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Implementation of Pump Irrigation Projects in the Northeast of Thailand

Wathana Wongsekiarttirat

Introduction

The implementation of the Economic and Social Development Plans of the Thai government during the last two decades has resulted in the progressive expansion and improvement of infrastructure, social facilities and agricultural activities. The national planners realized that, although incomes on average have risen and the incidence of poverty has declined, inter-regional income disparities have tended to increase. The gap in per capita income between the Northeast and other regions has increased, and the Northeast has the lowest share of agricultural production resulting from the low productivity per rai of crops, especially paddy. In order to raise the income level of agricultural households in the Northeast, the expansion of the irrigated area together with the promotion of dry-season cropping has been one of the major policies of the government. In the provision of irrigation facilities, the Electric Pump Irrigation Project has been substantially supported by the government since 1975 to promote dry-season cropping in the areas along rivers in the Northeastern region. However, contrary to government aims and expectations, much of the irrigated land has been left uncultivated in the project areas.

The subject of irrigation improvement has become one of the most interesting fields in the study of agricultural development. Many social scientists have observed that, in several parts of Asia, inequalities in water distribution and the lack of economic incentives to increase agricultural
yield are major factors affecting the underutilization of irrigation facilities. With respect to inequalities in water distribution, some have shown that distance from farm plots to water sources has a direct effect on the utilization of irrigation,\textsuperscript{1} while others have emphasized efficiency of water organization and management as being positively related to the utilization of irrigation facilities.\textsuperscript{2} In the resolution of inequalities in water distribution, engineering and organizational improvements were considered to be essential.\textsuperscript{3} However, another group of social scientists has argued that the lack of economic incentives directly determines the underutilization of irrigated land.\textsuperscript{4} To solve this problem, the provision of agricultural promotion services in the fields of technical assistance, credit and marketing were recommended.


However, such an assessment of the factors affecting the underutilization of irrigated land cannot be applied so straightforwardly in the case of contemporary Thailand. As mentioned above, the government has paid much attention to the expansion of the irrigated area and the extension of agricultural promotion services. According to the national planners, "The 16 million rai of irrigated area that has not been fully utilized for agricultural purposes, particularly for double cropping, is due to an incomplete water distribution system and lack of maintenance, and the insufficient use of water in the irrigated area."\(^5\) Similarly, from a study on the development of water resources in the Northeast undertaken in 1978 by the Asian Institute of Technology (AIT), it was observed that, in many irrigation projects, areas where main canals did exist had neither the necessary secondary and tertiary canals, nor the necessary ditches and drainage canals. Also, operations and maintenance procedures have been left to the local people, with little explanation or assistance from the main irrigation agencies. Thus, many of the systems were incomplete, non-existent or were in serious disrepair.\(^6\)

The AIT study considered that a comparison of alternative project types on the basis of economic returns and ease of implementation indicated that irrigation by pumping from reliable rivers was the most attractive alternative. This assessment was based on the finding that farmers in pump irrigated areas using the high-yielding rice variety RD-7 obtained an average yield of 400 kilograms per rai\(^*\) during the dry season, or twice the average rainy season yield, and the net benefit from this single crop was more than enough to pay for the irrigation pump. This remarkable success was attributable to the combination of a reliable water supply and agricultural extension services that provided all the necessary inputs on credit when they were required.\(^7\)

\(^*\) 1 acre = \(\frac{21}{2}\) rai

\(^5\)Fifth Plan (Bangkok: National Economic and Social Development Board), p. 45.


\(^7\)Ibid., p. 43.
Despite the existence of reliable water sources and the high yield per rai from dry-season cropping, the fact that much of the irrigated land in the pump irrigation project areas had been left unclutuvited was ignored by the study. However, it is the view of the writer that research on the problem of the underutilization of irrigation facilities is essential in order to help formulate policies which are more appropriate for the expansion of the irrigated area in Thailand, for planning more sensibly the improvement of existing irrigation facilities, and for the successful implementation of irrigation projects at the local level. If one of the main objectives of the government in providing irrigation facilities in the Northeast of Thailand is to promote a fuller utilization of land and other resources in the region, thereby helping to raise levels of agricultural production and thus income, then the underutilization of such facilities suggests clearly that this objective is not being fully realized. Thus, in the context of a volume which examines the process of rural development in the Northeast of Thailand, a study of the utilization of irrigated land in pump irrigation project areas is considered to be both interesting and relevant to the broader issue of the role played by infrastructural investment in promoting the development of rural areas.

