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Thailand

Northeast Rainfed

Agricultural Development

Project

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Supplemental Analysis to the

Project Paper

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Northeast Rainfed Agricultural Development Project

Supplemental Analyses to the Project Paper

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ANNEX V - Introduction
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1. Area and Population

The Northeast of Thailand has an area of about 167,308 Km^2. bounded by the Mekong River on the North and East, the Phanom Dongrak escarpment on the South, and the Phetchabun ridge on the West. It comprises 16 provinces listed in alphabetical order as follows:

Buri Ram, Chaiyaphum, Kalasin, Khon Kaen, Loei, Maha Sarakham, Nakhon Phanom, Nakhon Ratchasima, Nong Khai, Roi Et, Sakon Nakhon, Si Sa Ket, Surin, Ubon Ratchathani, Udon Thani, and Yasothon.

A map of the Northeast is shown in the Project Paper. The region has a population of about 14 million which constitutes about one third of the population of the country.

1/ Information in this section was freely borrowed from:

(1) Water for the Northeast: Drought Analysis Part I: Rainfall Analysis. Prepared by the Asian Institute of Technology and published by the Water Resources Planning Subcommittee, National Economic and Social Development Board, Kingdom of Thailand, Bangkok 1978.

(2) Report No. 1, Seasonality and Intensity of Rainfall in Northeastern Thailand by Frank Nicholls, Damrong Charoensook, Ittipon Padungwit, Anuri Chintakananda and Suparn Chamswasdi. Published by the Applied Science Research Corporation of Thailand, Bangkok 1967.

(3) Northeast Rainfed Agricultural Development Project - An Opportunity Framework. Published by the Regional Planning and Development Project, Universit of Wisconsin under Contract No. AID/DSA-C-0060. Madison 1979.

(4) Village Level Study for Northeast Rainfed Agricultural Development Project by Damrong Thanee and Pit Sompong, Ramkhamhaeng University, Bangkok, Thailand, 1980.

2. Physical Features

a. Topography

Except for the hilly areas along the southern and western boundaries of the region and South of Udon Thani and Sakon Nakhon, the Northeast consists mostly of a very flat plain or plateau tilted gently towards the southeastern corner. The western edge of the plain at the foot of the Phetchabun mountains has an elevation of about 200 m. Along the Mekong River, the elevation for the most part is less than 150 m. In the South, the general elevation is 500 m., the highest peak being Khao Laen with an elevation of 1,328 m.

b. Drainage

Two main rivers, namely the Mun and the Chi Rivers, drain about four-fifths of the total area. The Mun River originates near Nakhon Ratchsima (Korat) and flows eastwards through Ubon Ratchthani to the Mekong River, draining the northern slopes of the Phanom Dongrak mountains. The Chi River drains all the western portion of the plain and most of the interior flowing southeast to reach the Mun River near Ubon Ratchathani. The combined drainage area of the two rivers is 125,500 $Km.^2$

The northern and eastern fringes of the region are drained by several small rivers such as the Luang, Songkhram and Kham. All these rivers eventually flow into the Mekong River.

c. Geological Structure

The Northeast of Thailand is structurally unique in that it is located at the centre of a series of concentric mountain folds that encircle Burma, Thailand, Malaysia, Indonesia and Philippines.

Except for a few small outcrops of balsalt in the South and limestone and igneous rocks along the North-South trending ridge between Loei and Udon, the region is made up of a series of fine grained sandstones and shale beds overlain in valley depressions by alluvium and river terrace deposits.

The upper strata are most important from the water balance standpoint. Over a large portion of the region embracing Khon Kaen, Kalasin, Ubon Ratchathani, Surin,

Nakhon Ratchasima, and Chaiyaphum provinces, the near surface rocks are fine to medium grained sandstones, tan to pinkish-red in colour, interbedded with mottled purple and grey fine sandy shale. This formation is also found in some parts of the Udon Thani and Nong Khai provinces. In almost the rest of the region, in a strip of 10 to 15 Km. wide, the surface rocks are massive with fine to coarse grained sandstones, some conglomeritic, with a variety of colours and interbedded with shale. The sandstones in the upper strate, being least consolidated, are highly pervious.

d. Soils

Soils of the Northeast have been differentiated into broad groups based on soil landscape relationships as follows:1/

(1) Soils Occurring on Flood Plains: Soils on this landform consist of very deep, well drained and poorly drained soils developed from recent alluvium. Soils occupying natural river levies are well drained, medium textured soils. They are usually used for garden crops. Soils in river basins are poorly drained, fine textured and are used for rice cultivation. The soils developed on this type of landform generally fall in the great groups Ustifluvents and Tropaquepts according to the U.S. Soil Taxonomy classification system.

(2) Soils Occurring on Low Terraces: These soils have variable characteristics such as soil depth, texture, and salinity. They are moderately to poorly drained and are extensively used for rice production. they are classified in the great soil groups: Paleaquults, Plinthaquults, Natraqualfts, Halaquepts, and Dystropepts.

(3) Soils Occupying Middle-High Terrace: Soils developed on this type of landform are composed of soils that have varied diagnostic characteristics which include color, soil, depth, and texture. All are well drained and are usually devoted to upland crop production or forests. These soils are classified as: Paleustults, Phinthustults, Haplustults, Haplustox, Rhodustults, Dystropepts, and Quartzipsamments.

(4) Soils Occurring on Erosion Surfaces: Soils occurring on this landform are also variable in texture, color, soil reaction, soil depth, etc. These differences in properties occur primarily because of differences in parent materials. The soils occur mainly in the southern and western part of the region. They are generally heavier textured than soils of the middle to high terraces. These soils are classified as Paleustults and Haplustuits.

1/ Unpublished (Memo), no date, no Author. Supplied by Dr. Wanee Samphantharak, Department of Land Development, July 1979.

(5) Soils Occupying Hilly Areas: These soils occur on hilly and mountainous areas and are usually included in mapping units as "slope complex soils".

3. Meteorological Factors

a. Climate

The climate of the Northeast is seasonal in nature. The Southwest Monsoon, caused by low pressure over Central Asia, brings heavy rainfall to the whole region. Beginning with the month of April, the precipitation increases steadily as the wet season progresses until the maximum monthly rainfall is reached, which normally occurs in September. This is accompanied with a slight rise in humidity and a simultaneous decrease in temperature and radiation. The average wind velocity during the wet season remains fairly steady at about 5 Km. per hour.

Precipitation decreases rapidly in late October or early November. Even though occasional tropical storms with heavy rainfalls do occur along the Vietnamese Coast during these two months, these weaken rapidly as they penetrate inland.

The reverse airstream, the Northeast Monsoon, starts in December. The temperature falls to a minimum in December or January, then rises rapidly at first and then more gradually until it reaches a maximum in April. During this period, the weather is hot and dry moderated slightly by light breezes, cool nights and very occasional light showers.

b. Rainfall

Rainfall distribution during the rainy season of April through October has a bimodal tendency which is more pronounced in the North and Northeastern provinces. The more pronounced bimodal pattern in these provinces is a result of higher rainfall in the early part of the season and these same provinces usually have the highest total rainfall. Total annual rainfall varies from about 1,100 mm. in Chaiyaphum and Nakhon Ratchasima provinces to more than 1,800 mm. in parts of Nong Khai and Nakhon Phanom provinces.

Rainfall is generally quite variable from year to year. Early season rainfall tends to be variable both in timing and amount. Heavy late season rainfall almost always occurs but

the peak period can vary by a month or so in timing and the sharpness of the peak also varies from year to year.

c. Evaporation

Evaporation in the Northeast varies geographically as well as seasonally. The ridges of high evaporation extend through Nakhon Ratchasima, Khon Kaen and Udon Thani, with a trough to the west embracing Phetchabun and Loei, and a shallower depression centered in Sakon Nakhon. For Class A. pan evaporation, the higher annual values are found at Udon Thani, Khon Kaen and Ubon Ratchathani with values of 2,315 mm., 2,244 mm., and 2,339 mm., respectively. A typical value of pan evaporation in the western trough at Loei is 1,590 mm. per year. Around Nakhon Phanom and Sakon Nakhon, Class A. pan evaporation amounts to about 1,800 mm. per year. The seasonal variation is regular in transition from minimum values in September - October to maximum values in March - April.

d. Temperature

The temperature in the Northeast is lowest in December - January with a mean monthly temperature of about 22.5°C. The mean temperature then gradually increases until it reaches a maximum of 30°C in April.

e. Humidity

The humidity of the region varies according to the trend of the monsoons, with a mean relative humidity reaching a minimum of around 60 percent in March and rising to a maximum of about 80 percent in August or September.

4. Agriculture

During the past 20 years, agriculture in Northeast Thailand has evolved from being almost totally subsistence in nature to a mixed cash-subsistence type farming. The subsistence component, particularly the production of rainfed paddy rice (glutinous rice in most areas) continues to dominate in terms of farmer's concerns and farming decisions. The shift to partial production of cash crops has been made possible by a vast improvement in transportation infrastructure, particularly highways. Continued population increase, almost total utilization for paddy rice of all lands even marginally suitable, and increasing availability

of consumer goods have provided motivation for shifting to upland crops. The increasing need for cash income and the strong seasonality and low productivity of agriculture also relate to the current importance of off-farm and non-farm employment for many Northeastern farm families.

a. Rice Production

Typical farming patterns include production of rice on all lowlands except those flooded almost every year. Rice is also grown on lower terraces and most middle terraces. The amount of rice production attempted on middle and upper terraces and uplands is dependent on the availability of other lands and population pressure in a particular local area. Rice planting is normally started on the lower fields as soon as they are wet enough for transplanting and proceeds to higher elevations as the fields become saturated. In the dryer years, many paddy fields (as much as 30 to 40% of the total) may not be planted. In wetter years some of the lower elevation fields will have the crop destroyed by flooding. The area of land left out of production or destroyed by drought during the drier years is much greater than the area subject to floods in wet years, so the wet years are normally the years of highest total production. The purchased inputs for rice production frequently include a low level of chemical fertilizer, the application of which is often confined to the rice seedling nursery and paddy areas which exhibit more than usual chlorosis; hired labor during the peak labor demand periods of transplanting and harvest; some hired equipment, often for the early first plowing of the paddy to increase water retention, and hired buffalo when family-owned draft power is limited; and, infrequently, agricultural chemicals.

b. Kenaf and Cassava

Upland crops are dominated by kenaf production, which became commercially significant in about 1962, and cassava, which became significant after 1970. Thai kenaf (*Hibiscus sabdariffa* var. *altissima*) is native to Thailand and has been propagated on upland soils for centuries for local use. Cuban kenaf (*H. cannabinus*) was introduced into Thailand in 1951 and is cultivated on upland soils and in some paddy areas before rice. Kenaf is mostly exported as the baled fiber but a significant part is manufactured into bags and other products in Thailand; a pilot plant for the production of paper pulp from kenaf has recently been opened in the Northeast. Kenaf production fell markedly in the mid seventies but has been increasing again since that time. Cassava is produced mostly for export as dried

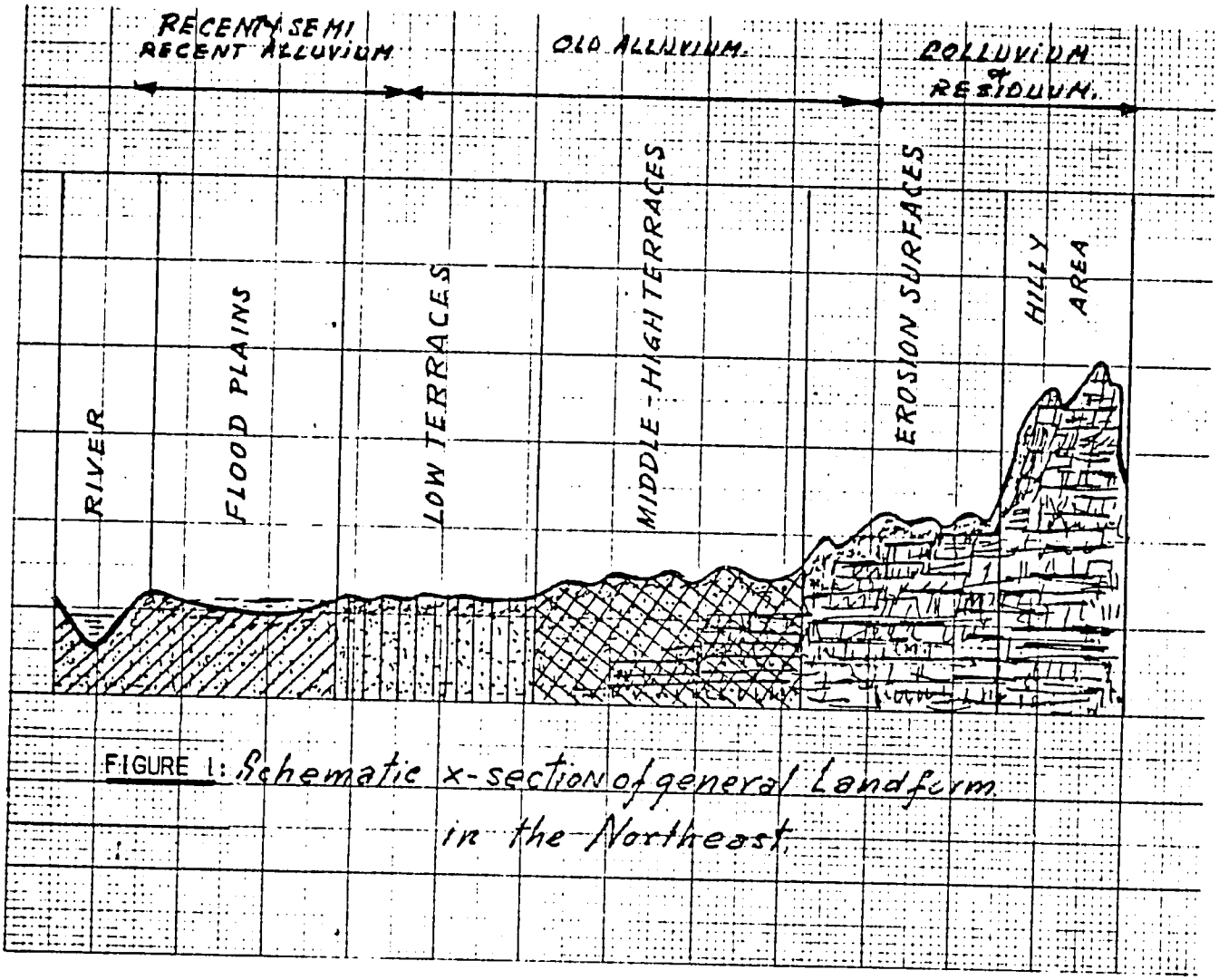


FIGURE 1: Schematic x-section of general Landform in the Northeast.

chips or pellets for use in animal feed in Europe. Production in the Northeast increased almost four times between 1975 and 1979. The crop is especially well-suited to Northeast Thailand conditions due to its drought tolerance and ability to thrive on soils with low mineral nutrient status, as well as to the fact that it can be both planted and harvested within a rather flexible time frame and thus has minimum competition for labor supply with other agricultural enterprises. The rapid increase in production is a matter of considerable concern, however, due to the prevailing production practices which are "soil mining" in nature and to the large amount of land which has been cleared for its production. The fact that the market is dependent on tariff preference is also a cause for some worry.

c. Other Crop Production

Other crops are of much less significance, but are still important. These include legumes (peanuts, mungbeans, and soybeans), sugar cane, tobacco, maize, cotton, sesame, vegetables and fruits. Production areas for some of these, especially maize, cotton, and sugar cane tend to be concentrated in certain areas of the Northeast. Others, especially sugar cane and tobacco, tend to have their commercial production tied to the availability of processing facilities. Production of several crops for home consumption, including peanut, mungbean, tobacco, fruits, and vegetables, is common. Subsistence fruit and vegetable production tends to be concentrated around village houses and small water resources, utilizing traditional cultivars and management practices.

Dry season cropping occupies a rather small area, but is of growing importance. In addition to some dry season cropping in the limited (less than 4%) irrigated areas, small hand-watered plots of vegetables and tobacco are widely produced. Non-irrigated production of several crops, especially watermelon, cucumbers and string beans immediately after rice harvest is common. In certain areas such deep rooted and/or short duration crops can be produced at this time of the year utilizing only ground water reserves.

d. Livestock Production

Livestock is important in Northeast Thailand, with the percentage of agricultural income from livestock being higher than in any other region of the country. In 1978/79, there were over 4,000,000 buffaloes, almost 2,000,000 cattle

and more than 1,000,000 hogs in the region. Most farm families (80%) own 1 to 5 buffalo, mainly for draft purposes, while a smaller percentage (23%) own 3 to 5 cattle. Increases in livestock production are usually limited by feed shortages, especially in the late dry season and very late in the rainy season when land is occupied with crop production. Pig raising is conducted primarily on a small scale basis, with feed coming from rice by-products. There are relatively few commercial poultry flocks in the region, but almost every village household has a few chickens or ducks providing both food and some cash income.

e. Other Farm Enterprises

Harvesting of fish for home use is very widespread, and in areas having access to larger bodies of water, many families receive significant and sometimes their main cash income from fish sales. Traditionally, Thai culture has attached special importance to both rice production and fish capture.

Silk production is widely practiced for home use and a number of areas have a significant concentration of silk production for sale either as the raw product or as finished goods. Mulberry production is often a limiting factor due primarily to lack of moisture during the dry season and/or to the planting of ungrafted cuttings of root rot susceptible cultivars.

Figure 2 - Major Crop Data for Northeast Thailand 1978/1979*

	Planted (Ha.)	Production (tons)	Yield (Kg/Ha.)
Rice	4,451,200	5,260,000	1,180
Rice (second crop)	25,440	65,000	2,560
Cassava	673,760	9,572,000	14,200
Kenaf	313,889	330,570	1,060
Maize	327,670	556,900	1,700
Sugar cane	44,186	1,387,500	30,000
Peanuts	22 652	23,280	1,025
Cotton	22,447	23,420	1,040
Mungbeans	11,668	8,180	700
Soybeans	6,381	5,560	875

*Source: Agricultural Statistics of Thailand Crop Year 1978/79, Agricultural Statistics No. 108, Ministry of Agriculture and Cooperatives, Bangkok, Thailand, 1979.

Figure 3 - Cash Income and Expenses Per Farm Family Baht/Year (1976/77)*

	Northeast	North	Central	South	Kingdom
Cash Income	9,960	18,549	36,982	13,479	17,827
Agriculture	5,428	13,255	28,642	7,766	12,224
Livestock	874	1,274	3,763	892	1,538
Crops	4,302	11,572	24 510	6,684	10,378
Misc.	248	409	368	189	308
Non-Farm	4,532	5,294	8,340	5,713	5,603
Cash Expenses	8,823	14,008	30,188	11,028	14,515
Agricultural	2,637	4,718	15,995	1,938	5,636
Non-agricultural	6,186	9,290	14,193	9,090	8,879

*Source: Agricultural Statistics of Thailand Crop Year 1978/79, Agricultural Statistics No. 108, Ministry of Agriculture and Cooperatives, Bangkok, Thailand, 1979.

