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Irrigation Development and Agricultural Progress in Northeast Thailand

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Several irrigation projects have been implemented in the semi-arid Northeast of Thailand during the past two decades. But the average yield of paddy of the region has not been satisfactorily increased. This study shows that to obtain the high and reliable yield the irrigation system needs to be improved and upgraded. Moreover, the emphasis should not be placed solely upon the rice production and the diversification programme should be introduced to avoid the risk of rice price fluctuation.

INTRODUCTION

Northeast region is one of the poorest regions of the Kingdom of Thailand. About 18 million people or 35 % of the total population live in this region. About 60 % of this population work as tillers on the farm. Their average cash farm income per farm per year is about 11,500 baht which is below the national average and the smallest of all regions. Most of the land in the region or about 6 million hectares is devoted to rice growing and becomes the second largest rice growing area of the country. However, the average yield of rice, both dry and wet season, is the lowest, about 2.4 ton and 1.4 ton per hectare respectively. Northeast region has therefore received more attention from the central goverment with respect to development project, especially irrigation development for rice production since the inception of First National Development Plan.

The purpose of this paper is to review the irrigation project developed in the Northeast with respects to irrigated area increase and agricultural progress with the emphasis on rice technology generated in the Northeast region.

IRRIGATION DEVELOPMENT

Irrigation has played a very important role in contributing to the progress of Thailand's agriculture and to the economy in general for the past three decades (Royal Irrigation Department, 1983). Irrigation projects development in Thailand can be classified into three categories ; namely,

(1) *large-scale projects* : They cover nearly 75 % of the irrigated area, servicing area exceeding 20,000 hectares. Each project on the average costs more than 200

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million baht. All large projects are supplied by storage reservoirs allowing important dry season irrigation. This large-scale project is constructed, operated and maintained by Royal Irrigation Department,

(2) *medium-scale projects* : The project cost of this category is 200 million baht or less and can be implemented within four years. This project can serve the area ranging from 1,000 to 2,000 hectares. About 80 % of these medium-scale with storage are in the Northeast. Royal Irrigation Department is responsible for construction, operation and maintenance of all medium-scale projects, and

(3) *small-scale projects* : The small-scale project costs four million baht or less per project, and designed to supply farmers' water need for both household consumption and agricultural production and being completed within one year. Of the total project completed, each project can serve the area not less than 25 hectares and about 50 % of them are in the Northeast. The construction is made by Royal Irrigation Department and other government agencies. However operation and maintenance of this smalllscale project is carried out by the farmers.

Geographically, Northeast is a high plateau bounded by Mekhong River in the North and East and Dong Praya Yen mountain in the west (Wasano et al. 1987). Most of rivers therefore run very rapidly into Mekhong River because of steep elevation. Three large river basins are in this region. The first one is Mekhong Basin having a watershed area of 43,000 square kilometers; the second is Chi Basin with watershed area of 55,000 square kilometers; and third is Mun Basin with 82,000 square kilometers of watershed. All important irrigation development projects have been constructed in the Northeast around these major river basins.

Due to the economically depressed and politically endangered conditions of the Northeast, the government in the earlier 1960's decided to implement the first National Development Plan in 1961 with major emphasis on the Northeast region. Most of the public investment since the inception of the National Development Plan has been made toward the construction of infra-structures such as road, education, health centers, irrigation and electricity, etc.

Irrigation development project was the first priority for the Northeast region. The irrigation projects were constructed around the key river basins; namely Mun, Chi and Mekhong which occupied nearly the entire Northeast. All irrigation development projects in the Northeast are under supervision and management of Regional Irrigation Office IV with Khon Kaen as headquarter, Regional Irrigation V with Ubol Ratchathani as headquarter and Regional Irrigation Office VI with Nakhon Ratchasima as headquarter. These offices are under the Royal Irrigation Department (RID). More than 50 % of the total budget of the Ministry of Agriculture and Cooperative (MOAC) was allocated to the RID. For example, in 1977 the annual budget received by the RID was 3,467 million baht or about 51 % whereas in 1984 was 9,007 million baht or about 57 %. Most of projects developed in the Northeast belong to the medium and smalllscale categories and not many large-scale types being constructed. Since 1977 the growing tendency of the government investment is to include medium and small-scale project. Especially the new projects at present are smalllscale ones accounting for the most of the construction expenditures and mostly outside the Central Region.