The Utilization of Irrigated Land

The first electric pump irrigation project in Thailand was established by the National Energy Administration (NEA) as a pilot project in 1965; it was to serve an area of 1,000 rai in the village of Bang Sai Yai, Mukdaharn District in the Northeastern province of Nakhon Phanom (now Muang District in Mukdaharn Province) by using electricity from the power transmission route of the Nam Pung Hydro-electric Dam in Sakon Nakorn Province. In 1968, the Department of Local Administration requested the technical assistance of the NEA to install eight pump stations along the Mekong River, two in Nongkhai Province and another six in Nakhon Phanom Province. In 1969, with the support of the Lower Mekong Development Committee, the NEA installed another two pump stations in Nongkhai Province to serve an area of between 3,000 and 7,000 rai each. And, in 1970, with the financial assistance of the United Nations Development Programme (UNDP), through the Lower Mekong Development
Committee, the NEA started a survey in order to draft an electric pump irrigation plan for the area along the Mekong River. Its final plan was released in late 1973. In 1975, electric pump irrigation was officially accepted as a national scheme and was allocated a budget in the fiscal year 1976 for the improvement of the eleven old stations, and the installation of a new station in Sisaket Province. Between 1977 and 1978 the NEA installed a further 27 pump stations. According to the stipulations of the Cabinet between 1979 and 1982, a large budget was allocated for the installation of additional 325 stations. From available data, by 1982 the total area in the Northeast which was considered by the NEA to be irrigable by pump irrigation had risen to 665,500 rai.

With respect to project design, the main purpose of the electric pump irrigation projects is to promote double-cropping in areas along the rivers in the Northeast which, it is hoped, will lead to an increase in the incomes of farmers in the project area. The NEA has estimated that "...from the utilization of 3,000 rai for double-cropping with a 30 year project life, the benefit/cost ratio equals 1.908 and the internal rate of return equals 34.78% of the total cost of the project."\(^8\) In the NEA estimates, it was expected that productivity per rai of paddy would be 530 kilograms due to supplementary irrigation in the wet season; in the dry season, 70.0 per cent of the irrigation project area would be used for growing paddy with an average productivity per rai of 530 kilograms; the remaining 30.0 per cent would be used for growing field crops with an average return per rai in baht at least as much as the return per rai from dry-season paddy farming. To achieve its targets, an area of approximately 3,000 rai would be irrigated with a total two-year construction cost of 7.26 million baht in each project.\(^9\) The major components of each project

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\(^9\)Ibid., p. 4.
include pumps and equipment, buildings, main and lateral canals, supplies for on-farm ditches and dikes, electrical power system, surveys and general administration.

Realizing the importance of efficiency in both engineering and technical management in water delivery systems, and the need for the cooperation of the farmers, the NEA set down the following criteria for the installation of a pump station:

(1) the proposed project area must not be further from the river than one kilometre, and the river must potentially supply water to meet the water requirement all through the year.

(2) the proposed project area must not be more than 10 kilometres from a power transmission route.

(3) the amount of cultivated area which is expected to be irrigated must be over 2,000 rai.

(4) Villagers in the cultivated area must agree to co-operate in the implementation of the project by:

   (4.1) providing land for the construction of canals,
   (4.2) being willing to pay for the cost of electric energy,
   (4.3) intending to use water for cultivation all through the year,
   (4.4) being ready to take part in the extension of modern agricultural techniques, and
   (4.5) being willing to form a water users’ group which is, in a later stage, able to carry out the operation maintenance works in the form of co-operatives.