Figure 4 - Land Use in Northeast Thailand*

Use	Hectares
Total land	17,023,000
Farm land	7,727,000
Housing	156,000
Paddy land	5,546,000
Field crops	1,448,000
Fruit and tree crops	65,000
Vegetables and flowers	12,100
Idle	303,000
Grass land	32,700
Other	163,000
Unclassified	9,295,000

*Source: Agricultural Statistics of Thailand Crop Year 1978/79. Agricultural Statistics No. 108, Ministry of Agriculture and Cooperatives, Bangkok, Thailand, 1979.

PROJECT COMPONENTS AND TECHNICAL ANALYSIS

A - EXTENSION SUPPORT

The expressed intent of the Northeast Rainfed Agricultural Development project has been to maximize contributions of all governmental units that can contribute to efforts to improve the agricultural productivity and livestock of low income families in the Northeast. The primary implementing personnel or key agent in implementation will be the Tambon Extension Agent (TEA) of the Department of Agricultural Extension (DOAE). Provision of resources, including support from Ministry of Agriculture and Cooperatives (MOAC) departments and training of personnel, that will enable the TEA to better perform his job will be a major part of the project.

Of the 8 project tambons, only 2 in Roi Et and 2 in Si Sa Ket have had TEA longer than 2 years and the other 4 (2 in Chaiyaphum and 2 in Nakhon Phanom) initiated the TEA program in 1980. The expansion into these provinces is part of an ambitious plan to establish a ratio of 1 TEA to 1,000 farm families in each tambon. As a result of this very rapid expansion the Department of Agricultural Extension has encountered numerous problems, most of which are related to (a) a shortage of well-trained personnel causing many vacancies and much turnover of TEA, and (b) the limited experience of most TEA and of many in positions that should be supportive of the TEA. As a result the young, inexperienced TEA lacking necessary direction and support may feel very inadequate and lose confidence, thus further eroding his desire and ability to adequately serve rural families.

Because of the present situation it is essential to ensure TEA successes so they will gain confidence and enthusiasm for their work. To assist the TEA become a more effective worker we propose to provide additional training for them. TEA will not receive training in all fields in any one year but over several years most TEA will have received additional training in subjects important in their tambon. Since new TEA will be employed to fill proposed TEA positions, it will be desirable to provide them with 6 weeks of induction training, with emphasis on practical aspects. This necessitates a two-week increase in the current training program. The increase is essential because TEA, Amphoe and provincial officials interviewed generally feel the TEA needs

further training to improve work skills with rural people and training in areas important to the program but not received in vocational training, i.e., livestock, fisheries and forestry.

A major constraint in TEA knowledge and confidence is the lack of familiarity with researchers, current research and with the techniques involved in putting research results in practice. The project provides for close association of researchers, TEA and farmers in planning and conducting Research Field Trials, Demonstration Trials and Extension Trials. Research Field Trials will be conducted on cooperating farmer fields with the TEA as an observer/participant. Demonstration Trials based on research results will be carried out by farmers under the immediate supervision of the TEA but with technical backstop support. Extension Trials based on research and demonstration results will be conducted by farmers with input subsidy by the project. The TEA will be involved in farmer selection, farmer training and observation of Extension Trials.

Current TEA schedules and work responsibilities tend to preclude the TEA becoming well known to and respected by the farmers, a relationship essential for effective extension work. As a partial solution to this problem it is proposed to reduce the current TEA/household ratio from 1:1,000 to 1:500, a ratio representing a consensus of opinions expressed in design team interviews with DOAE personnel in the Northeast and Bangkok. This will permit TEA to carry out scheduled meetings with Contact Farmers (Co.F.) and in addition do enough work in tambon villages with individual families to learn to know the farmers, to better understand their problems and to appreciate the reasons for production practices carried out by both the poor and good farmers. This should assist in the development of farmer confidence in TEA which in turn will increase TEA self-confidence, satisfaction and effectiveness.

Farmers tend to resist change and adoption of new practices particularly when they do not know the TEA and lack confidence in him. The farmer's current image of TEA as individuals and as part of an institution is not good. Farmers often have said that the TEA have little value to farm families. Thus there is a need for intensive TEA work with few enough families to establish mutual trust and acceptance of each other so that the farmer's image of TEA as persons and as an institution is positive. This is a must if the DOAE TEA program is to achieve its potential and have a significant impact on farm productivity.

The effectiveness of teaching is greatly improved by the use of good illustrations and materials, especially if they include identifiable local people and situations. It is for this reason that the project will provide cameras, projectors, posters and other illustrative materials for each tambon. Imaginative use of such materials will not only increase farmer learning but should make educational meetings more interesting and thereby increase farmer attendance at TEA meetings and expand the production knowledge of village farmers.

There seems to be rather complete agreement that TEA should live and work in the tambon to which they are assigned. This is generally not now the case for various reasons, primarily because of lack of adequate facilities in the tambon. It is therefore planned to provide a building in each tambon consisting of residence, office, storage room and meeting room, Figure 1. This will make TEA available to interested farmers any time they have agricultural problems on which they need assistance. This can be arranged by having the TEA be in the office and available to answer farmer questions at some specified time each work day. This is not now possible since most TEA have their office in the Amphoe city and, with their tight pre-arranged schedule of visits to the Co.F. They have little opportunity or demand for office farmer contacts. It would also reduce travel time and expense currently required for TEA to get to their tambon from amphoe offices.

Currently transportation is not available to some TEA, a constraint that very seriously affects their ability to visit in villages with Co.F. and other farmers. These contacts are essential to development of effective working relations between farmer and TEA. It is planned to make motorcycles available for TEA transportation.

The contact farmer approach to extension work has not been uniformly successful in all mubans. It is not proposed to eliminate this approach but to strengthen it by providing training for what may be termed specialist contact farmers i.e., farmers who receive intensive training at regional agricultural headquarters. This process over a few years will increase technical know how available in each village. Another supplement to the Co.F. effort, made possible by increased TEA staff, will be TEA sponsored village and/or tambon meetings to discuss local problems and potential solutions and then to establish project priorities and ways to approach or solve the problem. This means there will be

ocal input in decision making, an essential ingredient for farmer participation in improvement activities. This is largely lacking at this time.

One of the proven teaching techniques in any rural area is the demonstration technique. DOAE personnel have indicated that many of their demonstrations were failures which is interpreted as meaning that it did not show or demonstrate the point intended. This is a source of embarrassment to the TEA, eroding both his confidence and his credibility with farmers. This must be due to (a) poorly conceived demonstrations, or (b) failure to properly apply treatments to the plots It is proposed to largely eliminate this problem by having only very carefully planned and implemented demonstration trials and by designing these trials not to prove a point but rather that compare new and or old practices. The intent will be to provide the farmer with decision making rather than to merely show what should be done. This will increase TEA confidence and job satisfaction and enhance his image with farmers.

Since most TEA are young, insecure and unfamiliar with Extension programming and methodology, it is essential that the Amphoe or District Extension Officer (DEO) provide them close supervision, guidance and assistance in becoming established in the tambon and in developing tambon programs, especially when they are the first agent in a tambon. DEO failure to do this effectively will result in continuation of the current weak farmer image of TEA, frustrated TEA and sub-optimal use of public funds. It is also imperative that DEO be effective administrators to ensure common direction and purpose of extension personnel. This kind of leadership can not provided by Changwat Extension Officers because of the heavy representational and paperwork requirements of that position. Thus it seems necessary to provide intensive training on job responsibility and performance for DEO. It is planned to add a field manager in each changwat to provide more direct technical support to the project tambons and to insure better design and implementation of test-demonstrations. The field manager will not be responsible either to or for the DEO but will be a resource person that can indirectly assist in improving some function of that office.

The Subject Matter Specialist (SMS) function has been varied and inconsistent perhaps due to (a) inexperience, (b) minimal direction and job role understanding, (c) assignment of other duties by Changwat Extension Officers, and

(d) inadequate training in teaching, test-demonstration design and implementation. TEA often need subject matter assistance which should be provided by SMS but for various reason it is not provided. SMS need additional training especially in applied aspects of agriculture and methodology so their TEA training activity will be more productive.

Since upgrading extension personnel is a very important part of this project, the training function is very important. It is therefore proposed that a training officer position be established to ensure that all training activities of the project are coordinated and planned to provide personnel with all skills and understanding of job requirements necessary for successful work performance. The latter is needed for maximum impact on rural income and job satisfaction of personnel.

Earlier reference has been made to a general education programs for farmers to be provided primarily through TEA activities. There are 2 other means of providing farmers with timely information that will help them make better decisions. One is through the use of mobile units that develop comprehensive, interesting and understandable information on timely topics of interest and importance in project tambons. The other activity of educational value relates to use of agriculture-oriented radio programs of interest and value to farm families. Such programming is currently being effectively done through Khon Kaen stations. Because of lack of facilities, equipment and necessary supplies distribution of programs is limited to Khon Kaen stations. The project will provide equipment at the regional office to (a) increase the number of programs produced; (b) improve quality of programs produced; and (c) distribute them to project Changwat stations and perhaps in Sakon Nakhon since it gives better radio reception in Tambon Na Ngua. This should be an effective educational tool since most farm families have transistor radios and often take them to the field.

Inadequacies of present DOAE program pointed out herein should not be interpreted as criticism of that program for it is intended to point out areas where its effectiveness can and should be improved if extension workers are to achieve their full potential for improving income of farmers in the Northeast. The economic and social study data show progress is being made. For example, nearly 44% of villagers in the two tambons that had TEA since 1977 reported having secured help from extension personnel tambon and amphoe. In 3 tambons that initiated the TEA program in 198[illegible] the corresponding figure was 15%.

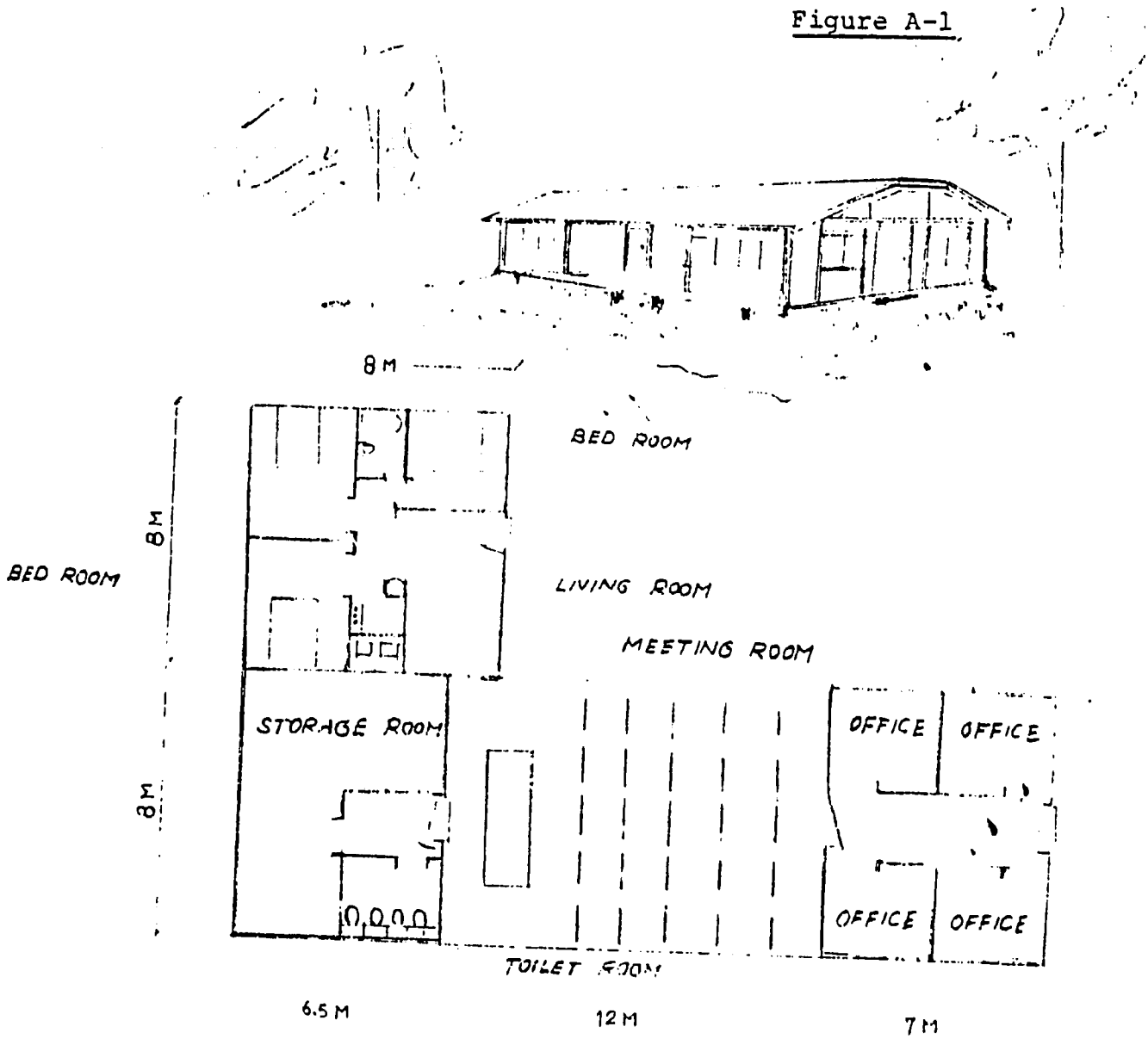
Current acceptance of extension personnel recommendations may be primarily limited by lack of farmer confidence in TEA and it is essential that constraint be removed. The project will attempt to accomplish this by improving knowledge and work skills of TEA; helping them to develop confidence by assisting them in achieving successes in their tambon; providing better supervision and guidance; providing more adequate technical back-up resources; reducing the number of farmers with whom they work with to permit intensive work with and better understanding of farmers; and providing offices and housing in tambons to increase farmer-TEA contact.

The increased level of activities for TEA and the additional time they will need to spend away from the tambon for training will be disruptive of the current "train and visit" schedule of these officials. The project will compensate for this disruption by providing additional TEA for the project tambons. These additional TEA will make it possible for at least the current level of "train and visit" activity to be maintained at the same time that project activities are being implemented. With respect to TEA activities, the project should be viewed as an experiment in a possible mix of TEA activities which could be considered when and if the DOAE is able to generally provide the more desirable ratio of one TEA per 500 families.

TABLE 1. Implementation Schedule, Extension Support

Activity	YEAR 1	2	3	4	5	6	7
Employ additional TEA, No.	4	10					
Employ support personnel, No.	5						
Specify and order equipment	x						
Tambon facilities, design and contact	x						
Plan training curricula	x	x					
Revise training curricula		x	x				
TEA induction training, No.	6	10		8			
TEA speciality training, man-wk.		120	120	120	120	120	120
Other Extension Officials trained, man-weeks	21	21	21	21	21	21	21
Field managers trained, man-wk	4		4		4		
TEA overseas training, No.		2	2	2	2	2	2
Radio broadcasts, No.		364	728	1456	1456	1456	1456
Mobile unit training programs		50	100	100	100	100	100
Farmers specialists trained							
TEA farm family visits, No.		2500	5500	5500	5500	5500	5500
TEA village meetings, No.		100	210	210	210	210	210
TEA contact farmers, contacts per 2 weeks		1000	1000	1000	1000	1000	1000
Farmer-TEA office visits, No.		2400	5000	7500	8500	9000	9500
Field, demonstration, and extension trials		(See cropping systems section)					

Figure A-1



YANCHAI

FIGURE 1. Sketch of Proposed Tambon Extension Facility

B - SOCIAL SUPPORT

Major needs in area development projects in addition to financial support and technical expertise, include:

1. a system for decision making

2. mechanism for bringing together individuals who because of their position or recognized leadership can contribute to decision making, planning and implementation.

3. Procedures for dissemination of information.

Existing channels, the village meeting and the Village Development Council and the Tambon Council will be utilized for decision making. At the village level the village meeting is probably also an adequate vehicle for bringing together the individuals involved. At the tambon level a mechanism for this is needed. As discussed more fully in the social soundness analysis it will be suggested to the Tambon Council that it invites TEA, Co.F leaders, CDD workers and school teachers to meet with it periodically in the format of a Tambon Agricultural Development Committee to develop the tambon developmental plan and monitor its implementation.

It is also found that the three major groups involved in agricultural development at the district level, villagers, government officials and businessmen have different cultures and each feels that the others are constraints to development. It is proposed that regular meetings be held in the project districts and that these involve project, district and tambon officials; farmers selected from Co.F leaders and/or Tambon Council members; and businessmen (merchants, buyers, financial institutions) doing business with project tambons. The purpose of these meetings will be to inform everyone of project objectives and scope, to explore developmental possibilities to obtain suggestions from all as to agricultural activities needed in project tambons, to publicize project plans, to inform businessmen of project needs for inputs, markets, credit, etc. and to inform government officials of non-project funded needs of the project tambons. These meetings would also serve to provide training for all participants in the process of area planning for development. The project field managers will have responsibility for providing the leadership needed to bring about the organization of these tambon and district activities.

Farmer occupational groupings and cooperatives are also potentially strong vehicles for providing villagers with access to specialized technical support and credit or marketing assistance. Existing organizations will be supported and strengthened by technical support from project technicians and by organizational and management support from the DCP official assigned to the project. Where studies show that new or expanded cooperatives are needed, as discussed in the economic support section, the DCP official will also assist in the formation of appropriate and viable organizations. The DCP training program for cooperative managers which is now being organized should provide valuable support for this activity.

There is also a need for creating a sense of community among all project participants: government officials, village leaders, Co.F, specialist farmers, farmers participating in research experiments, demonstration, and extension trials and farmer adopters. It is proposed that a regular newsletter be circulated to all of these. In addition to carrying information on project activities and some gentle instruction on developmental processes, the newsletter would carry information on current prices for inputs and produce, tips on production and marketing, information on obtaining and using credit, etc.

TABLE - Social Support Implementation Plan

Activity	YEAR 1	2	3	4	5	6	7
District meetings, No.	7	14	14	14	14	14	14
TADC meetings	8	16	16	16	16	16	16
Newsletter distributed	4	12	12	12	12	12	12
Circulation	2000	3000	5000	5000	5000	5000	5000

C - CROPPING SYSTEMS MODIFICATIONS

Background

Intensive cropping systems research for the rainfed Northeast of Thailand were initiated at Khon Kaen University 1/ in 1975. The Rice Division 2/ and the Field Crop Division of DOA are also active in cropping systems research. A large number of cropping patterns have so far been screened for suitability on different landscapes of the Northeast, namely, low, middle and high terrace. It is only recently that some promising cropping patterns, applicable to low-income farmers, have been found agronomically feasible and these will therefore be included in the NERAD program.

Rainfed cropping systems in the eight selected tambons for this project are the monoculture of paddy rice, cassava and kenaf/jute; the patterns are therefore quite similar to other locations in the Northeast.