The irrigation development at the earlier period was primarily aimed at the supplement of rainfed wet season rice growing in the Northeast due to water shortage. Subsequently more projects were built around the river basins mentioned earlier and the later development of the projects during the mid 1970's could supply water for dry season rice. However the irrigated area in the dry season rice is still less than one percent of total rice area in the Northeast. The report by the RID, basing on the random sample survey of the small-scale projects completed by 1980, indicated that 80 % of the total project is without water distribution facilities. The small projects practically serve a variety of purposes ; such as fishing, irrigation, animal hasbandry and domestic water.

Before the inception of the first National Development Plan, the accumulated irrigated area in the Northeast was 116,853 ha (Table 1). Within the first Plan (1961/66), the irrigated area was increased to 145,744 ha. By the end of fourth Plan (1977/81), the irrigated area was 224,582 ha. Since the fifth Plan will terminate by the end of 1986, the accumulated area obtained in Table 1 covers only four years till the end of 1985 and was 310,502 ha. It can be seen that the irrigated area since the inception of the first Plan, was tremendously increased, nearly three times of 1960's area. There is no doubt that such an increase allows more production of rice in the region.

Table 1. Irrigated area under large and medium-scale projects, Northeast Thailand, 1960－1985.

	Period	Incremental (ha)	Accumulated (ha)
	1960		116,853
1st	1961／66	28,931	145,784
2nd	1967／71	17,462	163,246
3rd	1972／76	10,736	173,982
4th	1977／81	50,600	224,582
5th	1981／85	85,920	310,502

Source : Royal Irrigation Department, *Water Resources Development in Thailand,* 1983.

Table 2 shows the irrigated area under the small-scale projects developed considerably in the Northeast since 1977. In 1977 about 3,051 ha was brought under irrigated land by the small-scale projects and by the end of 1981 it was increased to 94,166 ha. This abundant increase is more than 30 times for the period of just five years. This really reflects shift in the irrigation investment policy of the government toward more small-scale projects (Royal Irrigation Department, 1982).

In addition to new irrigation projects being constructed, many existing irrigation projects are now in need of upgrading the existing systems and improve their performance. Efforts have been made to improve the performance by upgrading the physical structure at the tertiary level and by leveling the farm field through the Land Consolidation Project. Land Consolidation Project were mostly finished in the Central Plain and very small completed in the Northeast and confined to only two provinces ; Sakon Nakon and Khon Kaen. In 1984 the total consolidated areas were 32,485 ha and in 1985 increased to 37,654 ha, about 16 % of the total consolidated area of the country. Most of them were extensive type.

Table 2. Irrigated area under the small-scale projects, Northeast, Thailand 1977-1981.

Year	Incremental (ha)	Accumulated (ha)
1977	_	3.051
1978	25,949	29,000
1979	18,574	47,547
1980	22,952	70,526
1981	23,640	94,166

Source : Ministry of Agricultue and Co-operatives, *Agricultural Statistics of Thailand*, 1986.

AGRICULTURAL PROGRESS

Investing in irrigation projects will produce new crops, increased crop yields, changes in factor-inputs use, and etc. This kind of changes we may call changes in agricultural technology which also imply the agricultural progress. This agricultural technology changes have generally occurred not only for the whole kingdom but also for all four important regions including the Northeast. The section below will summarize some of the major changes in the agricultural technology (Adulavidhaya, 1982).

Rice varieties The Rice Division (now Rice Research Institute) ; Department of Agriculture (MOAC) has released more than 30 recommended varieties to the public since 1956. Those varieties are suitable for specific areas based on adaptation to local condition and stress. The basis of selection has been : resistance to diseases and pests, response to feasible agronomic practices, high yielding potential and acceptable grain quality. The well-known local improved varities are Niaw Sanpatawng, glutinous rice, Khao Dawk Mali 105, and Khao Pahk Maw 148, non-glutinous rice. These three varieties are photo-period sensitive, susceptible to blast reaction, but moderately susceptible to bacterial deaf blight. These two varieties are widely grown in wet season.

Since 1969 many new high yielding varieties (HYVS) have been released and recommended to areas with good irrigation and management. The naming of these new rice varieties carries the RD (Rice Department) designation and the RD naming system assigns odd numbers to non-glutinous rice and even numbers to glutinous type. The new RD varities are high yielding, nitrogen-responsive, disease resistant or tederant, photo-period insensivity, short growing season of 100-125 days and short straw. Because of such high yielding characteristics, these varieties require more proper water management and control than can be provided by the traditional rice-growing technology. List of new varieties suitable for the Northeast is shown in the Table 3.