(5) the proposed project area must not be the area under the present and future irrigation plans of other agencies.\textsuperscript{10}

\textsuperscript{10}\textit{Ibid.}
In addition, two units of irrigation organization have been established for the efficient management of each project as follows:

1. **Provincial Center for Electric Pump Irrigation Service.**

   A center is established in each province where electric pump irrigation is operated, and is headed by a first-grade official of the NEA who is responsible for administering the engineering, financial, cadastral surveys and agro-economic sections; inspecting all kinds of engineering problems; collecting water fees; giving advice to water users’ groups; supervising pump control units; and administering other activities ordered by the central office of the NEA.

2. **Water Users’ Group.**

   A water users’ group is also established in each project area. The group is composed of all household heads in the area, and is administered by the representatives from each canal area, called the heads of canal administration (*Hua-na Sai-nam*). In principle, a head of canal administration is to be selected by the water users and the irrigation authority, and has to co-operate in setting up a timetable for rationing water and controlling the flow of water in his canal.

   Regarding the co-ordination arrangement, apart from assistance from the Provincial Electricity Authority in electrical power transmission, contact between the NEA and other agencies involved in agricultural development has only begun in 1978 when the government established the Agricultural Extension in Electric Pump Irrigated Area Project. In project implementation, the Tambon Agricultural Officer (*Kaset Tambon*) of the Department of Agricultural Extension (DOAE) has been employed, and an annual budget for the promotion of dry-season cropping has been allocated.

   As the pump irrigated area was expanded, with the help of a large amount of public investment, the National Economic and Social Development Board (NESDB) set up the Sub-committee of Irrigated Agricultural Development in Electric Pump Irrigated Areas. This sub-committee was
chaired by the Director of the Electric Pump Irrigation Division of the NEA, and composed of four representatives from each of the Department of Agricultural Extension, the Department of Agricultural Co-operative Promotion, the Office of Agricultural Economics, and the Northeast Agricultural Development Center; all are under the Ministry of Agriculture and Agricultural Co-operatives. A further three representatives came from the Bank for Agriculture and Agricultural Co-operatives, the Marketing Organization of Farmers, and the Provincial Electricity Authority. In 1981 the NEA sought support from the Krung Thai Bank, which is a government enterprise, to provide farmers in the irrigated areas with agricultural credit. Provision was made for six months' credit at no interest for the purchase of fertilizers and pesticides procured by the Bank, with no limitation on the amount which could be purchased by each household.

The interpretation by the representatives of the sub-committee of the concept of integrated agricultural development was restricted simply to the assignment of the duties of the various agencies concerned, so that they would provide individually their agricultural facilities (i.e. engineering control, crop demonstration, irrigated crop research, agricultural credit, marketing advice, statistical surveys). The plan for co-ordination at the local level was neglected. Moreover, since the appointment of the sub-committee, no progress report has yet been made. The multi-agency structure of irrigation project implementation in the Northeast of Thailand, and the relatively low level of coordination between the various agencies and departments concerned, has certainly added to the problems which have been encountered in attempting to promote the development and use of pump irrigation facilities in the region.

Before moving on to present the findings of an intensive study of irrigation utilization undertaken by the writer in the Northeastern province of Roi-Et, some background data concerning the extent of, and trends in

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the utilization of pump irrigation at the regional level will be presented (see Table 1). The data presented here were compiled from the annual records of land utilized for dry-season cropping made by the NEA from its cadastral surveys used for collecting water fees in each project area. In the compilation of the data the projects were sub-divided according to the year in which irrigation facilities were first provided. This is for two important reasons: first, if the figures for the old and new projects are mixed, the real situation concerning the degree of utilization of irrigated land may be distorted. This is because the first year of irrigation is generally a trial period for water delivery along the concrete canals; by the second year the villagers are expected to have completed the ditches and dikes. However, in practice, due to some delays in the construction of canals and ditches, some project areas could not be wholly irrigated until the third year. Second, such a sub-division can be used to demonstrate whether or not the utilization of irrigation facilities will increase with successive years of the operation of the irrigation service.