Traditionally, local photosensitive rice varieties are planted around the edge of flood plain up to the middle terrace with low production input (fertilizer and insecticide). Rainfed rice yields 3/ are variable and range from 70-200 kg/rai on the middle terrace, 200-400 kg/rai on low terrace and 400-600 kg/rai on the edge of flood plain. Constraints for rice production are erratic rainfall and poor soil fertility. Rice is normally transplanted during June-August and harvested during October-January depending on the local agro-environment.

Kenaf is grown on the middle terrace and kenaf and cassava on the high terrace with absolutely no cash input. Therefore the yield is low : 150 kg. 4/. and 2,000 kg/rai 4/ respectively. Varieties of kenaf and cassava are mainly local, with seed or propagating stock of poor quality which often results in poor crop establishment. Low yields also appear to be attributable to poor crop care. Cassava can be planted

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1/ Annual Report of KKU-Farm Cropping System Project, 1976-78.

2/ Annual Report of Cropping System (Thailand) Project, 1977. Kasetsart University, Ministry of Agriculture and Cooperatives, International Development Research Centre.

3/ Private communication with farmers in the selected tambons.

4/ Private communication with farmers in the selected tambons.

nearly all year round March-November, and harvested after the age of 10-14 months whereas kenaf, a photosensitive crop, is mainly grown in April-May and harvested in October-November. During the past few years cassava has replaced kenaf as the most popular crop on the high terraces of many tambons. No other field crops have been grown in large quantity and therefore diversification in crop production is narrow. Any drop in price or disaster to crop growth will have a negative bearing on net income of farmers practicing only one kind of field crops.

In the areas, particularly on the flood plain and low terrace, where supplementary water is available on soil moisture is adequate for a long period of time, many farmers commercially raise vegetables or high-value crops for cash after rice harvesting. Examples of vegetable crops are yard-long bean, cucumber, squash, shallots, spring onion, cabbage, radish and lettuce. Examples of high-value crops are tobacco and watermelon.

Traditionally, rice (glutinous varieties in 5 and non-glutinous varieties in 3 tambons) is raised for home subsistence consumption whereas cassava, kenaf, high-value vegetable crop and only the surplus of rice will be sold for cash. Farmers normally alternate their farming activities between their subsistence and cash crops with preference to the former. Nevertheless, in many tambons next to swamps or on lowland with supplementary irrigation, farmers are willing to move from rice production into high-value crops such as vegetables (Tambon Lahan), or to take on other farming activities such as fisheries (Tambon Lahan and Tambon Na Thom). The decision depends on the income from cash crops being consistently obtainable and significant enough to safely buy rice for consumption. However, the majority of farmers, particularly on the undulating topography with middle and high terrace, are not equally fortunate. They are traditionally rice farmers and regard rice farming as a risky operation because of frequent crop failure due to unreliable rainfall. They 1/ complained that rain either comes late and/or stops early and/or stops for a while resulting in a long drought during the mid-season. But they have to carry on, since rice is their staple food.

Therefore, cropping patterns which can at least stabilize rice yields through the years, economically increase

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1/ Personal communication with farmers in the selected tambons.

any crop yield/area, or provide regular or increased cash income will be welcomed by poor farmers in the eight selected tambons of the NERAD project. These are the kinds of cropping patterns that the project will suggest to the farmers. They include the built-in soil and water conservation practices. They require no expensive equipment other than draft animals, need minimum cash input, and optionally utilize the existing farm labor.

Design for Improved Cropping System

In addition to depending on the prevailing rainfall pattern and other climatic conditions, varieties of crops grown and cropping patterns promoted will depend upon location. Each landscape position has characteristics in moisture holding capacity, drainage and degree of fertility. These features will, under rainfed conditions, determine the planting date of cropping pattern, crop duration and eventually crop production.

Therefore, the actual design of improved cropping system will be based on the type of landscape, with traditional cropping systems and prevailing rainfall patterns in mind.

1. Flood Plain

This agricultural land is located near the lowest point of topography, normally adjacent to a swamp or river. It is found in 3 out of 8 tambons : Na Thom, Lahan and Na Muang - with the estimated total arable land of nearly 16,000 rai. Although late start of rainfall is possible, soil moisture for crop growth is plentiful in the first half of rainy season despite any dry spell occurrence. Flash flooding appears in approximately 2 out of 5 1/ years in the latter part of the season (late August-early October). Duration of flash-flooding is between 4-15 days. The soil is relatively fertile due to accumulation of organic fertilizer after flooding.

The major crop grown in the rainy season is traditional long seasonal tall varieties of rice with very productive yields (400-600 kg/rai) 1/ without additional fertilization in a good year. However, the yield could be reduced to near zero 1/ with flash flooding. In recent years, the area has been plagued with flooding more frequently 1/

1/ Personal communication with farmers in the selected tambons.

than in the past, resumably due to heavy deforestation, and therefore, the farmers often lose their crop. To alleviate the problem, the project will introduce some newly released deep water rice varieties, namely RD 17 and 19, to stabilize the long-term rice yield/area on this agricultural land. These RD rice varieties can withstand submergence for 7 days without serious damage and can elongate their stems up to the water depth of 1 meter. 1/ To distribute risk, individual farmers will be encouraged to plant up to 40% of flood-prone land with deep water rice. These varieties, however, could be expected to produce slightly lower yield than traditional rice varieties in a year without flooding.

During the early part of rainy season, there is a large proportion of area further down on the flood plain remaining unplanted with any crops prior to flooding. To increase land utilization, short-duration field crops of 70-90 days (e.g. mungbean, sesame) will be sown in May-June and harvested in early August before flooding.

After the rainy season, farmers normally grow off-season rice or high-value vegetable crops with supplementary irrigation from swamp, river or shallow wells on the flood plain. With the construction of a new dike or submerged dam, or renewal of a swamp, more farmers will be attracted to vegetable growing. Commercially produced vegetables and high-value crops as currently found in Lahan and Na Muang are given unnecessarily heavy applications of dangerous pesticides, such as Phrodrin, Parathion, Domethorate or even DDT, and often these chemicals and sometimes even fertilizers are misused. This kind of wrong management results in unnecessarily high cash inputs as well as hazards to health of farmers and consumers. Advice on improved vegetable and high-value crop productions will therefore be handed out via tambon training programs, specialist farmers and extension farmers (see details in the later sections).

After the rainy season, there are the areas where water resources are not readily available for supplementary irrigation, but soil moisture is adequate to support full

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1/ Available informations released from RD of MOAC. The typical yields of deep-water rice varieties released from RD range from 390-640 kg/rai under experimental conditions.

growth of short to medium-duration crops. Farmers will be introduced to marketable drought-tolerant field crops, such as peanuts, mungbeans or sesame, after rice harvesting. Investment in this kind of crop is moderate and with good crop care the farmers will get a handsome net income/area.

There are quite a few fallow lands left uncropped after the rainy season. The farmers who own these lands will be encouraged to sow mungbeans, red cowpeas or leguminous pasture prior to or right after rice harvest. This kind of pattern can be handled by a low level of management. There is a dual purpose: pods can be harvested for cash or home consumption or the whole plant can be left as high-protein forage for domestic animals.

At the end of the project, it is hoped that more land will be introduced into crop production and thereby help to keep farmers on the farm, away from off-farm employment.

2. Low Terrace

This land is situated between the flood plain and the middle terrace. The soil in this area is less fertile than that in the flood plain but still holds moisture longer than that of the middle terrace.

The area next to the flood plain, where soil moisture is readily available throughout the growing stage of rice even with the occurrence of a drought, will be planted with high yielding RD rice varieties which are responsive to heavy fertilization. The yield increment of rice is expected to be about 40%-100% 1/ by this technology. It should be noted that in the past farmers refused to accept new high yielding rice varieties because they cannot afford to apply expensive fertilizer. This project therefore aims to win back the farmers' confidence by totally subsidizing production inputs to a group of interested farmers for conducting extension trials on high-yielding rice varieties. Proper training of extension personnel will also be needed to ensure that new technology in effective fertilizer application and pest control will fully reach the farmers.

1/ Private communication with farmers in the selected tambons. Average yield of traditional rice varieties on this area is about 200-400 kg/rai without heavy fertilizer addition.

Nevertheless, in years when the rainy season begins late, rice-planting in many low-terrace areas is late also. To ensure transplanting of rice at the normal time, a nursery seed bed will be prepared early by supplementary irrigation from pit pond construction or renewal by the project at some points in some tambons (See full details in 'water benefits').

Since the lower part of lowland terrace generally have numerous shallow wells and some pit ponds, many farmers in the selected tambons of Nong Kaew, Na Muang, Tae, Takek and Na Ngua raise vegetables and high-value crop for cash after rice. After commencement of the project more shallow wells and pit ponds will be constructed and as a result more farmers will take on vegetable gardening. The project will aid the farmers in this program as previously described in Section A.

Even without supplemental irrigation many areas on the low terrace have prolonged soil moisture residue, and therefore can be planted with a drought-tolerant crop such as watermelon. This is now done extensively in Tambon Nong Kaew. However, watermelon is perishable crop requiring high cash input (฿1,000/rai), so it is not grown by many low-income farmers. Equally marketable, drought-tolerant, but lower-investment crops, such as peanuts, sesame, and mungbeans will be introduced to low-income farmers to utilize vacant land after rice harvesting in this area (also see Section A). Furthermore, farmers will be encouraged to sow mungbeans, cowpeas, or leguminous pasture into rice straw prior to rice harvesting in order to provide forage for animals, or for pods if there is adequate soil moisture (also see Section A).

3. Middle Terrace

This is the place where the farmers are normally found to be extremely poor due to low rice yields and frequent crop failure caused by erratic rainfall, poor water holding capacity and low fertility of the prevailing sandy soils. Long term average rice yields on this area may be about 100 kg/rai or even lower.1/ The farmers complain that the rain may either come late and/or withdraw too soon, or comes early but disappears for 3-6 weeks mid-season (during June-August). Late-starting rain results in late transplanting of rice and/or low soil moisture available during rice grain filling phase. Mid-season drought can restrict rice growth or even kill the newly transplanted rice crop. Farmers frequently say that rice yields are satisfactory in only in 3 out of 5 years.1/

1/ Private communications with farmers in selected tambons.

To overcome the problems of low rice yield on the middle terrace, direct seeding of rice will be introduced to the farmers in place of the traditional transplanting - that is, dry rice seed will be sown directly into the soil. Later, when the heavy rains come about one month after seedling emergence, water will be impounded. Rice planted in this way will well withstand some mid-season drought, because its roots will be deeper. In a year with good rain, direct-seeded rice will not markedly outperform traditionally transplanted rice, but will outperform it by a large margin in a dry year. The most promising rice variety for direct-seeding purpose is currently found to be the non-glutinous RD15 1/ - with a large number of both glutinous and non-glutinous varieties 2/ showing a high degree of promise. To promote this kind of crop practice, a man-pushed rotary weeder, essential for quick weeding, and a specially-made wooden harrow, for quick seeding, will also be made available on loan to the interested farmers under "extension trials" arrangements. Training will also be intensive for extending this technology to the farmers.

Apart from direct-seeded rice, any promising transplanted rice varieties found by the Rice Division to be tolerant to drought will be on-farm tested before releasing it to farmers for trials.

In long run, farmers should be encouraged to grow 4-5 rai of direct-seeded rice with a few rai of drought-tolerant rice varieties and to plant the remainder with tradition varieties in order to distribute both risk of crop failure and peak-labour periods.

For all rice varieties grown in the middle terrace, farmers will be advised to use a moderate amount of nitrogen fertilizers with a large proportion applied at the critical panicle initiation stage (in September for early photosensitive varieties). This method is found to increase crop yield by 15-20%. 3/

1/ Personal communication with Rice Division of DOA.

2/ Typical rice yields obtained from direct seeding are 200-500 kg/rai depending on varieties, treatments and locations - from Rainfed Rice Improvement Pioneer Project - Northeast Thailand, 1980. Rice Division, DOA.

3/ Eastin, J.D., et al., 1969 Physiological aspects of crop yield. American Society of Agronomy and Crop Science Society of America, Madison, Wisconsin, USA. Also reported successful by one of TEA in one tambon.

On the middle terrace where rice is normally transplanted late in August, one short-duration crop of 70 days, such as mungbeans, can be successfully grown before rice transplanting. Vacant land can thus be used. This new technology will also be transferred to the farmers through the training program and extension trials.

There is a considerable portion of middle terrace, adjacent to high terrace, which remains uncropped in 2-3 out of 5 years due to insufficient water for paddy production. These areas should be transformed into relatively more productive field crop production. This can be done either with a monocrop of long duration (e.g. peanut or kenaf), or with sequential cropping combining two short-duration crops (e.g. sesame-mungbean). It is expected to take a considerable time for the farmers to adopt this technology and therefore experiments and on-farm trials will be conducted at the early stage of the project.

4. High Terrace

Cassava and kenaf currently occupy this landscape in all selected tambons, since they are drought-tolerant and relatively minimum-care crops. Nevertheless the two crops have some present and future limitations. At present a kenaf grower has the problem of finding water for retting. Repeatedly planting cassava on the same land without soil improving practices appears to deplete soil fertility and destroy soil structure (if planted in the early rainy season). The future market for cassava produce could also be limited due to trade restrictions. Therefore, alternative crops will be introduced to the area in order to provide diversity and avoid risk in case of marketing failure of one particular crop. Monocropping of one long-duration crop and double-cropping with two short-season crops will therefore be introduced to the farmers through training programs and demonstration/ extension trials. Peanuts, mungbeans and sesame will be the newly introduced crops for this purpose. They are popularly grown in some areas of the Northeast after rice harvesting on the low terrace, but are found on only a small scale in the selected tambons of the NERAD project. Trial plantings of Cashew or other fruit or tree crops will also be encouraged where they appear to have a potential and farmers appear to have sufficient interest.

The remaining cassava and kenaf on this landscape type will be further improved by introducing new high-yielding varieties such as Rayong 1 for cassava and TSH 30 for kenaf. To significantly increase yields, farmers will also be encouraged to apply some fertilizer to these crops by deep placement of fertilizer into the soil (banding). Weeding and planting techniques will also be included in the training program.

To conserve soil fertility and reduce soil erosion as well as increase net income/area to the cassava farmers, other short- to medium-duration legume such as peanuts will be introduced for intercropping in the early rainy season in between rows of slow growing cassava which is normally planted at 1 x 1 m. This technique has been tested in the past by the KKU-Ford cropping systems project with considerable success. Due to the possible competition for labour between weeding and rice transplanting, it is expected that in the long year one family will grow no more than 3 rai of cassava with legume intercropping. An alternative for soil conservation is to encourage the farmer to grow cassava at the end of the rainy season, to rotate cassava planting with another long-duration crop, or to use two short-season crops.

Activities Taken in Introducing Improved Cropping Systems to the Farmers

To ensure that new technologies are adopted by a large number of small farmers, it is necessary to carry out several interrelated activities. These include recruiting of technical resource people and their assistants; establishing expertise at the village level; setting up training programs at different levels; arranging research field experiments, demonstration and extension trials, and producing seed.

Technical Resource Specialists

Technical resource specialist in various fields will be required throughout the NERAD program to design and promote improved cropping systems for the small farmers in the eight tambons. Specialists recruited will include specialists in cropping systems, rice production, agronomy, soil fertility, soil conservation, horticulture, and plant protection. Although these people will be stationed at NERCA, they will pay frequent visits to all eight tambons (about eight visits/tambon/year). Their duties will be:

- to design and test promising cropping patterns and new farming practices in the form of research field experiments conducted at the early stage of the project.

- from the results obtained from the field experiments, to design more appropriate cropping patterns or practices that can easily be adopted by the small farmers; then promote them through demonstration and extension trials at the later stages of the project.

- To support tambon training programs as instructors.

Works of technical specialists will be aided by technical assistants and TEA throughout the project.

Technical Assistants

Four technical assistants with bachelor's degrees in plant or soil science will be needed to aid development of improved cropping systems in the eight selected tambons. One technical assistant will be assigned to take care of 2 tambons in the same province. In the first year, they will be trained in cropping systems, rice production, and seed production and technology. Although they are based at NEROA they will be expected to make about 10 trips/year, each with 2 weeks duration, in year 2 - 7. They are expected to perform the following functions:

- to survey the existing cropping patterns and methods of farming practiced in each tambon (in year 1).

- to conduct research field experiments according to instructions given by technical resource people, then record and report the progress to the latter.

- together with TEA and field manager, select specialist farmer (SF).

- to help TEA and SF supervise field demonstrations and promote extension trials.

- to obtain feed-back information on the problems of recommended cropping patterns and practices

arisen from demonstration and extension trials and report to the technical backstops and experts.

- help in organizing tambon training programs.

Tambon Extension Agents (TEA)

After having received intensive training in the first year of the project, the TEA will play many vital roles in improving cropping systems both during and after the NERAD projects.

During the NERAD project, the TEA is expected to work closely with technical assistants in cropping systems as follows:

- help technical assistants in selecting sites and labour for research field experiments.
- follow and record the progress of all research field experiments in absence of technical assistants.
- together with technical assistants and field manager, select specialist farmers for cropping systems.
- supervise all works of specialist farmers.
- deliver necessary production inputs and informations for demonstration and extension trials.
- supervise demonstration and extension trials with specialist farmers and report the progress to higher authorities.
- organize tambon training of villagers on cropping systems.

After the end of NERAD project, the TEA is expected continuously to play a vital link between amphoe extension agent and specialist farmers in delivering new agricultural technologies and in dealing with problems in crop production encountered by the farmers in his own tambon.

Specialist Farmer (SF)

The majority of the farmers remain poor due to unchanged farming practices. One of the main reason they do not change is that they have very limited opportunity to consult with experts

on their prevailing cropping problems or to be exposed to new agricultural technology. Supplying 1 TEA for every 1,000 farm families, a method adopted recently by DOAE, has not yet solved the problems in transferring new agricultural technology to small farmers. Therefore, to solve such problems at grass-roots level, it is proposed to furnish each village or every 100 farm families with a specialist farmer in cropping systems.

A specialist farmer will be selected from among the most promising contact farmers already selected by TEA, or from among the labourers who show deep interest during work on research field experiments at the early stage (year 2) of the project.

The individual farmer selected as a specialist farmer will receive 3 one-week training courses in general cropping systems and seed production and technologies. He will be provided, free of charge, with a set of farm tools necessary for working in intensive cropping systems. Wages will also be available because the NERAD job will sometimes be so demanding that the specialist farmer will have to reduce his regular farming activities. A storage room will also be built at the specialist farm's residence to keep seed, fertilizers, farm tools and other field supplies for extension trials.

During NERAD project, the individual specialist farmer is expected to:

- aid the NERAD officers in spreading and demonstrating new technologies to neighbouring farmers at the village level.
- help to recruit the extension farmers and organize the tambon training program.
- look after and also provide half of the labour needed for demonstration plots (if they are on his own farm).
- store and distribute supplies of agricultural inputs to the farmers selected to run extension trials.
- closely follow the progress of extension trials and report to TEA and/or technical assistants.
- raise selected varieties of rice and field crops for seed production.