Most of RD varieties are grown to dry season irrigated area where water management and control are fairly good. The average yield ranges from 2.00-2.8 ton/ha in the Northeast (Table 4). This yield level is considered good for Thailand standard, however rather low compared to rice yield of other countries. As for wet season rice, the average yield is rather low ranging from 1.1-1.5 ton/ha (Table 4), and much lower than the dry season rice yield. These yield were low because of many

Table 3. RD Rice varieties suitable for Northeast and their characteristics.

Year released and name	Photoperiod		Endosperm*		Height†		Adaptabilityf and special traits	
	Non-Sens.	Sens.	NG	G	SD	I - T		
1969 RD1	X		X		X	–		(1)
1969 RD2	X		–	X	X	–		(1)
1969 RD3	X	–	X	–	X			(1)
1973 RD4	X	–	–	X	X		For N, NE	(1)
1977 RD6	–	X	–	X		X	For N, NE	(2)
1975 RD7	X		X		X			(1)
1978 RD8	–	X	–	X	X		For N, NE	(2)
1975 RD9	X		X		X	–		(1)
1981 RD10	X	–	–	X	X	–	For N, NE	(1)
1977 RD11	X		X	–	X	–		(1)
1978 RD15		X	X	–		X	For NE	(2)
1981 RD21	X	–	X		X	–	For ragged stunt	(1)
1981 RD23	X	–	X		X		For ragged stunt	(1)
1981 RD25	X	–	X		X	–	For earliness	(1)
1981 RD27	–	X	X	–	–	X	For ragged stunt	(2)

Note : * NG = Nonglutinous, G = Glutinous
† SD = Semi-dwarf,, I-T = Intermediate to tall
‡ (1) Adapted to irrigated areas. (2) Primarily for rainfed monsoon.
Source : Rice Research Institute, *Annual Report,* Ministry of Agriculture and Co-operatives, 1983.

factors such as poor soil, uncertainty of rainfall, poor management practices and most of local improved varieties are not responsive to fertilizer.

Table 4. Rice yield of dry and wet season, Northeast and some provinces, 1982-1985.

Region/Province	Year				Average
	1982	1983	1984	1985	
		Dry season (ton/ha)			
Northeast	2.3	2.4	2.5	2.5	2.4
Khon Kaen	2.8	2.5	2.7	3.1	2.8
Nakhon Ratchasima	2.7	2.3	3.1	2.8	2.7
Ubon Ratchathani	1.7	2.0	2.0	2.2	2.0
		Wet season (ton/ha)			
Northeast	1.3	1.3	1.6	1.6	1.4
Khon Kaen	1.2	1.6	1.7	1.7	1.5
Nakhon Ratchasima	1.2	1.4	1.6	1.6	1.4
Ubon Ratchathani	1.0	1.0	1.1	1.2	1.1

Source : Ministry of Agricultue and Co operatives, *Agricultural Statistics of Thailand,* 1986

Fertilizer Fertilizer is a modern input and important for increasing rice yield. Usually farmers apply fertilizer NPK as a basal dose at planting and later some N as a top dressing. For the period of 1978-1984 the amount of fertilizer used in wet season rice prodcution increased from 325,820 tons to 443,808 tons or about 1.4 times the quantity used in 1978. An average increase is annually 6%, and average fertilizer used

Table 5. Fertilizer used in paddy field, whole Kingdom, 1978－84.

Items	Year						
	1978	1979	1980	1981	1982	1983	1984
Fertilizer (ton)							
Wet season	325,820	335,202	359,441	340,055	373,851	466,454	443,808
Dry season	128,635	178,500	100 (940	154,092	169,483	189,236	204,125
Area planted (1000/ha)							
Wet season	8,554	9,346	9,099	9,101	9,023	8,987	9,298
Dry season	476.6	681.1	336.5	516.5	572.5	634.1	716.9
Fertilizer(kg/ha)							
Wet season	38.06	35.87	39.50	37.50	41.44	51.87	47.75
Dry season	269.87	262.06	3000.80	298.37	296.00	298.43	284.89

Source : Ministry of Agriculture and Co-operatives, *Agricultural Statistics of Thailand,* 1986.

per ha is 41.71 kg. For the same period the amount of fertilizer used in dry season irrigated rice was about 1.6 times the amount used in 1978, (128,635 tons rising to 204,125 tons) (Table 5). The annual increase is about 10 % and the amout of fertilizer used per ha is 287.08 kg. It can be seen that rate of fertilizer application to both wet and dry season rice seem to be rather slowly increasing. There are many factors precluding the higher fertilizer application such as flooding risk, high price of fertilizer and unreliable irrigation. With the minimization of such risk and more favourable price of fertilizer and domestic availability of urea, fertilizer use in irrigated area will be likely increasing, thus enhancing the rice yield.