From the bottom line of Table 1, it can be seen that less than one-fifth of the total irrigated area has been utilized in the dry season. The highest rate of utilization was 16.9 per cent in 1979. Among the project areas categorized by the first year of irrigation, those irrigated before 1978 had relatively higher rates of utilization than those irrigated after 1978. This was because many of the latter were undergoing a trial period of water delivery along the main canals, and ditches and dikes were still under construction. These factors also affected the initial stage of irrigation in the projects implemented between 1976-78, but to a lesser extent, due to a policy that irrigation could commence whether or not the construction of ditch-dike systems had been completed. As for the project areas first irrigated in 1975, the rates in the initial stage were relatively high because water was first delivered after the completion of ditch-dike systems. The low rates of utilization between 1974 and 1976 in the project areas first irrigated before 1970 are explained by the fact that most of the main canals there, which had been under operation for more than ten years by then, were being renovated.

The bottom line of Table 1 also indicates that the irrigated area utilized for dry-season cropping gradually increased to 16.9 per cent in
1979, and subsequently dropped in the latter years. When focusing on the project areas operated before 1977, the rates of utilization increased to between 22.6 and 26.5 per cent in 1979. After that, the rates between 1980 and 1982 were between 10.5 and 12.9 per cent. This implies that, contrary to expectations, the rate of utilization of irrigation does not increase in successive years of the operation of each irrigation project.

Table 1: Area Utilized for Dry-Season Cropping in the North-East of Thailand, 1974 and 1982

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<td>16.9</td>
<td>12.6</td>
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<td>8.6</td>
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Source: NEA data.
At this stage, three main points concerning underutilization of irrigation can be made. First, there appears to be a link between climatic conditions and the utilization of irrigation facilities. It can be noticed that the trends were more or less consistent with the quantity of rainfall in the Northeast. The trends moved upwards in 1978 following the drought of 1977, and they moved further upwards in 1979 following the devastating floods in 1978. Clearly, the incidence of floods and droughts, which frequently cause the loss of paddy production and thus lead to shortages of rice for consumption, has a strong influence on the utilization of irrigation. Secondly, when drought occurred in 1981, the trend in land utilization was marginally downward in 1982, which was the year when the NEA increased water fees from 65 to 100 baht per rai for paddy, and from 50 to 85 baht per rai for field crops. This suggests that the increased costs of production might have influenced decision-making on the amount of land to be utilized for dry-season cropping. Finally, another important trend is that the levels of land utilization after 1979 were generally lower than the levels in the year before 1979, and a little over a half of the level in 1979. This indicates that a part of the land which used to be fully irrigated has subsequently been left uncultivated. This suggests that the underutilization of irrigation facilities cannot be explained simply in terms of adequacies and inadequacies in the water delivery system.

The preceding investigation has demonstrated that the promotion of irrigated agriculture has been one of the major government policies for the development of the Northeastern region. But at the same time, the government has realized the need to provide agricultural incentives in order to avoid the failure of the irrigation projects. In general, the design of pump irrigation projects appears to be sound, with the realization of the importance of engineering/technical management in the water delivery system, the cooperation of the farmers in the project areas, the provision of agricultural credit and the promotion of dry-season cropping. Nevertheless, in spite of government attempts to encourage the use of irrigation facilities for dry-season cropping in order to raise farm production and incomes, it appears that only a small amount of the total irrigated area is being utilized. An examination of the trends in the utilization of irrigation suggests that, in
addition to the problems of water distribution, an investigation of the
decision-making process of farmers in the Northeast of Thailand is needed.

A Study of Farmers’ Decision-Making on Dry-Season Cropping.

In order to design an intensive study of pump irrigation facilities,
three main criteria were employed. First, because the improvement of
agricultural extension is one of the major policies of the Thai government as
it attempts to promote agricultural development, pump irrigation projects
which had been established in the areas where the National Agricultural
Extension Improvement Programme Phase-I has been implemented since
1977 were selected. Secondly, to collect adequate data concerning changes
in irrigation utilization over a reasonably long period, project areas which
have been irrigated for more than five years were chosen. Finally, for a
comparison of water management between two projects, the areas to be
chosen should be those which began their first operations at more or less the
same time. Using these criteria, two project areas in Roi-Et Province were
selected for investigation, called here “Area-A” and “Area-B”. Data were
collected by using a questionnaire survey of households in these two study
communities.