After the end of the NERAD project, the individual specialist farmer is expected to serve as a close link between the villagers and the TEA in transferring new agricultural technologies and in reporting the problems confronted in crop production. He is also expected to give, on his own initiative, free advice on every aspect of cropping systems to neighbouring farmers.

There will be a total of 116 specialist farmers selected in the 8 tambons of the NERAD project.

Training

There are a number of training programs arranged for technical assistants, TEA, specialist farmers and villagers.

Technical assistants, TEA, and specialist farmers will be intensively trained with lectures and field/laboratory practices in cropping systems, rice production and seed production and technologies. Although equally intensive, the courses for specialist farmers will be simpler, with fewer technical terms than for the TEA. For training efficiency, the class will be kept small, with about 30 trainees/program.

One-week training courses in cropping systems and seed production and technologies will be held at NEROA with instructors from NEROA, DOA and KKU. Courses in rice production will be held at one of rice research stations at Ubonratchathani or Pimai. 1/

Topics in training programs for cropping systems will include the design of suitable cropping patterns to meet prevailing agro-environments and socio-economic conditions, cultural practices suitable for various kind of crops, proper use of improved varieties and fertilizers, proper handling of pesticides, crop diversification to avoid crop and marketing failure, practices of soil and water conservations, etc.

For rice production, emphasis will be on use of improved rice varieties according to appropriate landscape and other agro-environments, cultural techniques for rice establishment under difficult environments, etc. For seed production and

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1/ These two rice research stations already have trained a number of the Northeast farmers in rice production. Training facilities and accommodations are available.

technology, training will be focussed on production, processing, storage and identification of seed belonging to desirable varieties of rice, field crops and vegetables.

In contrast to the training program for TEA and SF, tambon training program will be much shorter, simpler, and less intensive, containing materials which are currently of special interest to the farmers in that particular tambon. Each tambon training program will include about 70 villagers. The course content will be quite similar to the above but special emphasis will be on the proper use of pesticides. Currently, there are two extremes in the use of pesticides: either not applying any, or over-using them (commercial vegetable or high-value crops). The farmers will be taught to use pesticide only when necessary, and to start off from the cheaper and less dangerous grade rather than taking on the more expensive and dangerous ones at the first jump. Lectures and demonstrations will also include applications of correct kind of pesticides with correct timing and dosage pest infestations above economic threshold level. Before making a decision to apply any pesticides, farmers will be encouraged to use resistant crop varieties or species or employ appropriate cultural practices to avoid the concerned pests.

Research Field Experiments

It is quite inappropriate to transfer directly whole new agricultural technologies developed in one agro-environmental and socio-economic conditions to another without further testing or modifications for local suitability. Therefore, field tests will be developed on the farmers' fields in all eight selected tambons prior to full-scale extension. Examples of research experiments will include testing for suitable crop combinations, varieties, spacing, fertilizer and pesticide trials, utilization of newly introduced farm tools using draft animals or human power, monitoring of seasonal changes in soil moisture on different landscapes, etc. All tests will be replicated - using various experimental designs. Research field experiments will be conducted from year 2 - 6 of the project.

Design of the experiments will be carried out by technical specialists based at NEROA. Actual experiments will be conducted and looked after by technical assistants and TEA. Graduate assistants will be needed in years 3 - 5 for the rather complicated field experiments - these will be part of their master's degree theses.

Land will be rented at low rate, with the owner being employed as labour to prepare and look after the fields. Supporting labour will be needed from time to time at the peak of activities.

Demonstration Trials

Research field experiments are normally done on a small scale with the area per replicate often less than 1/4 rai. Lay-out of the experiments is rather complicated and in most cases cannot be readily used as a demonstration to motivate the farmers to adopt new technologies.

Therefore, it is quite necessary to establish on-farm demonstration plots managed by the farmers using tools and techniques which are usable by the average small farmers. Each demonstration plot will be large, about one rai, and will be planted to only one cropping pattern with a package of simple technologies, or will involve simple comparisons of a few promising treatments. For clear comparison, demonstration plots will be established side-by-side to the fields planted traditionally.

Preferably, land used for demonstration plots should be owned by specialist farmers (SF). They are expected to operate the trials so that they can clearly understand every step of activities; this will help them to gain more confidence in transferring the technologies to neighbouring farmers. However, the project still plans to support labour to half of the field activities as SF may be overloaded with other commitments.

Extension Trials

One of the main reasons why the small farmers fail to adopt new agricultural technologies is because they are rather expensive and, in the farmers' opinion, may involve such great risk that the farmers dare not make the investment. The project aims to remove this kind of constraint and gain the farmers' confidence in trying out recommended cropping patterns or farm practices by providing funding for all cash production inputs to the interested farmers. Farm tools will also be lent out during the trial periods.

Each extension farmer will operate 1 - 2 rai under new cropping practices. They will be supported with free production inputs for only one crop. After becoming interested,

they will be encouraged to obtain BAAC loans if needed for the following year's operation. Under this scheme, new farmers will be provided with funds to try out new technologies each year. Some of these trials can be used for demonstration purposes.

The individual extension farmer is expected to report the progress of trials and crop yields to SF in his own village.

Seed Production

Due to high demand and/or limited resources, DOAE may not be able to afford continuously to produce high-quality seed of the needed varieties for the NERAD project. But even if they can, the price of seed is likely to be rather expensive, due mainly to high operational costs such as transportation, seed processing, storage, etc. Seed of most varieties required are also not available at the local market or if they are, the price will be very high and the quality; e.g., probability of germination, is quite doubtful.

Therefore, it is proposed that the local specialist farmers be trained in seed production and technology so that they will be the main seed producers within the villages.

The project will, however, support seed production in only year three, as the seed could subsequently be readily obtained from the farmers who have grown the varieties in the previous year.

Table 1 - Estimated Area[1/] (rai) of Arable Land Located on Different Types of Landscapes in the Eight Selected Tambons

Tambon	Landscape				Total Arable Land
	Flood Plain	Low Terrace	Middle Terrace	High Terrace	
Taket	-	8,100	-	-	8,100
Tae	-	5,100	-	-	5,100
Na Thom	6,500	6,700	4,700	4,000	21,900
Na Ngua	-	18,500	10,100	1,900	30,500
Lahan	7,400	9,500	10,100	10,400	37,400
Kwang Chon	-	33,000	21,000	8,200	62,200
Nong Kaew	-	25,200	2,800	200	28,200
Na Muang	1,800	12,700	5,100	600	20,200
Total	15,700	118,800	53,800	25,300	213,600

1/ Estimated from Tambon baseline survey.

Table 2 - Estimated Area[1/] (rai) Planted to Major Crops in Eight Selected Tambons

Tambon	Rice	Cassava	Kenaf	Vegetables + High Value Crop + Other Field Crops	Total
Taket	8,100	-	-	800	8,900
Tae	5,100	-	-	400	5,500
Na Thom	18,000	2,400	1,700	900	23,000
Na Ngua	28,600	1,600	300	1,000	31,500
Lahan	27,000	8,100	2,400	8,700	46,200
Kwang Chon	54,000	700	7,500	7,000	69,200
Nong Kaew	28,000	-	200	5,000	33,200
Na Muang	20,000	600	-	1,000	21,600
Total	188,800	13,400	12,100	24,800	239,100

1/ The Design Team found no published statistics on agricultural land use at the tambon level. The above estimates for rice were based on extrapolation of average household rice planting reported by farmers in the household survey. Reported data were reduced by 25% which was suggested as the normal degree of overestimation by farmers. Area in other crops was estimated primarily from observation, from calculations of survey data.

Table 3 - Area (rai) Expected to Be Planted with Modified Cropping Systems by Year 20

Patterns	Tambon								Total
	Taket	Tae	Na Thom	Na Ngua	Lahan	Kwang Chon	Nong Kaew	Na Muang	
1. Deep water rice	-	-	2,600	-	3,000	-	-	700	6,300
2. Short duration crop before flooding	-	-	700	-	700	-	-	200	1,600
3. Improved prodn. of vegetable/ high value crop	700	300	1,500	1,500	700	2,800	2,800	600	10,900
4. Less-care legume after rice	800	500	1,300	1,900	1,700	3,300	2,500	1,500	13,500
5. High yielding rice varieties	4,000	2,500	5,400	9,300	4,700	16,400	12,600	6,300	59,200
6. Field crop after rice	1,600	1,000	2,600	3,700	3,400	6,500	5,000	2,900	26,700
7. Short duration field crop before trans-planting rice	-	-	900	2,000	2,000	4,200	600	1,000	10,700
8. Direct seeded rice	-	-	1,900	4,100	4,000	8,400	1,100	2,100	21,600
9. Drought tolerant rice	-	-	1,400	3,000	3,000	6,300	900	1,500	16,100
10. Double cropping of field crops	-	-	1,300	1,800	3,100	4,400	500	900	12,000
11. Monocropping of field crop (peanuts)	-	-	1,300	1,800	3,100	4,400	500	900	12,000
12. Intercropping of cassava & legume	-	-	700	500	2,400	200	-	200	4,000
13. Improved cassava	-	-	1,000	600	3,200	300	-	200	5,300
Improved kenaf/ jute	-	-	1,200	200	1,700	5,300	-	-	8,400
Total	7,100	4,300	21,800	30,400	36,700	62,500	26,500	19,000	208,300

Table 4 - Project Inputs in Terms of Total Area Used in Experiments and Trials and Area Expected to Be Planted with Modified Cropping Systems

Patterns	Project Inputs (rai)			Area (rai) expected to adopt modified cropping systems	
	Research field experiments	Demonstration trials	Extension trials	By Year 7	By Year 20
1. Deep water rice	57	123	450	1,200	6,300
2. Short duration crop before flooding	33	75	153	300	1,600
3. Improved production of vegetable/high value crops*	64	128	260	1,600	10,900
4. Less-care legume after rice*	112	256	672	1,800	13,500
5. High yielding rice varieties	168	320	520	12,000	59,200
6. Field crop after rice*	96	192	388	4,800	26,700
7. Short duration field crop before transplanted rice*	72	192	356	2,000	10,700
8. Direct seeded rice	108	192	544	4,000	21,600
9. Drought tolerant rice	108	192	544	3,600	16,100
10. Double cropping of field crops*	72	96	186	2,400	12,000
11. Monocropping of field crop (e.g., peanut)	80	160	340	2,400	12,000
12. Intercropping of cassava with legume	68	128	260	800	4,000
13. Improved cassava	80	160	360	1,000	5,300
Improved kenaf	80	160	360	1,400	8,400
Total	1,198	2,374	5,393	39,300	208,300

* Area involved in double cropping.

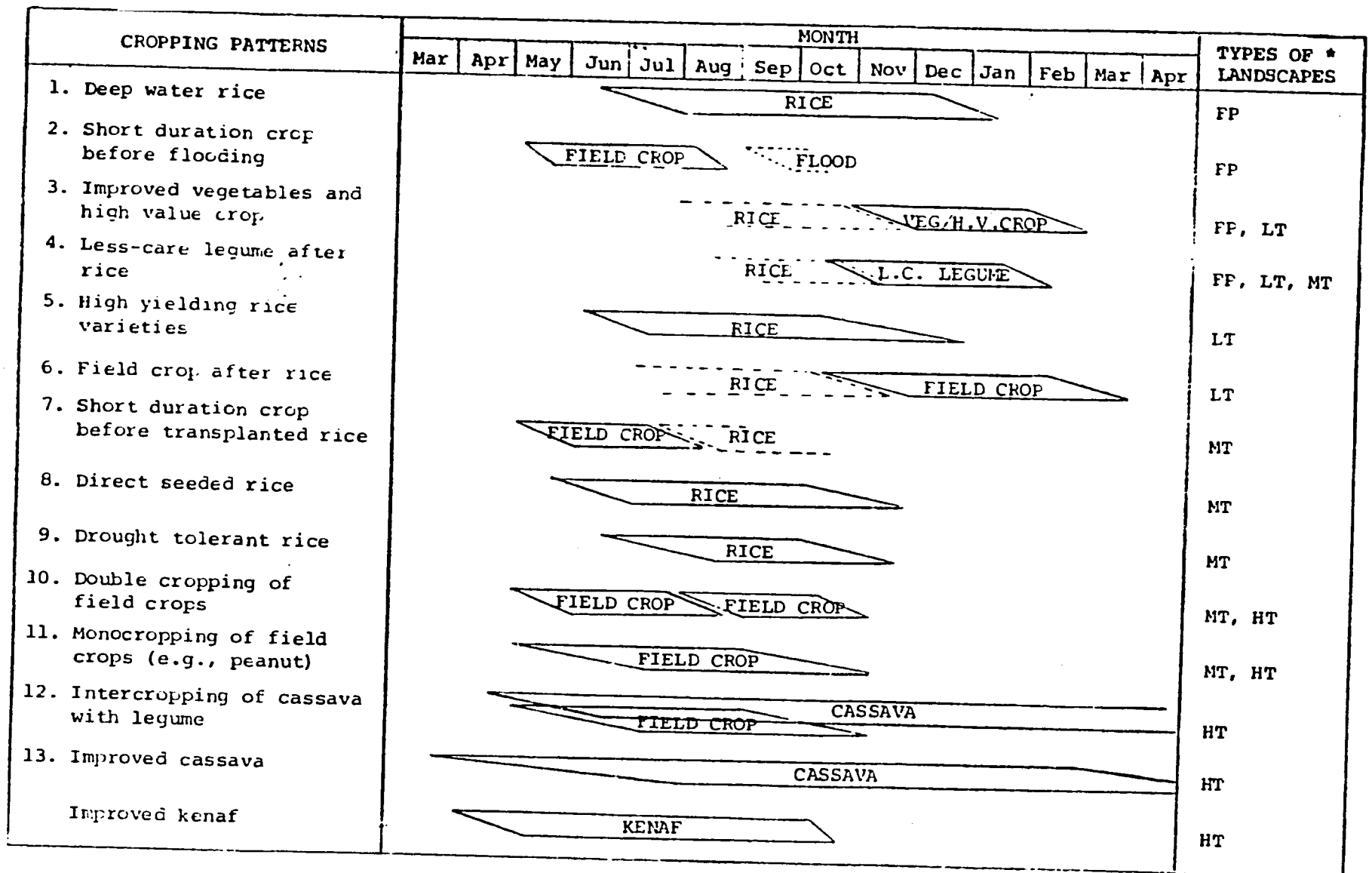
Table 5 - Cumulative Distribution of Project Inputs and Area Expected to Be Planted with Modified Cropping Systems

Components	Year						
	1	2	3	4	5	6	7
Research field experiments (rai)	-	332	614	833	1,041	1,198	1,198
Demonstration trials (rai)	-	-	296	888	1,480	1,927	2,374
Extension trials (rai)	-	-	-	546	1,474	3,031	5,393
Specialist farmers (No.)	-	58	116	116	116	116	116
Villagers trained (No.)	-	-	-	560	1,680	3,360	6,160
Area expected to be planted with modified C.S.	-	-	-	9,800	19,700	29,500	39,300

Table 6 - Implementation Schedule for Modifications of Cropping Systems

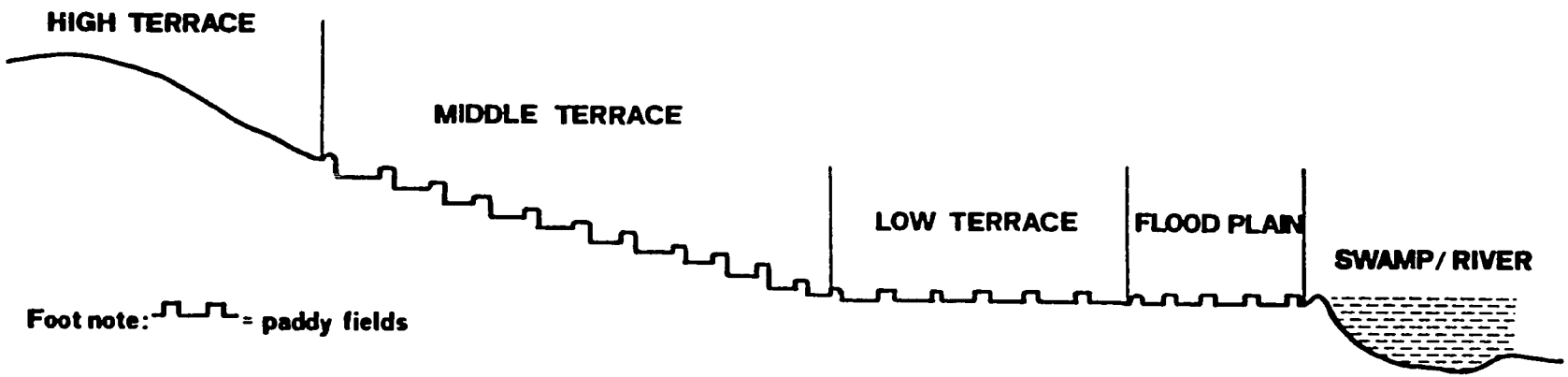
Project Components	Year						
	1	2	3	4	5	6	7
1. Technical support personnel							
- Recruitment	x						
- Functioning							
Tambon visits	x	x	x	x	x	x	x
Experiments and trials		x	x	x	x	x	
Training programs	x	x	x	x	x	x	x
2. Technical assistants							
- Recruitment	x						
- Training	x						
- Field excursion	x		x		x		
- Functioning							
Tambon visits	x	x	x	x	x	x	x
Experiments and trials		x	x	x	x	x	x
Tambon training programs				x	x	x	x
3. TEA							
- Recruitment	x						
- Training	x						
- Field excursion				x	x	x	x
- Functioning							
Experiments and trials		x	x	x	x	x	x
Tambon training program				x	x	x	x
4. Specialist farmers							
- Recruitment		x	x				
- Training		x	x				
- Field excursion				x	x	x	x
- Functioning							
Demonstration & extension trials			x	x	x	x	x
Tambon training program				x	x	x	x
Extension service		x	x	x	x	x	x

Project Components	Year						
	1	2	3	4	5	6	7
5. Graduate assistants in field experiments			x	x	x		
6. Training programs							
- Technical assistants and TEA	x						
- Specialist farmers		x	x				
- Villagers (Tambon training)				x	x	x	x
7. Experiments and trials							
- Research field experiments		x	x	x	x	x	
- Demonstration trials			x	x	x	x	x
- Extension trials				x	x	x	x
8. Seed production			x				



CALENDAR OF MODIFIED CROPPING SYSTEMS

* FP = Flood plain, LT = Low terrace, MT = Middle terrace, HT = High terrace



TYPE OF LANDSCAPES IN THE SELECTED TAMBONS

D - OTHER FARMING SYSTEMS MODIFICATIONS

Farming system research per se is not yet a part of Thailand's technical programs. The proposed reorganization of DOA will have a farming systems research institute as one of six multi-disciplinary research institutes. For the present one can utilize the information and expertise of individual departments and departmental divisions for analysis of technical feasibility. However, many of the components have not been thoroughly tested under conditions suitable for our purposes. Volumes of data and reports are available but within the time frame allocated for project design only a limited number of these could be carefully studied.

