply. Second is the catch rate which is dependent on fishing effort and the type of equipment used. If harvest rates (X) can be determined by survey methods then annual yield (Y) can be estimated by: $Y = XMB$ where M is natural mortality and B is standing stock (kg/ha).

The dry season production benefits will be difficult to estimate since there are a wide range of crops grown. In addition the market price appears to exhibit a high variable from year to year. In most cases, the family will grow only a small plot or a garden. If a garden is grown most of the production is consumed at home and price must be imputed. Since before the new supply of water no dry season crops were grown, benefits are the net returns from all dry season crops produced.

For the wet season rice crop including the rice nursery a different problem arises in measuring benefits. Here irrigation only supplements rainfall and benefits arise from higher yields and possibly more acres cropped under irrigation. Yields must be obtained under irrigated and non-irrigated conditions. If irrigation allows rice to replace some other crop such as groundnut then the benefit is the change in net returns between the two crops.

The additional question that is highlighted by the farm system model is the trade-off among the various benefits. For example, will more water for wet season irrigation reduce dry season crop and fish production benefits and by how much? Heavy use of water during the wet season may even affect domestic water use in the dry season. In contrast, if the tank is kept full for the dry season, run-off from late rains may be wasted.

Another aspect of the trade-off is the degree of farmer control. In the case of the pump project saving water for the dry season is not possible. In addition, the farmer can control when water is available for irrigation. The tank projects are quite different in these respects. Water saved during the wet season can be carried over to the dry season but the farmers have very limited control over water delivery. Thus, there are no incentives for the farmer to save water for the next season at the expense of the wet season crop.

Besides the problem that rainfall variation causes for measuring wet season irrigation benefits, there is a variation in benefits among farms. Benefits appear to vary by location in the system. For example, those at the head of the canal tend to have higher benefits than those at the tail. In addition, the small scale farms (less than 2.5 hectares) tend to have higher benefits per hectare (Tubpun, 1981). Thus, some weighted average benefits may have to be obtained. Weights would have to vary both by location and farm size.

Measuring benefits by farm size will also provide the decision maker with information on the distribution of benefits. One may also find that the household's allocation of time and labor varies with farm size.

Conclusion

The farming system model of small scale irrigation in Northeastern Thailand highlights the important trade-offs between different benefits. One can probably estimate the total benefits for each output but the marginal benefits are also needed. We need to know how much in fish production is lost if dry season irrigation is increased 10 percent in a year with normal rainfall.

We probably know least about how the household will use the time saved from collecting water. Will this time be used in productive activities or for leisure? With the new water supply, will livestock be available longer for tillage operations or will primary savings be in household time?

The farming system model provides a rich understanding of the many impacts of small scale irrigation in Northeastern Thailand. As contrasted with large scale irrigation projects, the primary benefit from these small scale projects is not just crop production. Consequently, impacts that might be ignored in evaluating large systems need to be evaluated in these small systems that are trying to meet the basic water needs of farm families.

References

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