The two village communities in “Area-A” and “Area-B” were
established more than 200 years ago. That of the former used to play an
important role as a traditional commercial center to which farmers from
neighboring villages along the Chi River transported their paddy to sell to
the rice mill. That of the latter played an important role as a religious
center, where monks from neighboring villages came to study. Such traditional
roles have obviously changed, particularly since the expansion of social and
economic infrastructure resulting from the development of state investments
in the Northeast. Since a metalled highway replaced the laterite road from
Area-A to the provincial center of Roi-Et about two decades ago, and with
the construction and improvement of local by-roads, villagers’ access to the
provincial towns and to other provinces has been greatly enhanced. This has
also led to an increase in the out-migration of villagers to urban areas,
especially to Bangkok, in search of employment and further education.
In 1970 the Provincial Electricity Authority extended its power transmission route to the community of Area-B. As a consequence, this community has rapidly come to play an important role in modern commerce. In 1978, power transmission was extended to the community of Area-A for the purpose of electric pump irrigation. This enabled people in the latter community to buy and operate televisions, and thus to gain access to information from outside. In comparing the two communities, it was found that villagers in Area-B, because of the nearby highway, have more regular contacts with the provincial towns and the district center than is the case with Area-A. In addition, the regular contact between villagers and local shopowners in the commercial center, who frequently read newspapers and distribute news of the outside world to their customers, together with the longer period of using electricity for television, have obviously played a part in generating a higher degree of modernity in this community in comparison with that of Area-A. This difference provides an important basis for a comparison between the two study areas, and will be further elaborated below.

Electric pump irrigation was introduced to the two communities in 1978, its implementation being supported by the Department of Agricultural Extension and the Krung-Thai Bank. Since 1978 the Tambon Agricultural Extension Officer has received a special budget for supporting dry-season cropping activities through crop demonstrations and the dissemination of agricultural information. In 1979, following the year of the great flood, the District Agricultural Extension Office distributed new types of paddy seeds (called RD-6 for glutinous paddy and RD-7 for non-glutinous paddy) to the villagers in order to replace the traditional seed varieties (called khaaw sanpathong for glutinous paddy and khaaw daeng for non-glutinous paddy). Because of their higher yields per rai and similar taste to the old types of seeds, RD-6 and RD-7 have been widely accepted in the two study communities, as elsewhere in the Northeast. Since 1981, at the request of the NEA, the Krung-Thai Bank has provided farmers with agricultural credit for dry-season cropping in the pump-irrigated areas with six-months’ interest free credit for the purchase of fertilizers and pesticides procured by the Bank, and with no limitation on the amount which could be
purchased by each household. It was found that a few households had asked for a larger amount of fertilizer than they actually used; some kept the additional amount for use in the following wet season, and others re-sold their subsidised inputs to their relatives in other villages.

A number of farm households in each of the study communities were unable to fully utilize their irrigated farmland. From a total of 143 farm plots in Area-A and 104 plots in Area-B, it was reported by interviewers that 24 plots and 7 plots respectively in fact received no irrigation water because some had no ditches connecting their fields to the main irrigation canals, and some were located on land higher than the level of the canals. The remainder included plots which received a supply of water which was adequate for dry-season cropping, and plots which, whilst obtaining water from the irrigation system, received inadequate water for this purpose. However, with regard to the utilization of irrigated plots, there was only a weak relationship between adequacy of water provision and the utilization of land for dry-season cropping. From Table 2 it can be seen that, of the plots which received adequate water, 57.6 percent in Area-A and 68.1 percent in Area-B were used in the dry season of 1984. And, of the plots which received inadequate water 37.7 per cent in Area-A and 44.0 per cent in Area-B were utilized. In other words, decision-making on the utilization of irrigated land does not appear to be wholly influenced by the adequacy of water.

Table 2: The Utilization of Farm Plots for Dry-Season Cropping in 1984, By Water Availability.