Mechanization The majority of rice farmers in the Northeast still use draft animals. Mechanization is an important factor in increasing rice production. Land preparation in commonly performed by tractor in all regions of Thailand, especially two-wheel tractors and small four-wheel tractors of less than 45 hp. It can be seen in Table 6 that in 1978 there were 192,004 two-wheel tractors and increased to 408,827 in 1984. It was increased two times of that 1978 with annual rate of 18 percent. For the same period, the four-wheel tractor increased from 26,984 to 46,092, increasing about 1.7 times or at annual rate of 12 %. In the Northeast there were 13,602 two-wheel tractors and 1,510 four-wheel tractors in 1978. Based on the annual rates of increase, by 1984 there would be 29,000 and 2,600 two-wheel and four-wheel tractor respectively in the Northeast.

Treshing machine is becoming more important in Thai agriculture. In the Northeast region threshing machine has just begun to receive more interest by farmers and many have used it. It can be seen in Table 6 that there have been rapid diffusion of the threshing machine in the country. For the period of 1978-1984, the number of threshing machine was increased from 5,557 to 36,800, rising nearly 7 times. It is hoped that the threshing machine will be more adopted in Northeast region like in the Central Plain in the near future. The increasing demand for these labour-saving machines seems to be in the form of contract services which will give a chance to small farmer use the service.

Crop *diversification* Crop diversification has been well and considerably

Table 6. Number of important farm equipment, whole Kingdom, 1978-84.

Items	Year						
	1978	1979	1980	1981	1982	1983	1984
2 -wheel tractor (power tiller)	192,004	230,591	280,591	284,351	323,846	364,948	408,827
4 -wheel tractor (less than 40 hp)	26,984	31,158	36,158	39,158	45,688	45,092	46,092
Treshing machine	5,557	6,224	18,394	20,601	30,091	33,100	36,800

Source : Ministry of Agriculture and Co-operatives, *Agricultural Statistics of Thailand, 1986.*

practised in Thai agriculture for more than three decades, especially outside the irrigated area. The Thai government has recently expressed more interest in crop diversification within irrigated areas because of the overproduction of rice, the downward trend of world rice price in the existence of poor export markets. In the Northeast as in the rest of the country, the farmers prefer to grow rice in the wet season to assure their families food supplies, and irrigation water is too much for upland crops in the irrigated areas. The potential for crop diversification within irrigated areas is therefore limited to the dry season. Promotion of crop diversification has already been carried out in several dry season areas in the Northeast, especially with vegetables, soybean, mungbean, maize, cotton and sorghum. Vegetables, already being produced in the dry season, seem to have high potential for the canning and freezing industry. However many problems concerning market and marketing should be seriously considered beforehand, particularly the awareness of demands for diversified crops in local, regional and national markets, the production potentials of the dry season irrigated areas and finally the quality of the products. In addition, the other major problems always expressed by farmers are lack of capital, shortage of labour and soil salinity which altogether seems to hinder the adoption of crop diversification in the dry season. In many Northeast irrigation projects, there have been inherent salinity problem because of basic soil chemistry characteristics. Therefore a high degree of water control and efficient water management is necessary in the Northeast for long-term development of diversified cropping in the dry season irrigated areas.

CONCLUSION

There have been significant development of irrigation projects in the Northeast since the inception of the First National Development Plan. Recently small-scale irrigation projects have been intensified to supply water not only for irrigation but also for household use. Irrigation development projects resulted in increase in irrigated areas allowing more rice production in the Northeast. Some major rice technologies were reviewed, especially new HYVs, RD varieties, suitabe for the region. The average yield was rather low and slowly increasing. To obtain high and dependable yield, the irrigation system needs improvement and upgrading. Hence the supply of reliable water can be assured. Many diversified crops were promoted in the dry season

irrigated areas to assure the better income of the farmers when rice price declined.

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