The Northeast Thailand farmer is operating at a high degree of efficiency considering the constraints of low fertility of soil, erratic rainfall with periods of floods and/ or drought, primitive farm equipment and animal power, erratic prices for produce, distance from markets, little government assistance, etc. These same constraints apply to all who try to increase the farmers' income. The rate of return may not be as high as that for more favorable environments but favorable returns should be possible. Components of the farming systems will be discussed separately with some references to total farming system.

Animal and Poultry Health

The need for animal health is well known and documented worldwide. Vaccination can help to control many animal diseases. Animal disease(including parasites)is still a major problem in Northeast Thailand according to the NERAD site survey report and conversations with livestock officers and village farmers. The expressed need was for availability of vaccine at the village level and more knowledge of disease symptoms and control measures. This project will provide assistance by placing a refrigerator and vaccine boxes in each tambon. Farmers will be trained in vaccination techniques through the household poultry improvement program. Apparently it is unlawful for farmers to vaccinate large animals and possibly this law needs to be changed. Some farmers said it was easier and less expensive to obtain a medical doctor to care for humans than a veterinarian to vaccinate their large animals. In the meantime the project will train farmers to recognize the typical symptoms of common diseases, to be able to assist livestock officials in the vacinnation process, and to have some knowledge of medications.

Two activities are scheduled. For each activity all villages will be offered the opportunity to participate. Those choosing to participate and developing an acceptable plan of operation will be given a small grant of supplies, minor equipment and other necessary services for initial operation of the program. The grant will be available for no more than three years and is intended to (1) reduce the perceived risk of the activity and (2) provide a mechanism whereby the village will have an incentive to organize the activity as an on-going operation. Qualification for a grant under either of the proposed activities will require that the village:

(1) Nominate a suitable individual for training as a farmer specialist.

(2) Provide a mechanism whereby the services of this individual will be available to work on project activities.

(3) Develop a suitable mechanism for authority and decision making on project activities and use of the grant.

(4) Develop a workable plan for continuation of project activities after the grant is discontinued.

Grant applications must be approved by the Tambon Council upon recommendation by the TEA.

Proposed Activity
Household Poultry Improvement

Techniques are available for control of disease and for improving supplemental feed supply for native poultry. Native poultry have a ready market and also provide a significant source of protein for family consumption. Selected villagers (usually one per village) will receive training courses (one week each) in poultry health and in poultry nutrition and upgrading of poultry flocks.

They will initially be furnished with supplies of vaccines, medicines, etc. They will vaccinate village poultry and will be able to advise villagers on sources of supplemental feeding materials. Improved male birds will be furnished to families who show promise of serious intent to improve their poultry enterprise and agree to build suitable chicken coop. It is calculated that vaccination, appropriate

medication and a small amount of supplemental feeding (about 1/2 kg/bird of commercial feed plus 1 kg. of paddy per bird) can result in increased production of 48 birds plus 114 eggs per family per year. 1/

Proposed Activity
Large Animal Project

Techniques are available for control of disease and parasites but have not been put fully into practice due to lack of adequate Department of Livestock Development personnel and funds for tambon level programs. The knowledge is present to provide for adequate diets for present or even expanded herds, but economic and social considerations do not give a clear indication of how this knowledge can be put in practice. However, the Northeast Livestock Development project has shown that the feed situation can be improved by sowing Stylosanthas Hamata in public and other unused lands. The project will provide for better access to disease control services by providing training for the tambon agent and for farmer specialists who will assist veterinary officers in vaccination, dispensing drugs for parasite control, etc. They will also be trained in the use of Hamata seed and in other improvements which can easily be made in the feed supply. Vaccines, drugs and hamata seed will be supplied initially. The farmer specialists will assist in vaccination and drug and seed use. Benefits are expected to include the equivalent of an increase in output of 100 3-year-old animals per year in year 3 increasing to 500 animals per year in year 7.

Fish Production

Fish production in newly constructed reservoirs and improved fish production in existing reservoirs could provide needed food and additional cash income, but production methods presently used by villagers do not approach the production levels which can be obtained using modern methods of fish culture. 2/ Present low production is a result of reliance on natural stocking in most cases and essentially no management other than controlled fishing in some reservoirs.

1/ Personal Communication NEROA Staff.

2/ Project Paper: Village Fish Pond Development Project, USAID, Bangkok/Thailand

Proposed Activity
Fish Production Improvement

In locations where there is a desire to develop improved fish production in either constructed facilities or in existing suitable facilities, a villager will be trained in improved fish production and initial stocks of fry and associated supplies will be furnished. Activities proposed include small fry stocking and fertilization in reservoirs in which predators can be controlled, production of large fry by the trained specialist farmers, stocking of uncontrolled reservoirs with large fry and cage production where there are suitable locations. The total area of constructed reservoirs is 107 ha. and it is estimated that 50% of this area will be suitable for improved fish production. In addition it is estimated that 130 ha. of existing reservoirs can be used for improved fish production. According to the Village Fish Pond Development Project Paper, production of from 1,000 to 3,000 kg/ha, depending on the intensity of management, can be expected from improved fish ponds. We estimate a production of only 1,200 kg/ha in this project in new reservoirs because most will be multipurpose and management for fish production will consequently be less than optimum. Increased production in existing water is estimated at 300 kg/ha.

Sericulture

Silk production is limited by lack of appropriate facilities, use of unimproved mulberry, poor mulberry production practices, use of unimproved silkworm strains, and sub-optimal silkworm rearing practices.

In areas where villagers have a desire to increase silk production and where land for mulberry production is available, production can be increased by providing training other technical assistance and demonstration supplies and equipment.

A more efficient mulberry variety is available and it has been estimated that the use of high leaf yielding stock budded on root rot resistant root stock along with good cultural practices could double silk yield per unit of land. Improved silkworm strains can increase silk yield without increasing the size of the rearing operation.

Proposed Activity
Sericulture

Seventy four villagers will be trained in mulberry and silk production. These individuals will be furnished with demonstration materials for improved silk production. Increased technical assistance provided to them and to other interested villagers. Improved mulberry will be made available through the nursery enterprise activity. It is estimated that one farm family with one rai of mulberry can increase its silk yield by 10 kg. per year.

Propagation Stocks

Plans for propagation of seed and plant stocks of improved varieties have not been successful in rapidly providing these at the farm level. A new plan has been developed for crop seed but a national plan for distribution of propagation stocks of fruits, vegetables and forest trees has not been developed. A means of providing a supply of propagating material at the village level is needed. An approach which has been successful in many parts of the world is to do it through private enterprise, i.e., the farmers themselves. Farmers will be trained to produce propagating material at the village level and distribute it to their neighbors for exchange or as cash sales. This should provide a core group to further develop private propagation enterprises in cooperation with governmental enterprises. Plans for promotion of crop seed availability are discussed under cropping systems improvement. There are, however, a number of improved fruit and tree (including mulberry) crops for which there is no adequate system for distribution at the village level.

Proposed Activity
Fruit and Tree Crop Nursery Enterprise

Private nursery stock producers will be trained and provided with an initial stock of seed, etc. for production of tree and fruit planting stock. Twenty such individuals will be trained in producing seedlings and grafted or budded planting stocks. Initial emphasis will be on plants which are easy to produce. As the farmers develop skills, emphasis will shift to planting materials which are more difficult to produce. During the initial years, the project will purchase some of the materials produced for use in demonstrations.

TABLE - Implementation Schedule of Other Farming Systems Modifications

	YEAR 1	2	3	4	5	6	7
Household Poultry Improvement							
Farmer specialist trained, No.		20	40	20	21		
Village programs initiated, No.		20	40	20	21		
Educational materials prepared	x	x	x	x			
Village meetings, No.	25	75	50	50	20	20	20
Large Animal Project							
Farmer specialist trained, No.		50			51		
Village supplied		50	50	50	51	51	51
Village assistant employed		50	50	50	51	51	51
Fish Production							
Technicians employed, No.	0.5	3	3	3	3	3	3
Farmer specialist trained, No.		20	30	30			
Equipment ordered	x						
Fry and supplies distributed		x	x	x	x	x	x
Sericulture							
Farmer specialist trained, No.			37	37			
Rearing chambers constructed, #			37	37			
Technician, No.		1	1	1	1	1	1
Mulberry distributed			x	x			
Village meetings, No.		20	20	20	20	20	20
Fruit and Tree Nursery							
Growers trained		20	20	20	20	20	20
Supplies furnished		x	x	x			

E - SOIL AND LAND MODIFICATIONS

Background

The survey and classification of soils for the Northeast region is the detailed reconnaissance type made at the provincial level. Soils are classified as to series, association, and complex. Each series defined is classified into the soil family and other higher categories of the U.S. Soil Taxonomy classification system. The relationships along with land capability classes are given the following table.

Soil of the eight tambons in Chaiyaphum, Roi Et, Si Sa Ket and Nakhon Phanom have been studied and differentiated into broad groups based on soil landscape relations as follows:

Soils Occurring on Flood Plains consists of very deep, well drained and poorly drained soils developed from recent alluvium. Soils occurring on natural river levees are well drained, medium-textured soils. They are usually used for garden crops. Soils in river basins are poorly drained, fine textured and are used for rice cultivation or cannot be used because they are submerged in the rainy season. The soils developed on this type of land form fall in the great groups Ustifluvent and Tropaquepts. These soils are found in Tambon Lahan, Tambon Na Thom and Tambon Na Muang.

Soils Occurring on Low Terraces are variable in such characteristics as soil depth, soil texture and salinity. These soils are somewhat poorly drained and are extensively used for rice production in this region. They are classified in the great groups Paleaquults, Halaquepts and Dystropepts. These soils are occurred in all eight tambons. In addition, Halaquepts occur in Tambon Lahan, Chaiyaphum province.

Soils Occupying Middle-High Terraces are varied in diagnostic characteristics for classification. These characteristics included color, soil depth, content of coarse fraction in the profile, and texture. However, all are well drained and are usually used for upland crop production (kenaf, cassava, mungbeans and string beans) or are forest area. Soils on this land form are classified in the great groups Paleustults, Plinthustults, Dystropepts and Quatizipsamments. These types of soils are mainly found in Tambon Lahan, Tambon Kwang Chon, Tambon Na Muang, Tambon Na Thom and Tambon Na Ngua.

Table - Soil and Land Capability Classification

Tambon	Soil Classification		Land Capability	
	Soil Series	Great Soil Groups	Upland Crop	Paddy
Lahan	Ac.	Ustifluvents	U - II f.	P - II f.
	Cm.	Typic Ustifluvents	U - II f.	P - II f.
	Tm.	Typic Ustifluvents	U - II f.	P - II f
	Sa.	Typic Ustifluvents	U - III d.	P - II f.
	Rb.	Aeric Tropaquepts	U - [illegible] d	P - II f.
	Pm.	Vertic Tropaquepts	U - IV fd.	P - II f.
	Ss.	Vertic Tropaquepts	U - V f.	P - II f.
	Re-l.	Aeric Paleaquults	U - III d.	P - III s.
	Re.	Aeric Paleaquults	U - III ds.	P - III s
	Ud.	Aeric Halaquepts	U - VI x.	P - IV x
	Cy	Epiaquic Ustropepts	U - III d.	P - III m.
	Rn-l.	Aeric Paleaquults	U - III s.	P - IV [illegible]
	Kt.	Oxic Paleustults	U - III sm.	P - V t.
	Wn.	Oxic Paleustults	U - III s.	P - V ts.
	Wn-sh.	Oxic Paleustults	U - III s	P - V ts.
	Yt.	Oxic Paleustults	U - III ts.	P - V ts.
	Bb.	Aquic Plinthustults	U - VI es.	P - V ts.
Kwang Chon	Re-l.	Aeric Paleaquults	U - III d.	P - III s.
	Re.	Aeric Paleaquults	U - III ds.	P - III s.
	Re-h.	Aeric Paleaquults	U - IV ds	P - IV s.
	Nn.	Aeric Plinthic Paleaquults	U - III ds.	P - III s.
	Kt.	Oxic Paleustults	U - III sm.	P - V t
	Pp.	Typic Plinthustults	U - VI ts	P - V t
	BbC.	Aquic Plinthustults	U - VI es	P - V t.
Nong Kaew	Re.	Aeric Paleaquults	U - III ds	P - III s.
	Ub.	Aquic Dystropepts	U - IV sd.	P - IV sm
	On.	Plinthaquults	U - III ds	P - III s.
	Kt.	Oxic Paleustults	U - III s	P - V t
Na Muang	Ac.	Ustifluvents	U - [illegible]	P - [illegible]
	Re.	Aeric Paleaquults	U - III ds.	P - III s.
	Re-l.	Aeric Paleaquults	U - III d	P - III s
	Ub.	Aquic Quartzipsamments	U - [illegible]	P - IV sm.
	Kt.	Oxic Paleustults	U - [illegible] sm	P - V t
	Yt.	Oxic Paleustults	U - [illegible] ts	[illegible]
Tae	Re.	Aeric Paleaquults	U - III [illegible]	- III [illegible]
	Re-l.	Aeric Paleaquults	U - [illegible]	[illegible] III [illegible]
	Kt.	Oxic Paleustults	U - III sm	[illegible]

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Tambon	Soil Classification		Land Capability	
	Soil Series	Great Soil Groups	Upland Crop	Paddy
Taket	Re.	Aeric Paleaquults	U - III ds.	P - III s.
	Re-1.	Aeric Paleaquults	U - III ds.	P - III s.
	Kt.	Oxic Paleustults	U - III sm.	P - V t.
Na Thom	Ac.	Ustifluvents	U - II f.	P - II f.
	Ss.	Vertic Tropaquepts	U - II f.	P - II f.
	Re-1.	Aeric Paleaquults	U - III d.	P - III s.
	Re.	Aeric Paleaquults	U - III ds.	P - III s.
	Pn.	Aeric Plinthaquults	U - IV ds.	P - IV t.
	Kn	Aeric Paleaquults	U - III s	P - IV t
	Kt	Oxic Paleustults	U - III sm.	P - V t.
	Pp	Typic Plinthustults	U - IV tsm	P - V t
Na Ngua	Ac	Ustifluvents	U - II f	P - II f
	Re.	Aeric Paleaquults	U - III ds.	P - III s
	Pn	Aeric Plinthaquults	U - IV ds.	P - IV t.
	Tu.	Entic Tropaquods	U - IV sm.	P - V t
	Kt	Oxic Paleustults	U - III sm.	P - V t.
	Pp	Typic Plinthustults	U - IV tsm.	P - V t.

Soils Occurring on Erosion Surfaces occur in Na Thom, Lahan, and Na Muang. They are variable in diagnostic properties, e.g. texture, color, soil reaction, soil depth and amount of coarse material in the profile. These differences in properties occur because of differences in the parent materials. However, all of these soils are well drained and are mainly used for upland crop cultivation (kenaf, cassava) or they are covered by natural forest. These soils are classified at the great group level as Paleustults and Plinthustults.

Soil survey results indicate that predominant soils in the eight tambons are sandy and have developed from sedimentary rock deficient in both macro and micro essential elements. DOA has some information on recommendations for proper fertilization of certain crops as a result of research. Emphasis, however, has been on the utilization of chemical fertilizer, compost, and compost with chemical fertilizer in seasonal mono-cropping only. Consideration will also be given long-term soil improvement and to the overall cropping pattern. Because most soils are coarse-textured, highly erodable, and of low organic matter content, soil nutrients are rapidly depleted through erosion. This problem can be addressed through a program of soil conservation and improvement of physical properties through the addition of organic matter, an area which has thus far had little research. Soil properties can be improved through the application of compost, animal manure or green manure in small scale such as vegetable for second crops, (watermelon, tobacco, etc.), but the large areas of rice fields and upland crop fields are still a major challenge for research on the improvement of soil physical and chemical properties. Green manuring has been suggested as a solution for this problem, but farmers have been reluctant to adopt such practices since they do not have proper equipment and they do not realize any cash income or short term advantage. Azolla in rice and minimum tillage in cassava have been tried, but this work is still in the research phase, and many problems need to be resolved before the technology can be transferred to the farmers. Other means of soil improvement, such as crop rotation and legume crop sequencing before or after rice to reduce nitrogen fertilization requirements have also tried, especially in Nong Kaew, Na Muang, Taket, Tae and Na Ngua. Cropping system research for each tambon of different soil types is still needed, due to the dependency of crop sequencing on soil moisture and water-holding capacity. Recycling of crops wastes (kenaf residue, cassava residue, rice straw, rice hull, residual of legume) to both upland crop and paddy field is

another means of soil and crop production improvement. But as some farmers point out, rice stubble cannot be well mixed into the soil using existing equipment and buffalo power. If a short variety of rice is utilized, the amount of rice stubble available for recycling is reduced. In order to address these problems, an integrated research effort will include crops, soils, livestock, forestry, fisheries and mechanization.

There are related problems due to improper land utilization in Na Ngua and Na Thom, Nakhon Phanom province. It is well known that rice farming should be on the lowland, but the farmers are planting rice on high land. This results in low average yield due to an almost certain drought before harvesting time. Rice land with the most severe problems is usually situated on high terraces with soil of low water holding capacity. Another related problem results from the cultivation of crops on public land and in the reserved forest areas such as in Lahan, Chaiyaphum, Na Thom and Na Ngua, Nakhon Phanom and Na Muang, Roi Et province. In these areas most of soil types are shallow with laterite gravel subsoils, physiography is rolling to undulating and severe erosion occurs. Since these areas are not suitable for growing crops, reforestation or use as a livestock pasture is recommended. Soil in the flood plain along the Song Kram River cannot be used in rainy season, but it is a very rich soil. The land can be expected to produce well by cropping after the water has drained away.

Terracing

There will be control measures for the prevention of erosion of both easily affected sandy soil and soils on slopes in Lahan, Na Muang, Na Thom and Na Ngua. A policy will be formulated and a strong program will be implemented primarily in protected the watershed areas. Existing organizations involved in such efforts include RFD and DLD, but their programs are deficient in manpower, equipment and research results. A program of strong and effective control of deforestation in protected watersheds in Lahan, Na Thom and Na Muang is needed. Although forest reserves are not considered a direct concern of this project, project personnel will work closely with the Royal Forestry Department to encourage and, is possible, assist in obtaining support for this work. Support will be provided to expand on farm activities and to construct terraces of 50 km. in Lahan, 55 km. in Na Thom, 70 km. in Na Ngua and 30 km. in Na Muang. Terrace design will be based on previous DLD experience. 1/ Average distance between terraces is estimated at 40 meters, but will be dependent on slope.

1/ Terraces will be protected by being planted to long-cycle crops, forage crops or trees.