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<tr>
<th></th>
<th>Area-A</th>
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<th>Area-B</th>
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<tbody>
<tr>
<td></td>
<td>Adequate %</td>
<td>Inadequate %</td>
<td>Adequate %</td>
<td>Inadequate %</td>
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<tr>
<td>Used</td>
<td>57.6 (38)</td>
<td>37.7 (20)</td>
<td>68.1 (49)</td>
<td>44.0 (11)</td>
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<tr>
<td>Unused</td>
<td>42.4 (28)</td>
<td>62.3 (33)</td>
<td>31.9 (23)</td>
<td>56.0 (14)</td>
</tr>
<tr>
<td>Total</td>
<td>100.0 (66)</td>
<td>100.0 (53)</td>
<td>100.0 (72)</td>
<td>100.0 (25)</td>
</tr>
</tbody>
</table>
A Quantitative Study

From the analysis, which examined the influence of a number of (independent) variables on the utilization of irrigated land for dry-season cropping, it was found that:

(a) decisions of farmers with regards to the utilization of their irrigated land for dry-season cropping are made partly from an evaluation of their food requirements, and partly in order to earn a cash income. Irrigation has greatly aided those households which are unable to produce enough wet-paddy for household consumption from the preceding wet season. As for those producing a wet-paddy surplus, a "trade-off" between dry-season cropping and non-farm employment is made in order to obtain a cash income; the nature of the choice between these alternative strategies depends largely upon the skills of the individual and the off-farm opportunities which are open to him or her.

(b) the agricultural decisions of dry-season croppers appear to be made from an evaluation of their needs for the immediate future rather than from longer-term planning. They set the amount of land to be used in the dry season in order to obtain sufficient production to satisfy their food requirements. The dry-season croppers' households which do not produce enough wet-paddy for household consumption are inclined to use dry-season cropping in order to produce just enough paddy to avoid starvation or to achieve what they consider to be an acceptable level of income. In a similar vein, the dry-season croppers' households which owned large amounts of irrigated land tended to plant dry-season crops in order to produce rice which could then be sold to finance the purchase of various items such as modern clothes and electrical appliances, or to support their children's higher education. On this basis, the dry-season croppers' households in general do not expect to obtain high levels of productivity from their dry-farms due to their capacity to farm only on the fertile portion of their land served by irrigation, or, in other words, calculations of returns per unit area do not appear to be important in the decision-making process.

(c) the farming decisions of the dry-season croppers also depend upon the availability of non-farm employment opportunities for individual
household members, and upon the involvement of household heads in village leadership circles. Once the households’ food requirements have been satisfied from wet season farming, non-farm employment becomes an alternative means of earning a cash income. As non-farm employment in towns, especially in Bangkok, is widely available (especially with the help of friends and relatives who are already working there), it is possible for households to allocate a part of their labour to non-farming activities. Employment in town is not such a viable alternative for the households whose heads are village leaders, or who are heavily involved in village administration since participation in village committees requires full-time responsibilities for their tasks. To spend time on planning dry-season crops in their own villages is therefore a more suitable alternative way of earning a cash income.

(d) the agricultural decisions of the dry-season croppers are also affected by ecological and locational factors. In Area-B, the amount of paddy surplus produced and the size of earnings from non-farm sources are important variables; first, because a large proportion of the land area in Area-B is always flooded in the wet-season, thus the cultivation of dry-season paddy to substitute for the loss of wet-paddy is often necessary; and secondly, since Area-B is near the main highway and the local commercial center, the opportunity for villagers to earn income from non-farm activities in this community is higher than in Area-A. It is also possible for the household heads to participate in village administration and in business enterprises in the community, while those in Area-A do not have such an easy access to such activities, and are thus more inclined to invest in dry-season cropping as a way of earning a cash income.

A Qualitative Study

In spite of the fact that the vast majority of villagers in the two intensive study areas are farmers first and foremost, it has been shown in the foregoing discussion that the derivation of income from non-farm sources is both widespread and is gaining in importance. Throughout their individual life cycles, villagers accumulate skills and experiences both in farming and non-farming activities, and in both rural and urban pursuits. A very generalised synopsis of the work cycle of a household in the study area might be as follows: the labor force of the household tend to apply them-
selves to paddy farming in the wet season, and then the group breaks up as individual members participate in various kinds of activities in the dry season. The group then reforms in time for the following wet season. In the majority of cases, the heads of households are engaged in non-farm activities in the village area, and thus most of them tend to allocate some of their time to the cultivation of a small amount of land during the dry-season (rice and/or upland cash crops); the wife raises animals with the help of the younger children, whilst some or all of the older children go to work, mostly as unskilled laborers, in urban areas, particularly Bangkok. The exchange of labor, which is practised in the wet season, cannot be obtained for dry-season cropping.

Decision-making about the utilization of land in the dry season is therefore very much dependent on farm labor being available to the household during that season, and this depends on the allocation of manpower between farming and non-farming activities. The utilization of irrigated land has been shown to be influenced not only by the income derived from non-farm sources and the availability of agricultural labor, but also by the sufficiency of rice production during preceding seasons, and especially the main rice-growing period, the wet season. During climatically "normal" years, there will be little variation in the total amount of irrigated land utilized, but in the seasons following the incidence of severe floods or droughts, the amount of irrigated land utilized by all farm income groups will considerably increase.

It appears that, contrary to the expectations and intentions of the planners responsible for the improvement of irrigation facilities in the study area, the main benefit of pump irrigation to the farmers has been the capacity it provides for them to produce emergency crops of paddy to counter balance the negative effects of climate and physical environment on wet-season food production. From the feasibility studies, the planners expected a dramatic increase in levels of agricultural production resulting from the rapid expansion of double-cropping. This expectation has not been materialised in the case of the Roi-Et project area which has been the main focus for this study. In social terms, it cannot be denied that the "safety valve" that irrigation provides farmers, who constantly face the threat of
crop devastation due to climatic forces, is the most welcome infrastructure investment in the region. But in purely economic terms, one must question whether the vast sums of money spent on improving the irrigation resource of the Northeast (for it is clear that the pattern described above is replicated elsewhere in the region) may be more effectively employed in another way if the level of utilization of irrigated land in many areas remains very low.

CONCLUSION

Government investment in irrigation may have helped to alleviate some of the problems associated with short-falls in agricultural production due to environmental catastrophes, but in terms of its stated objective of raising farm production, and thus income, this objective clearly has not been achieved to the extent envisaged by the planners as large amounts of irrigated land remain unused. Evidently, therefore, it is not sufficient to simply provide irrigation facilities in the expectation that farmers will optimise their use in order to maximise their earnings from agriculture. There is a need to parallel infrastructural investment in irrigation with extensive back-up services for farmers to allow them to make the fullest use of this resource. To some extent this has been accomplished, especially through the work of the Department of Agricultural Extension and the Krung-Thai Bank. But in the final analysis it appears that there is a significant attitudinal barrier to be overcome. Planners are often left with the forlorn task of convincing farmers with scarce resources to invest time and capital in farming in a marginal environment, where risk and uncertainty impinge regularly on their decisions, while off-farm works in town look more preferable and far less risky.

For the future development of agriculture in the Northeast, it is recommended that the government re-assesses the present socio-economic conditions of the region. During the past two decades of the government’s national development plans, the per capita income of the population has been the main criterion employed in the assessment of the socio-economic conditions of the regions throughout the kingdom for planning and evaluating development efforts. More attention should be paid to the value of non-cash income from both farming and non-farming activities as
another significant criterion, in addition to per capita income. Furthermore, the government should base its policies more on the provision of basic needs than on increasing levels of income. In planning for the expansion of the irrigated area in the Northeast, a survey of socio-economic conditions in the areas under the existing plan is needed, particularly to obtain the data concerning the inadequacy of wet-paddy for household consumption and the non-farm employment opportunities available to villagers. Areas along the rivers which are heavily flooded and which have fewer opportunities to generate a high level of income from non-farm activities should be the main targets in the selection of areas for the implementation of pump irrigation projects. In addition, there is an urgent need to make farmers more aware of the potential income benefits from the cultivation of dry-season crops in irrigated areas. Otherwise, a substantial increase in the rate of utilization of irrigation facilities in the region is unlikely to be achieved, and a substantial amount of development investment which might be better employed in other ways will be eaten up in improving the water resources infrastructure of the Northeast.