Land Shaping (Paddy Contouring)

The paddies in the Northeast are usually very small and are not placed according to the contour of the land. Consequently bunds are high and occupy an unusually large percent of the land. Water control is much more difficult since the paddies are not on the contour and are consequently not level. This can be corrected by engineering skills presently available, by placing the bunds on the contour and enlarging the paddies. By reducing the bunds, 6 to 10% more land would be available for cropping and water use efficiency would increase. The enlargement of the paddies also makes it possible to use small machines in rice farming.

DLD has conducted 4 demonstrations of this method in Northeast Thailand. The areas range from 100 to 2,000 rai. In each demonstration, the latest technology (proper fertilization, adopted varieties) was also incorporated. In the demonstration near Ubon the yields were raised from 200 to 400 kg/rai. Farmer acceptance seems to be good, since more are willing to adopt the program. The program involves an agreement and understanding of all farmers in the demonstration areas as to the scope of the project. The soils and slopes must be sufficient slope and depth to allow the necessary soil manipulation. This can be determined from the detailed soil survey. The soil must be surveyed before, during and after earth work.

It is recommended that demonstrations be placed in 6 tambons. Priority should be on tambons in Roi Et and Si Sa Ket. These tambons may be close to the adoption of small machinery. All demonstration farmers should agree to incorporate the latest technology.

Demonstrations will be carried out on 1100 rai in 6 tambons. If the demonstrations are successful and additional farmers request the service, then additional lands will be shaped on a cost sharing basis. Cost sharing should be based on the results of the demonstration areas. The farmers share should be about 75%. The amount of area shaped would be limited by the amount of equipment DLD has available for this purpose. To expedite the process, contractors should be considered as alternative. If this approach is successful in causing farmers to adopt the entire technology package, yields should increase rapidly and areas to be reshaped should be tentatively considered to be 25% of the paddy area (157,000 rai) in the 8 tambons.

Composting

The value of organic matter in soils is well known. It increases the water holding capacity and fertility of soils. One method of increasing soil organic matter is by adding compost. Compost acts as a slow release fertilizer on these sandy soils where nutrients leach rapidly. It has a high water holding capacity, and when placed on the soil surface, acts as a mulch to conserve moisture. At the present time only a small portion of the farmers are using compost. It is mainly used on high value crops such as vegetables and tobacco. It is impossible to make large amounts of compost due to the labor requirement, water requirement, and lack of acceptable plant material for composting. However, kenaf residue and rice hulls are presently wasted or burned and could be used. Legumes such as peanuts are increasing in popularity and offer a good potential for composting. After peanut harvest the residue (0.5 ton/yr./rai) is either burned, thrown away, or spread back onto the soil. It could be used for compost. In order to encourage composting, it is recommended that each year 50 families in each tambon be encouraged through partial payment of costs to make 2 tons of compost and spread on the 2 rai of soil (1 ton/rai). This would demonstrate the value of composting. Different families would be chosen each year to continually expand the influence. This method of introducing compost making is being carried out by DLD in certain areas and has shown reasonable promise. The goal is to get as many farmers as possible making compost for 2 rai each year. Every 6 to 7 years compost would have been spread on all of an average-sized farm.

Soil and Land Modification Notes

1. Control Erosion (Terraces 205 km.)

Tambon	YEAR 1	2	3	4	5	6	7	Total Length Km.
Lahan	-	30	20	-	-	-	-	50
Kwang Chon	0							
Nong Kaew	0							
Na Muang	-	30	-	-	-	-	-	30
Na Thom	-	-	10	20	25	-	-	55
Na Ngua	-	-	10	20	20	20	-	70
Taket	0							
Tae	0							

2. Land Shaping

Tambon	YEAR 1	2	3	4	5	6	7	Total Area (Rai)
Lahan	-	100	-	100	100	100	100	500
Kwang Chon	-	100	100	100	100	100	100	600
Nong Kaew	-	100	100	100	100	100	100	600
Na Muang	-	100	100	100	100	100	100	600
Na Thom	0							
Na Ngua	0							
Taket	-	100	100	100	100	100	100	600
Tae	-	100	100	100	100	100	100	600
Total	-	600	500	600	600	600	600	3,500

3. Compost

a. 50 different families/tambon/year

b. Make 2 tons compost/year

c. ฿200/ton = ฿400/family subsidy

d. Each family would receive the subsidy for one year only

e. Benefits:

(1) Compost placed on 20,000 rai/year at the end of seven year period.

(2) Increase yields on all crops by 18% on first year and estimate 10% over 7 year period.

f. Source: Proceeding: FAO/Thailand National Workshop on Research and Development of Rainfed Crop Production, Bangkok, 1979.

Engineering and Construction, Land Shaping and Terracing

Engineering and construction of land shaping and terracing will be done by DLD staff using both equipment purchased under this project and equipment presently held by the department. This method is more desirable than contracting because of the relatively high costs for design and engineering and the necessity for working closely with the farmers during design and construction. Estimated project costs using contracting for construction and engineering (US$30/rai for land shaping--2% slope, US$0.75/meter for terracing, 15% for design and 5% for construction supervision) are US$256,500. Estimated costs using the method recommended in this project is US$274,800 which is slightly higher but which does not take into account the residual value of the equipment. DLD has experience in land shaping and terracing in a number of previous projects and has demonstrated the technical capacity to carry out the work. Estimates of equipment, manpower and operating expenses are based on DLD experience in previous projects.

F - WATER RESOURCE MODIFICATIONS

Eighty percent of the area in Northeast Thailand lacks access to large reservoirs and reliable rivers for irrigation. Small water projects are required to furnish water for domestic and agriculture use. These small projects may take the form of small tanks, natural or dug ponds, weirs and topographical alterations to neraby watersheds. 1/

A number of benefits accrue from water development investments. The AIT study has identified five types of direct benefits that accrue to the users of water: the value of wet season supplementary irrigation for earlier starts on paddy nurseries and drought periods; the value from dry season vegetable growing; value of household water (which includes a safe drinking water component); value of water to animals; and, the value of fish catch from ponds and reservoirs. There are also a number of non-quantifiable benefits associated with certain types of water development: flood control, soil erosion control, pollution control, and esthetic values for scenic and wildlife preservations.

The AIT study says, "A comparison of alternative project types on the basis of economic return and ease of implementation indicates that pumping from reliable rivers is the most attractive alternate: Small ponds, when initiated by the farmers and used for intensive vegetable or fish production are also attractive, but benefit only small numbers per project. Shallow wells and diversions weirs are economical but only some areas have suitable sites."

Where sites are available, surface water storage offers more alternatives for use than other water resource forms. Farmers in the 8 tambons have shown their willingness to use the water for vegetable production, rice nurseries, and, near larger reservoirs, for dry season rice. The water is also used for consumption, fish raising, livestock, and kenaf retting. In many cases the use of these reservoirs can be multipurpose; but, because of different local needs, the use will probably be confined to one or two purposes. Water loss by evaporation

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1/ Asian Institute of Technology. Water for the Northeast: A Strategy for the Development of Small Scale Water Resources. September, 1978, Bangkok.

and seepage is considered to average about one meter.[1/] All surface reservoirs should be at least 3 meters deep to ensure efficient water storage.

All surface water storage sites and decisions should be made based on joint input from the local tambon representatives (as they view their needs) and an engineering survey (to determine whether they are technically feasible). In all cases, cost-sharing should be used in the development of any water resource. When structures are placed on public land the beneficiaries should cost-share by stabilizing all unprotected land caused by construction, weeding of storage tanks, and removing sediment. On private land the structures should be cost-shared at the rate of 10 to 20%. The cost-share could be a combination of supplying fuel, oil or labor, but not money as mentioned in the Site Survey Report. For shallow well development the cost share portion for the farmer might be labor and transportation cost of concrete reinforced rings to the site.

Cropping of public land is illegal; however, in some tambons the public land is very good soil and is presently being cropped. Water resource development has been planned on these areas. The Site Survey Report has suggested an orderly method of assigning the land for cropping:

1. The Chief of the District, Tambon Leader, Village Headman, and their committee select poor farmers with proper motivation for planting of crops.

2. Divide public land in small plots and allot to farmers at no less than 2 rai per farmer.

3. In combination with above steps, charge a rent for land use. This rent should be used for further tambon development.

The detailed soil survey, which is recommended elsewhere in this report, has been planned to identify the potential reservoir sites as well as the suitability of the soils for reservoir construction and water holding ability.

1/ Asian Institute of Technology. Water for the Northeast: A Strategy for the Development of Small Scale Water Resources. September, 1978, Bangkok.

Natural Reservoirs

Many of the reservoirs in the eight tambons are natural swamps which are too shallow to hold water through the dry season. Since these are natural drainage basins and in many cases farmers are already using them as a resource, they could simply be deepened to at least a 3 meter depth. This would primarily be in tambons with somewhat level topography where other surface storage facilities would be impractical. This activity would be primarily in the tambons of Roi Et, Si Sa Ket, and Kwang Chon. Here it is expected that the water would be used for irrigation of vegetables, tobacco, and rice nurseries with fish being secondary. In Na Thom it is expected that fish would be a primary use. Dry season rice irrigation would increase with time. In several tambons farmers are using small, mobile mechanized pumps for irrigation and this would allow an expansion of this practice. In Na Thom alone there are 3,000 rai of dry season rice raised each year and it is estimated that there is an immediate potential for 6,000 rai.

The number for reservoir suitable for rehabilitation was estimated using observations made during site visits and a 20 meter interval topographic map. In order to establish the actual number of potential sites, a detailed engineering survey should be completed. Actual sites should be selected using the engineer survey and local clientele input.

Submerged Dams

Lahan and Na Thom have large public areas that are flooded each year during the rainy season. During the dry season the water recedes and a small part of the area is cropped in vegetables and dry season rice. The soils are very productive and yields are high (700-800 kg/rai for dry season rice). Development of water resources in these areas would give a potential for increasing dry season cropping and year-round fishing. There are natural drains and collection basins in the submerged area that if impounded would hold water during the dry season and allow increased production. Water could be used for vegetable and rice nurseries around the small water bodies as well as dry season rice around the larger ones. These structures are relatively cheap to build and would be under water approximately 6 months each year. Some structures of this type have been installed in both tambons with mixed success. Lack of proper engineering (such as adequate spillway design, etc.) seems to be the main cause of failure. Farmers are presently making effective use of this method by using small hand-made earth dams in some locations.

Earth Embankment Reservoir

In 5 of the tambons there is sufficient slope and drainage collection basins to impound water by using earth dams. These reservoirs would place water in areas where natural reservoirs do not exist. The uses of this water would be expected to be very similar to those in the natural reservoirs. If necessary the drainage area into these reservoirs can be increased by the use of diversion terraces.

Pit Ponds (with Catchment Areas)

There are areas in the tambons that cannot be served by the aforementioned water resources. There are the nearly level areas in 4 tambons which have few natural swamps. A pit pond is simply a pond where the earth is removed to allow storage of water. In some of these areas farmers and villagers are using pit ponds. These have had varying success. The more successful ones are constructed with underlying material having a low seepage rate, are deep enough to store 3 or more meters of water, and have a catchment area so as to be not totally dependent on rainfall for water input.

The use of water from these reservoirs is very similar to the previous stated reservoirs. However, the amount of water storage and area of reservoir would be much smaller than the other reservoirs and would lend itself more for private and small group farm use. The cost per unit of water stored is higher with this type of reservoir than the preceding ones mentioned.

There are a number of pit ponds presently constructed that are either too shallow or without catchment areas. These could be corrected fairly inexpensively, by deepening the pond and diverting additional drainage water into the reservoirs by constructing a diversion channel.

In Tae and Taket, road construction is planned by ARD. With proper planning and engineering, excavation sites for laterite could be used as pit ponds. They should be properly spaced. In the lateritic area of two tambons there is no other source for dry season irrigation water.

Weirs

There is only one stream in the 8 tambons that would lend itself to the use of weirs and it is in Kwang Chon. At present there are about 5 weirs established on the upper part of the stream. According to local information the lower part of the stream is undeveloped. It was estimated, using a contour map and local information, that sites for 10 more weirs might exist. Based on the local information, an increase of 200 kg/rai of rice might be expected on 300 to 400 rai. It is also anticipated that the dry season vegetable production would so increase. But at the present time vegetable production is limited by poor roads lack of knowledge of opportunities and techniques.

Electrical Pumping from the Chi River

In Tambon Na Muang near Ban Khwang, there are about 1,000 rai of land which is topographically suitable for flood irrigation by canal. The main delivery canal has already been dug by the villagers. With a small amount of technical engineering help, the system could be implemented. Villagers indicated that they wanted this done but did not have the necessary capital. They also said that they would be willing to finance the project on a loan basis. Villages should agree to improve the canal if necessary and pay for operation and maintenance of canal and pumping station.

Shallow Wells

In some areas the water table remains quite close to the surface of the soil. In these areas, second crops behind rice are presently being grown on a large percent of the land. Farmers dig shallow wells and dip water from these to supplementally irrigate the crops. In most cases these shallow wells are only 3 to 4 meters deep due to the shallow water table. Wells of this depth can be dug in 1 to 3 hours by 3 to 4 men. However, when the water table is deeper and the soil are quite sandy the sides of the shallow well will "cave in". This reduces the depth to which these wells will be dug; consequently, the amount of water available for irrigation is reduced. It causes the farmer to construct a shallow well each year. It also causes reduced productivity from the sites which are abandoned due by the well collapsing as the top soil is usually inverted. This could be prevented by inserting a concrete lining into the well. This condition exists in part of Kwang Chon, Mong Kaew, and Na Muang. Cost sharing should be mandatory to ensure that only farmers who need this

assistance receive it. In the other 4 tambons the use of shallow wells for supplementary irrigation is not widely used and is greatly limited to smaller areas with a shallow underground water table. Small numbers of wells in these areas are planned to encourage their use in the areas where the water table will permit.

In some villages the water supply is not adequate year around. The villagers depend on shallow wells in the dry season for water but they are not concrete lined in many cases. On the average two to three wells exist around each village. Since these wells will be used for consumption as well as agriculture purposes, they should be improved with a gravel filter around the concrete lining and a concrete apron at the surface to prevent pollution. It is estimated that an average of about 3 wells per village would satisfy this requirement where the conditions would permit their use.

Water Filter Systems

In Tambon Lahan, soil and water salinity are a problem. Therefore wells are not practical and all water for domestic consumption is from surface reservoirs. Small pit ponds exist in and around each village for domestic consumption. The water in these reservoirs are very turbid. Fishing is not allowed in the reservoirs due to the increased turbidity and pollution it might cause. In order to increase water quality and fish production, filtering systems are recommended for each public reservoir. The concrete lined wells along with the sand and charcoal filtering systems are low maintenance and could be installed by the villagers.

Flood Control

There are large flood plains in 3 tambons. However, its control in many cases is beyond the scope of this project. However, in Na Muang, flooding of Nong Chok can be reduced by deepening the outlet into the river. This would allow approximately 800 rai to drain into the Chi river and reduce the effects of flooding. At the present time the rice crop every 2nd or 3rd year is destroyed due to flooding and planting of second crops on this land is delayed or prevented. There is also short term flooding in Na Muang near Ban Sai Khao due to a road barrier. According to local farmers the flooding did not occur prior to the road installation. It is apparently due to inadequate water drainage through road culverts. This could probably be corrected by the addition of approximately 2 more drainage areas through the road. At

the present time this flash flooding has been confined to a 3 or 4 day period and has not caused severe damage. But if the length of time of flooding should increase the rice crop in this area would be ruined (7,000 rai).

Na Thom has approximately 27,000 rai of flood plain. Most of this flood plain has a great potential for production. Dry season rice is grown in the area with yields of 800 kg/rai. It is estimated that no more than 15% of the flood plain is utilized. If flooding could be controlled, most of the area could be readily developed for crop production. The only way the area could be protected is by a permanent dike. This dike could be constructed so as to prevent the rising water from the Songkhram river from over flowing into the area. The dike might be constructed so as to allow water into the protected area late in the rainy season and store it for irrigation on the land below the dike during the dry season. With present maps it appears that this approach might be accomplished by building no more than a 4 km. dike and consequently protecting about 15,000 rai. With present maps it is impossible to determine the feasibility of this project. Actual planning would be contingent on the completion of the detailed contour map.

Planned Activities

It is not anticipated that all of the potential sites for water resource modifications will be developed within the framework of this project. Full development of the potential sites will not be feasible primarily because of limitations in engineering and construction capabilities. The sites for development will be chosen on the basis of technical feasibility, economic returns, social needs and interest of villagers as evidenced by willingness to (1) participate in site selection and design, (2) share costs, (3) provide maintenance and (4) where needed develop a viable water use and distribution plan. Estimated construction includes rehabilitation of 25 swamps, 20 embankment dams, 13 submerged dams, 11 water filter systems and 1500 shallow wells. In addition a modest sum will be budgeted for other water resource developments which are determined to be quite essential during early implementation. These may include pit ponds, weirs, small flood control structures, individual farm size embankment dams, etc. It is not planned to fund the electrical pumping station under this project. Preliminary economic analysis indicates that this activity is so attractive that the users should be able to finance it through a loan. The project will assist in the design and in organizing the producers to obtain financing, provide maintenance and operation, and develop a usage plan.

FIGURE F-1

Figure - Schedule of Budgeted Construction by Year and Location of Water Resource Modification 1/

	Years 2/							Total
	1	2	3	4	5	6	7	
Swamp Rehabilitation	-	10	11	4	-	-	-	25
Embankment Dams	-	7	10	3	-	-	-	20
Submerged Dams	-	4	6	3	-	-	-	13
Water Filter Systems	-	4	5	2	-	-	-	11
Shallow Wells	42	215	361	518	344	20	-	1,500

Tambon

	Lahan	Kwang Chon	Nong Kaew	Na Muang	Tae	Taket	Na Thom	Na Ngua
Swamp Rehabilitation	-	5	8	4	1	2	3	2
Embankment Dams	3	1	-	2	-	-	6	8
Submerged Dams	10	-	-	-	-	-	3	-
Water Filter Systems	11	-	-	-	-	-	-	-
Shallow Wells	-	538	400	400	31	37	50	44

1/ ฿3,200,000 (US$160,000) is budgeted for additional critical needs scheduled during project implementation.

2/ Construction Year. Site survey and design is scheduled for the proceeding years.

Notes on Water Benefits

1. Vegetables and Other High Value Dry-Season Crops

   a. Water requirement

   3 mm. evaporation/day x 100 days = 300 mm. water

   300 mm. water x 0.7 (conversion of evaporation to plant use) = 210 mm.

   210 mm. minus soil water (50 mm/meter) = 160 mm. water need by irrigation.

   160 mm x 1,600 m^2/rai = 256 m^3/rai.

   b. Mulberry production can be increased by 2 times with supplementary irrigation

2. Rice Nursery

   a. Water requirement

   350 mm.[1/]

   350 mm. minus 150 mm. rainfall = 200 mm. water need by irrigation.

   Supplementary water 200 mm. x 1,600 m^2/rai = 320 m^3/rai.

   b. Benefits 7.5% increase in rice yield[2/]

3. Dry Season Rice

   a. Water requirement

   1.7 - 2.5 meters

   2.0 x 1,600 m^2/rai = 3,200 m^3/rai.

   b. Benefits - yield increase of 460 kg/rai.

4. Fish - See other farming systems modifications.

1/ Handbook Agricultural Irrigation, Royal Thai Irrigation Department, Sornscmbun S., 1976.

2/ Economic Possibility of Small Reservoirs for Irrigation: Northeast Thailand, University Pertanian, Malaysia, June 1979

Notes on Water Sources and Use

1. Natural Swamp Rehabilitation

Tambon	Potential Sites	Total Water Surface Area	Total Water Volume for Irrigation	Possible Irrigated Area by Crop (rai)		
	No.	Rai	M^3	Vegetable	Rice Nursery	Dry Season Rice
Lahan	0					
Kwang Chon	10	80	192,000	750	600	60
Na Thom	5	100	240,000	938	750	75
Na Ngua	2	14	33,600	131	105	11
Nong Kaew	28	280	672,000	2,625	2,100	210
Na Muang	9	45	108,000	422	338	34
Taket	6	60	144,000	563	450	45
Tae	5	20	48,000	188	150	15

Assumptions:

a. All reshaped swamps at 3 meter depth.

b. 1 meter water loss, 1.5 meter irrigation, 0.5 meter for fish, livestock and domestic consumption.

2. Submerged Dam Reservoirs

Tambon	Potential Sites	Total Water Surface Area	Total Water Volume for Irrigation	Possible Irrigated Area by Crop (rai)		
	No.	Rai	M^3	Vegetable	Rice Nursery	Dry Season Rice
Lahan	10	50	120,000	469	375	38
Kwang Chon	0					
Na Thom	3	100	240,000	938	750	75
Na Ngua	0					
Nong Kaew	0					
Na Muang	0					
Taket	0					
Tae	0					

3. Earth Embankment Reservoirs

Tambon	Potential Sites	Total Water Surface Area	Total Water Volume for Irrigation	Possible Irrigated Area by Crop (rai)		
	No.	Rai	M^3	Vegetable	Rice Nursery	Dry Season Rice
Lahan	5	78	187,500	730	585	-
Kwang Chon	5	78	187,500	730	585	-
Na Thom	14	219	525,000	2,044	1,640	-
Na Ngua	27	422	1,012,500	3,942	3,164	-
Nong Kaew	0					
Na Muang	4	63	150,000	584	469	-
Taket	0					
Tae						

Assumptions:

a. All reservoirs at 3 meter depth and average 75,000 m^3.

b. 1 meter loss, 1.5 meter for irrigation and 0.5 meter for livestock, domestic consumption and fish.

4. Pit Ponds with Catchment Areas

Tambon	Potential Sites	Total Water Surface Area	Total Water Volume for Irrigation	Possible Irrigated Area		
	No.	Rai	M^3	Vegetable	Rice Nursery	Dry Season Rice
Lahan	17	52	127,000	496	397	-
Kwang Chon	10	31	75,000	293	234	-
Nathom	0					
Na Ngua	0					
Nong Kaew	0					
Na Muang	0					
Taket	7	22	52,500	205	164	-
Tae	6	19	45,000	175	140	-

Assumption: Reservoirs average 15,000 m^3 with 3 meter depth.

5. Weirs

Kwang Chon - 3

Rice yield increase of 200 kg/rai on 200 - 300 rai.

Increase vegetable and tobacco production in dry season (60 rai).

6. Electrical Pumping from Chi River

Na Muang - 1,000 rai.

Benefits 1,000 rai of dry season rice at 800 kg/rai.

Extend credit to local organization over a long term.

7. Shallow Wells

	Supplemental Irrigation		Consumption	
Tambon	No.	Rai	No.	Families Served
Lahan	0		0	
Kwang Chon	500	2,000	38	950
Na Thom	30	120	20	500
Na Ngua	20	80	24	600
Nong Kaew	400	1,600	0	0
Na Muang	400	1,600	0	0
Taket	25	100	12	300
Tae	25	100	6	150

Assumptions:

a. Each well will provide supplementary irrigation for 4 rai.

b. Each well for household consumption will serve 25 families.

c. Most water will be used for supplemental irrigation high value crops (watermelon, cucumber, onions, garlic, tobacco and mulberry)

8. Water Filter Systems

Lahan - 11.

Average size of reservoir is about 3,000 m^2

Water use would be for domestic consumption

Increased water for fish production is 33,000 m^2

Labor should be furnished by villagers

800 families supplied with water (mainly drinking)

9. Flood Control

Na Muang

a. Deepen drainage channel (600 m.)

Area drained is 800 rai

Increase rice yields by 50 to 100%

Present rice yields about 200 kg/rai

b. Increase water drainage through road repair (adding culverts)

Area protected 7,000 rai

No damage at present. Potential destruction of rice crop in drainage area.

G - DEMONSTRATION AND RESEARCH

Soil Fertility Field Research

The soils of Northeast Thailand suffer severe agronomic limitations. In general, the soils of Northeast Thailand have very low levels of fertility in comparison to the medium textured soils of the temperate regions. The combination of low fertility and low moisture supplying capacity of these sandy soils, coupled with unfavorable or unpredictable distribution of rainfall, creates serious problems for crop production.

Even though the value of fertilizer has been shown to be quite profitable on many crops, such as rice and cassava, 1/ the adoption rate is slow. In order to improve and maintain soil fertility, chemical fertilizers must be used at an increasing rate. There are many constraints to fertilizer use: (1) lack of knowledge of its potential and proper use; (2) lack of money for purchase; (3) lack of a proper delivery system; and (4) poor response in the past due to weather, improper use, naturally fertile soils or adulterated fertilizers.

Simple evaluations of fertilizer response will be carried out in each tambon to help the farmers and professional recommenders better understand fertilizers, their proper use, and response of local crop varieties under local conditions. These will be in different areas of the tambon each year in order to spread the influence of the idea by exposing many people to it. They will be carried out in cooperation with the farmers and tambon and changwat extension personnel under the supervision of appropriate project specialists. The evaluations should at first concentrate on the soils which are better adopted for each particular crop, including, as well as the basic nutrients, practices and nutrients that show promise in the near future (such as azolla, lime silicate on rice, etc.).

1/ Possibilities of Agriculture Production Increase Through the Use of Chemical Fertilizers, Office of Agriculture Economics, Ministry of Agriculture and Cooperatives, Bangkok, 1980.

Soil Fertility Notes

a. Present Fertilizer Use (kg/rai)*

Tambon	Rice	Cash Crops (All crops besides rice)
Lahan	1.5	8
Kwang Chon	-	-
Na Thom	0	0.3
Na Ngua	4	6
Na Muang	10	21
Nong Kaew	8	41
Ta Ket	20	45
Tae	18	45
Average	9 (approximately)	

b. Fertilizer Field Evaluations

Tambon	Rice	Upland Crop	Total (Yearly)
Lahan	1	1	2
Kwang Chon	2	0	2
Na Thom	1	-	1
Na Ngua	2	0	2
Na Muang	2	0	2
Nong Kaew	2	0	2
Ta Ket	1	0	1
Tae	1	0	1

c. Benefits

(1) Increase fertilizer use on rice from average 9 kg/rai to 20 kg/rai.

(2) Using improved varieties, increases yield from fertilizer use alone by 40% (average 80 kg/rai).

(3) Present average yield 200 kg/rai.

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* Use reported may include manure and compost.

Shallow Well Improvement

Water is a limiting resource in Northeast Thailand. Water is limiting during short drought periods during the wet season and always limiting during the dry season. Water storage for use during the dry season is possible in areas where topography permits dams (large and small) to be built and natural reservoirs to be improved. Farmers are beginning to use this either for irrigation of vegetables, rice nurseries, and rice with motorized pumps. The practice appears to be spreading.* At the present time the motorized pumping is limited to above ground storage reservoirs. However, there are areas in the Northeast with a high water table and few sites for reservoirs. In these areas, shallow wells are used extensively. However, there are few if any that use motorized pumps to irrigate from these wells. The amount of water storage is small and the recharge rate is limited. As the trend to supplemental irrigation by motorized pumping continues, it will become more important to develop shallow wells that will allow this to happen. In much of Northeast Thailand there are several meters of water below the surface that, if tapped and delivered, could be used to great advantage throughout the year. DLD has reportedly irrigated 4 rai by pumping from a shallow well. This type of research should continue and expand to meet this coming need.

It is recommended that this research be a part of this project. After an acceptable design is found, it should be field tested in either Kwang Chon or Nong Kaew.

Minimum Tillage Field Research

The organic matter content of the soil is low. Increasing the organic matter content would improve water holding capacity and nutrient availability. However, the fast rate of organic decomposition under tropical conditions severely limits the possible increase. Annual plowing and stubble burning or removal further decreases the organic matter of the soil. The addition of compost to the soil can raise the organic matter content, but it is limited to only a small area per year and would be most beneficial on high value crops such as tobacco and vegetables.

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* Personal communication with Dr. Sam Johnson, Ford Foundation, Bangkok, Thailand, 1980.

Minimum tillage has been used in parts of the Northeast on corn, with the result that the soil organic matter content has increased to 2% (over twice normal).* Minimum tillage also reduces evaporation, increases water infiltration, and reduces soil erosion. At the present time research is just beginning on the use of minimum tillage on crops such as cassava; therefore economic and technical feasibility is unknown. This knowledge should become more apparent in the next 3 years. If it is feasible, minimum tillage offers much potential for increased production, soil conservation, and water utilization. Therefore, minimum tillage field trials on farmer fields are planned to take place in the last 3 years of the project. The personnel involved should be similar to that described in the fertility trials. Tambon Lahan has a large percentage of upland and mostly cassava is grown. Since minimum tillage is most promising with cassava, it is recommended that the field trials be located in this tambon.

Saline Soil Amelioration

There are about 2,500 rai of saline soil in Lahan. Most of the land cannot be used for agricultural production. At the Ban Nong Sombun area, 500 rai are used for salt production. This type of land is very difficult to develop and improve. Salt saturation percentage varies year to year and place to place, depending on the amount of rainfall and depth of ground water. To increase the productivity of this land, three methods will be used together.**

1. Survey the direction of ground water seepage and made a canal cutout in that direction drained to the interceptor Nong Lahan.

2. Mulch soil for keeping moisture as long as possible, by applying organic material such as rice hulls to the soil. By this technique the capillary tubes are cut and salt cannot move to the surface during the dry season.

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* Personal communication with Chakranopakhun Tongyai in Department of Agriculture, MOAC, 1980.

** Department of Land Development "Saline Soil in Northeast", 1979, Bangkok.

3. Use saline-tolerant species of crops, such as the two rice varieties Massuri and Domoder that DLD has found to have salinity tolerance. "Sakae" (combretum quadrangulare) can grow very well in salty area, it can be used as a fire wood and has good quality for charcoal. For pasture crops, bermuda and hybrid napier are grass varieties with salinity tolerance. One species of legume, clitoria ternetes, can be used as a cover crops on saline soil.

Names of Tolerance Plants on Saline Soil

Atmo. osmotic pressure	1.4	3	4.2	6.6
EC (mmhos/cm)	4 ↔ 6	↔ 8	↔ 10 — 12	↔ 14 ↔ 16
Salt percentage	0.26	0.51	0.78	1.1
	Horticulture			
	Radish Cucumber Squash Sweet corn Sweet pea	Onion Red radish Potato Garlic	Lettuce Cauliflower Sweet pepper Cabbage Broccoli Tomato Sweet potato	Asparacus Chinese cabbage Beet root Chinese radish
	Upland, Forage Crops			
	Clitoria sp. Castor bean Red bean Black bean	Sesile Sun-flower Maize Sorghum	Rice	Cotton Bermuda Hybrid Napier
	Fruit Trees and Wood Trees			
		Grape Cantaloup	Olive Fig Eucalytus	Noseberry Rose apple Tamaline Coconut Death palm Pine Cacia sp. Acacia sp. Combretum sp.

Saline Soil Amelioration Notes

(a) Lahan

(b) 500 rai/year

(c) 2nd, 3rd, 4th, 5th, and 6th of the project (area 2,500 rai)

(d) Activities:

Interceptor drainage

Demonstration and evaluation plot of tolerant rice sp.

Demonstration and evaluation plot of tolerant wood sp.

Demonstration and evaluation plot of tolerant grass sp.

Staff assistance and demonstrator

(e) Benefits:

Increase area for rice production 800 rai, woodlot 500 rai and pasture land 500 rai at the end of 7th year.

Public Land Use Demonstrations

Two well recognized weaknesses of farming systems in the Northeast relate to feed and wood supply. Feed is always short in the dry season and often short in the rainy season in areas where most of the land is cropped. Wood is becoming increasingly difficult for villagers to find. There are potential solutions to both of these problems. The solutions generally involve more efficient use of public lands, but a workable mechanism for such use has not been developed.

Two plant species which appear to have promise will be discussed in some detail.

Leucaena

Giant Leucaena was introduced into Thailand by Dr. Roy Sigafus, University of Kentucky Team member in the mid 1960's. Many of these trees are still at Tha Phra. At the present time Leucaena, both introduced and native, is grown in many parts of Northeast Thailand.

Leucaena has been discribed as a promising forage and tree crop for the tropics. 1/ It was recommended by the NERAD site visitation foresters. Discussion with Forestry department personnel and others suggest Leucaena as the most promising species for farming system use. Leucaena is a legume, grows well on marginal soils, grows well in the areas with extended dry season, makes excellent firewood and charcoal, can be reproduced easily from seeds and produces many seeds, is fast growing, has wood usable for poles and lumber, and has high protein leaves are suitable for livestock food and organic fertilizer. For livestock the forage is highly palatable, digestible and nutritious but mimosine-related toxicity may occur unless other feedstuffs are also used. The tree also regrows rapidly from stumps after cutting.

Planting Leucaena on village public land should conserve soil and increase soil fertility, provide firewood and lumber, provide high quality feed supplement, reduce destruction of reserve forests and possibly be a source of fertilizer for other crops. By spacing plantings it should be possible to establish good pastures in combination with Leucaena.

Stylosanthes

Stylosanthes species were introduced from Australia and appear to be the most promising pasture legume. Many studies have been conducted by Khon Kaen University and others. While pasture and forage crop production has not yet been shown to produce higher returns than food grain and commercial crop production, the growing shortage of pasture may soon become critical to farmers who are dependent upon animal power. Improved feed supplies coupled with better livestock health programs will eventually become profitable farming enterprises. The immediate need is for the renovation of public grazing lands. Stylosanthes can be used in conjunction with Leucaena to accomplish renovation of public lands. Seeding of Stylosanthes can be easily done as one of the first steps. Khon Kaen University, in cooperation with IDP, has been developing a seed production program so seed should be available. The livestock development project has been over-seeding natural pastures and also has a seed multiplication

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1/ American Association for the Advancement of Science, 1979. New Agricultural Crops. Leucaena. Versatile Tropical Tree Legume. James L. Brewbaker & E. Mark Hutton, AAAS Selected Symposium 38.

program. After two or three years of reduced grazing pressure, increased fertility level from Stylosanthes growth, and establishment of Leucaena trees, a highly nutritious native grass pasture under the Leucaena canopy should be possible.

Proposed Activity

The shortage of feed and wood along with the generally inefficient usage of public lands would seem to imply that these lands should be used for enhanced production of forage and/or wood crops. While there appears to be a number of possibilities for wood crops (Leucaena, Sakae 1/, Australian pine) as well as for forage crops (Stylosanthas hamata, Leucaena, forage grasses), there are few models of these having been developed into a system usable in Northeast Thailand and input/output data does not appear to be available. For this reason test demonstration plantings on a scale large enough to be important to a village are proposed as a means of collecting information and finding workable systems.

Ten villages will be chosen for test demonstrations based on village interest and need, on willingness to devote a suitable amount (20-50 rai) of village public land to the enterprise, and on village interest in actually taking over the demonstration and managing it as a continuing village enterprise. A villager who is available for employment will be hired to conduct the test demonstration. The village will be expected to furnish additional labor for peak demands such as land clearing. Fees will be charged for wood, fodder cutting, and grazing, and these will go into a village fund for the continued operation of the project. The project will pay for wages and operating costs until the test demonstration is self-supporting up to a maximum of 6 years. It is expected that the demonstrations will usually be designed for a combination of wood and forage production but the emphasis in each case will depend on the needs of the village.

1/ Combretum quadrangulare

Farming Systems Research

Introduction and Background

A recent paper points out that the development for small-scale farms of farming systems which are both feasible and more profitable than traditional ones has lagged in Thailand.1/ The paper asserts that this lag is, in part, a result of a disciplinary structure of research and extension activities which was borrowed from developed countries with predominantly commercial farming. It says that this structure provides little or no basis for understanding the complex of family and farming systems interactions, or even the biological and economic interactions among crop and livestock components of the farming system. General observation suggests that the same can be said about the capabilities of markets for farm products and production inputs, land tenure, credit, and other institutions. There is a relatively limited basis within the existing structure in Thailand for assessing the capability of markets and other institutions to support suggested changes in farming systems. Yet these markets and other institutions can be, and indeed often are, constraints to introduction of changes which are entirely feasible from a technological, managerial (economic) and social perspective.2/

Examples abound of limitational factors which are not normally embraced by the existing structure of research and development and extension. Examples can easily be found of mechanical, pest control, and water management innovations which were technically and economically feasible but beyond the developed managerial capacities of farmers. Others which exceeded the capabilities of supporting service systems are also easy to find. The cropping systems branch of the International Rice Research Institute has found that labor supplies constrain introductions of several multiple cropping

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1/ Charan Chantalakhana. Some Problems in the Development of Integrated Farming Systems in Thailand. Bangkok: Kasetsart University. Paper presented at a meeting of the "Fibrous Agricultural Residues Network", 21 October 1980, mimeo.

2/ Eldon D. Smith, "Assessment of the Capacity of National Institutions to Introduce and Service New Technology Cropping Systems". Proceedings: 1976 Cropping System Symposium. Los Banos, Philippines: International Rice Research Institute, 1978, pp. 426-439.

systems even in nominally labor surplus areas. The reason is that the feasibility of many second crops depends greatly on seasonally variable supplies of water and solar energy. This means that labor is required for very rapid harvesting and replanting. The initial failure of grain sorghum as a second crop when introduced by the Philippines Department of Agriculture was found to be an engineering limitation of existing threshing equipment and an undeveloped demand and marketing system for this close substitute for maize in animal rations.1/

These examples are meant only to illustrate a rather obvious point, one which is implicit in the references noted above. It is that for a research and development system and an extension system to contribute maximally, it must have (or the farmers and agribusiness sector must have) the capability to identify and remove any constraint to utilization of a potentially productive system. And such constraints may be mechanical, biological, managerial or institutional.

The real constraints to even very simple changes in farming systems have not been identified or removed. This is apparent in the very slow and uneven spread in the use of fertilizer and improved rice varieties. Improved rice varieties are scarcely used at all in six of the eight tambons.2/ Fertilizers are used in significant quantities in one of these but virtually none is used in the other for rice. According to recently announced credit policy, update the constraint to adoption of both fertilizers and improved rice varieties is insufficient credit. As a minimum we may conclude that credit is less constraining in some situations than others, and other factors appear to be operative which have escaped the meshes of the present research and extension system.

1/ A reference is not immediately available and the facts reported are from an description of the experience by Dr. Arthur Gomez (U.P. Los Banos) and is from memory. They are illustrative and not necessarily accurate.

2/ Source: Socio-economic survey data not yet reported. For the entire sample, 4% of the rice was reported to be improved varieties.

As noted before, both of these are very simple technologies which disturb other elements of the farming system minimally, or so it appears. But for more complex ones such as short season "catch crops" either preceding or following rice, the potential array of constraints is much enlarged and, accordingly, much more difficult to isolate.

Extension and Research

A close working relationship between research and extension is greatly needed if bottlenecks to application of new technologies are to be identified and removed or avoided. This is recognized and expressed well in a paper by Benor and Harrison1/ which outlines the model which forms the basic structure of the new extension program in Thailand. It states (p.16) that:

> "The initial message of the extension service can take advantage of the gaps between existing agricultural practices and the backlog of research findings which already exist but have not yet reached the farmers. Such gaps are now large. But within a few years the extension service can close many of these gaps. To remain effective extension must be linked to a vigorous research program, well tuned to the needs of the farmers. Without a network of field trials upon which new recommendations can be based and without continous feedback to research from the fields, the extension service will soon have nothing to offer problems farmers face. To promote such working relationships is an important component of the approach to extension."

The importance of this becomes even more evident if the problem is seen as one of developing more efficient general (integrated) farming systems. This is true because the productivity of research effort depends on identifying and developing the knowledge base required for successively removing barriers to improvements in productivity whatever their nature may be. A corollary of this is that on-farm testing of new technologies is a necessary and even critical part of any program of research. At the same time on-farm testing, if successful, provides an essential basis for demonstrating the merit of genuinely improved technologies, i.e., extension.

1/ Daniel Benor and James Q. Harrison. Agricultural Extension: The Training and Visit System. Washington, D.C. - World Bank, May 1977.

This line of reasoning suggests that if the Northeast Rainfed Agricultural Development Project is to succeed over the longer term, a farming systems research capability is needed. Specifically this capability should be one which builds upon and supplements the contributions of the present commodity research or existing agencies. But it can be, and should be, more than a supplement.

A continuing criticism of research both in Thailand and elsewhere is that it is to a meager degree focussed on genuine problems, i.e., on things which are limitational to productivity increases. A proper farming systems program of extension and research would both create a demand for further research and direct it to the bottlenecks which impede progress. Farming system research must be conducted on farms, working with farmers. This required contact provides for the farmer participation which is so often missing in traditional commodity- or discipline-oriented research programs. Moreover, the adaptive research of a farming system component provides a conduit which directs information to the ultimate clientile group, farmers and related agricultural agencies.

The need for and lack of that farming systems research-extension capability is clearly recognized by the National Institute for Development Administration in its draft report on the status and role of the regional agricultural centers (1980). Moreover, according to this report, such a role appears to be consistent with the legal mandate, or charter, of these centers and conflicts little, if at all, with the programs of the present emphasis of research and action agencies.

A Proposal

The PID of the NERAD project has already recognized that there should be a technical support staff available at the Northeast Regional Office of Agriculture. It also recognizes field testing and demonstration as appropriate activities. What is less explicitly recognized is that these field activities should be part of a general farming system research program. This way a connective link is made with the present main research agencies and their programs - a link which both integrates and extends the knowledge and information base which they independently provide.

To have such a program requires more than mere farm level field research. It will require a modest complement of laboratory facilities, land for more controlled plot trials in some cases, facilities for field data collection and processing, animal experiment facilities, etc. Therefore, it is proposed that this supporting activity be based at the Northeast Center where such facilities already exist. It should be considered as an integral part of the NERAD project with the center support staff functioning in multiple roles as (1) training and technical support agents for extension, (2) diagnostic agents or "trouble shooters" to deal with problems which are encountered in the field, and (3) as farming systems researchers and analysts.

Operational Framework

As outlined in the preceding pages the responsibilities of the support staff will be demanding ones. As a conduit of relevant information between research and action agencies and extension, they will be required to be familiar with and have the technical capability required to understand research programs of the traditional disciplines. Indeed, they must be fully qualified disciplinary specialists themselves. But if they are to be effective, they will function as an integrated working unit; i.e., a multidisciplinary team. Each member of the team must learn to appreciate and to understand the disciplinary perspectives of the others. Otherwise, those strategically important biological economic, physical and social interactions which now escape the meshes of disciplinary programs will continue to do so.

A multidisciplinary approach does not imply that all or even a majority of problems will require contributions from more than one member of the team. For example, the outbreak of a serious insect problem may require merely identification of the pest and the prescription of a simple method of control which is already available. On the other hand, if the available effective insecticides are very expensive, or leave dangerously toxic residues, other solutions may be required. Possibilities include information on varietal differences in resistance or tolerance of the pest, or crop yield and economic effects of changes in cropping sequences timed to avoid the period of heavy infestation.

An excellent example of exactly this type of problem was found in Malaysia in the early phases of its multiple cropping program. Rodent, bird and insect damage severely

reduced yield of small plots of second-crop rice. The solution to the problem involved the organization of farmers to simultaneously plant a large area of the crop so that the bird, rodent and insect populations did not converge on a single small area. Obviously, legal and organizational knowledge contributed to the solution of a pest control problem and the legal and organizational knowledge was specific to a particular area, culture, and institutional context.

The exact method by which the contributions of all members of the team may be effectively brought to bear on farming systems problems that transcend disciplines cannot be detailed here. In part, it is a problem of management which is specific to the personalities of team members. However, a minimum requirement is that open and regular communication must be maintained among team members, especially communication about problems which seem to be disciplines.

In conducting this research every effort will be made to plan activities in coordination with other groups working on farming systems research in Thailand. In particular, close coordination will be maintained with the Khon Kaen University cropping systems research and the cropping systems research of DOA. International Centers working on farming system, particularly ICRASAT (Rainfed systems), IRRI (Cropping systems), IITA (farming systems) and CIAT (animal based systems), will provide useful information and exchange of information and/or cooperation with these institutions will be sought.

The Approach to Integrated Farming System Research

While the need for integrated farming system research is widely recognized, a method of approaching this need is not easily developed.

One system could be to develop model systems based on assumptions or facts about resources (soil, water, labor, managerial skill, inputs, markets) and then to test these models in the field. A second method is to start with the given farming systems and attempt to modify these incrementally to provide for identified weaknesses. The latter approach is suggested.

Under this approach the first step is a thorough analysis of the present system (and its various permutations)

in a given village or, if they are similar, in a homogeneous group of villages. The study should lead to a thorough description of the farming system and a good understanding of why it has developed and operates in the way it does. It should also identify possible weaknesses and malfunctions in the present system. The second step is to conceptualize the changes which would be expected to overcome the weakness(es) being addressed. These would be analyzed "on paper" as thoroughly as possible using (1) common knowledge, (2) research results and, if necessary, (3) educated guesses. If component (3) is minor the changes which have been conceptualized and analyzed might proceed directly to field testing. If it is major, conventional experimentation may be necessary to test more adequately the educated guesses, or, if found to be invalid, to find alternatives. The proposed change would then be field tested on as small a scale as feasible (from one plot, one animal, one farm, or a whole village) and if successful, disseminated for use in all appropriate areas. If not successful, additional research on the weak components or even going back to a completely new tactic may be required.

Possible "Weakness" Areas

In the studies relating to the NERAD project several weak points in the farming systems of the eight tambons surfaced repeatedly. Three of those which would be amenable (either separately or together) to attempts to modify farming systems are briefly described below:

1. Cattle/buffalo feed. Next to his land, cattle and/or buffalo are the farmers most valuable asset. They are his farm power source, they provide occasional cash income, they provide his only "free" fertilizer/soil amendment and they serve as an emergency cash reserve as collateral for loans or through sale. Inadequate feed supply limits both the farmer's ability to expand the number of animals and the animal's utility (growth rates, reproduction, disease/parasite susceptibility, and strength or stamina for work). In many villages with small amounts of non-flooded, non-rice land, feed supply is limiting in the wet season. Feed supply and/or quality is limiting in almost all villages during the latter part of the dry season. Efforts to upgrade native cattle through introduction of exotic germ plasm of larger breeds further increases the feed supply requirements per head. Larger cattle, while stronger and more valuable, require more feed than the native cattle.

Most agronomists and animal scientists feel that farming systems could be developed which would both maintain present levels of crop production and improve the nutrition of present numbers of animals. In most instances, both the numbers of animals and amount of crop production could be increased. The two are potentially synergistic because increased numbers of draft animals may improve crop production (quicker plowing, more manure) and increased crop production may increase the amount of the crop residues usable for animal feed.1/

In addition to developing suitable agronomic systems, overcoming this weakness in animal feed will have to address important economic and social and economic constraints. Northeast Thailand farmers are not accustomed to directly providing for the nutritional needs of their cattle and buffalo. Feed appears to be essentially considered as a "free" or natural input. There may be a good reason for this. Although animals are valuable, they may not be as valuable as the cost of producing them unless most of the inputs or free or of little value otherwise.2/ Grazing lands except for harvested fields are usually common grounds and, would have to be managed on a village basis if at all. And even harvested fields are treated as common property.

2. Increase of household poultry production. Almost all farm households have some poultry. The birds largely fend for themselves but may be fed some garbage, low quality rice or rice bran. Mortality from disease and/or nutritional problems has been estimated at close to 90%. Effective and economical methods for control of major diseases are available and have been tested in a number of villages. Drastic decreases in disease mortality can only accentuate nutritional problems, and an increase in production will require supplemental feeding. Miniature commercial production units could probably be developed but these could not compete with integrated commercial production. It would also result in the loss of market preference for native chickens and of the value of that part of the diet which native chickens are able to scavenge. A farming system which would produce feed

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1/ On the other hand, dwarf rice varieties provide less straw for use as feed during the past-harvest season.

2/ See E.C. Price, Jr., Aggregate Bovine Supply in Northeast Thailand. Ph.D. Dissertation, Lexington, Kentucky : University of Kentucky, 1973.

suitable for supplemental feeding of native poultry locally would allow an increase in native poultry production without requiring outside purchase of expensive commercial feedstuffs and without competing for human food and large animal feed supplies. This could provide both for improving village diets and for a source of sales outside of the village. The market appears to be broad and not saturated.

Problems include a lack of knowledge of the present diets of native chickens, the need for identification of locally producible feedstuffs which will provide nutritionally satisfactory supplemental diets, and the development and integration of production practices for these feedstuffs into the farming system.

3. Rational reservoir/ground water use. Almost every Northeast Thai farmer or agricultural official queried will identify water as the highest priority physical need of Northeast Thai farmers. For the most part, however, available water resources are neither completely or rationally used. A major component of this project involves the increase in reservoir and ground water available for use. Reservoir water has many potential uses including fish production, household use, livestock use, rice seed bed irrigation and dry season crop production. The first four of these require that water be managed so as to be sure to have water available at the end of the dry season. Maximum dry season crop production, however, requires that the stored water be used as soon as possible after the end of the rainy season (to a great extent this also applies to use of ground water which is much nearer the surface at this time). Evaporation is very great in Northeast Thailand and reservoirs are typically so shallow that they decrease rapidly in area and volume as the water level falls. For example, in a typical reservoir having a depth of 2 meters at the end of the wet season, 80 or 90% of the water will be lost by evaporation (or seepage) of one meter. Thus the potential for irrigation becomes much less as the dry season progresses. Other factors being equal, growing an irrigated crop immediately after the harvest of rice would allow a greater area to be irrigated than at any other time.

This may mean that the same reservoir should not be used for dry season irrigation and for other uses. It at least means that multipurpose use will require careful decision about allocations among possible alternative uses.

Development of farming systems which take into account these competing uses and which allow rational decision-making regarding storate needs could ameliorate this problem. Village attitudes will be most important. If a reservoir is considered as a fish production resource, or as fishing water, fishermen will strongly object to use of the water for irrigation. It may be necessary that, if a reservoir is to be used for irrigation, this use will have to be established from the beginning as the purpose of the reservoir. Fears of late dry season water shortage for household or livestock use can probably only be overcome by having obviously adequate supplies.

Early dry season irrigated crop production has a problem of its own. Earlier maturing rice may be required. Harvesting and threshing operations of one season will compete seriously for labor with soil preparation and planting for the next. Input purchases may be required before there has been any income from the main season crop. The economics of reservoirs vs. shallow wells or even the hydrology and biological aspects of their use in specific sites for dry season crop production are not adequately predictable at this time. Site specific analysis may be required.

4. Climatic/soil crop suitability classification. A major need in improving farming systems is the ability to better predict the suitability of a given soil (including land farm position) and climatic combination for a particular crop or cropping pattern. The inability to do this leads to a heavy requirement for site specific adaptive research or trial and is, in fact, responsible, for the relatively large component of these activities in this project.

The project will provide for concentrated field research, demonstration trials and extension trials in 8 differing but relatively small areas. It will also provide detailed soil and topographic maps and accurate weather records during the project. These collectively provide a basis for research on classification of climatic-soil combinations according to adaptability for the crops and cropping patterns being studied. This research could provide a basis for a broader classification covering most of the Northeast and thereby greatly extend the utility of the cropping systems work done under the project and the replicability of the project as a whole.

5. Increasing soil organic matter. Maintenance or increase of soil organic matter is especially difficult in cultivated sandy soils in the tropics. Low soil organic matter content is generally considered to be a limiting factor in crop production in these soils. It has implications with respect to soil water holding capacity, soil structure, supply of soil nitrogen, phosphorus and sulfur and regulation of micro nutrient supply in the soil. Two project components are directed to the soil organic matter content, composting and minimum tillage research. The maintenance of soil organic matter is also an area which would be amenable to a farming systems research approach. Crop production, animal production, forestry, soil science are intimately related to the problem and all of these should contribute to a solution.

Other Factors

The focus of a farming systems research project on one or more of these points does not mean that other weaknesses of the present system must be ignored. These can be included to the extent possible without losing sight of the main focus. Some other important weaknesses which could be addressed as secondary issues include:

1. Soil fertility - especially such measures as better use of animal manures, composting, more effective use of residues, use of mulches (either grown in place or brought in), etc.

2. Wood production - wood for fuel is in short supply in many villages and most are concerned about the future. In addition wood for building, fencing, etc. is often scarce and or expensive.

3. A program of bio-gas production is being implemented in Thailand. Production of raw material for bio-gas generators is a factor which may need attention in farming systems development.

Table - Implementation Schedule for Demonstration and Research

Activity	YEAR 1	2	3	4	5	6	7
1. Fertilizer field evaluation							
Experiments, No.	-	13	13	13	13	13	13
2. Shallow well research							
Tambon projects, No.	-	2	2	-	-	-	-
3. Minimum Tillage							
Experiments, No.	-	-	1	1	1	-	-
4. Saline soil amelioration							
Salt diversion channels, rai protected			500	500	500	500	500
Tolerant plant demonstrations							
Rice (rai)			70	70	70	70	70
Woodlot (rai)			30	30	30	30	30
Pasture (rai)			30	30	30	30	30
5. Public land demonstration							
Farmer specialist training							
Man weeks	6	4	10		10		10
Demonstration meeting, No.	6	4	10		10		10
Demonstrations in progress, No.		6	10	10	10	10	10
6. Farming system research							
Selection of activities	x	x					
Research programs, No.		2	3	4	4	4	2
Final reports, No.						2	2

H - RESOURCE INVENTORY

Weather Data

According to Kopper's climate classification, N.E. can be classified as the "Aw" climate type. It has high rainfall with distinct wet and dry seasons. The driest month has less than 2.4" of rain. The natural vegetations are dipterocarp forest and grasses. There are wide varieties of crops under this climate condition. The most important ones are rice, cassava, kenaf, sugar cane, beans, vegetable, tobacco and fruit trees.

In Lahan, Kwang Chon, Tae and Taket, the rainy season begins in May and ends in October, but Nong Kaew, Na Muang, Na Thom and Na Ngua, it begins in April and ends in September.

To study the influence of the climate on the cropping pattern and the growth of crops in a specific area, knowledge about local climatic conditions of that area are needed. There is a lack of such information in the project areas.

There are few important elements controlling climatic condition:

Rainfall

Rainfall is the most important factor influencing agriculture. The growing periods are determined by water availability. The determination of the beginning of the growing season is based on the start of the rainy season. A normal growing period is defined as one with a period when there is an excess of precipitation over potential evapotranspiration. During the growing period, precipitation may again be less than potential evapotranspiration and crops often mature on moisture reserves stored in the soil profile. Soil moisture storage must be considered in defining the length of the growing period. However, the amount of soil moisture stored in the soil profile and available to the crop varies with the depth of the profile, the soil's physical characteristics, and the rooting pattern of crops. The project areas have erratic rainfall, the soil has low moisture holding capacity, and surface run off is rapid. To solve this problem, it is necessary to use cropping patterns which are suitable to the rainfall conditions.

Temperature

In general, temperature determines the rate of growth and development of crops, but in some crops temperature may also determine whether a particular developmental process will begin or not. In some crops both day/length and temperature may determine the time when the plant will flower; therefore low temperature can cause a problem through delay in flowering and maturation and poor seed set (e.g. maize and sorghum). Temperature affects many conditions of plants growth such as photosynthesis, respiration, cell wall permeability, absorption of water and nutrients, transpiration, enzyme activity and protein coagulation. The most suitable temperature range for agricultural plants is 15° - 40° C. Atmospheric temperature of the eight tambons falls in this range; therefore, temperature is not a limiting factor for plant growth, but it does limit the type of crops which can be grown.

Evaporation and Relative Humidity

There are no climatic data on evaporation and relative humidity in the eight tambons or in the amphoe city. Evaporation varies geographically as well as seasonally. In the Northeast the seasonal variation is regular in transition from minimum values in September - October to maximum values in March - April. 1/ The humidity or the region varies according to the trend of the monsoon, with a mean relatively humidity reaching a minimum of around 60% in March and rising to a maximum of about 80% in August or September. 1/

Evaporation data is essential for determining water needs and estimating the soil water budget. In addition to its effect on evaporation, relative humidity often correlates closely with the degree of disease infestation in crops.

In order to evaluate research field trials, demonstrations and farmer adoption of recommended practices, it is necessary to know the weather parameters during the life of the project. Rainfall, particularly, can vary greatly within short distances in the Northeast and weather records are not generally available outside of the provincial capitals. To monitor weather during

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1/ Asian Institute of Technology, Water For the North East: Drought Analysis, Part I: Rainfall Analysis. (December, 1979, Bangkok)

the project it will necessary to set up 7 simple weather stations. The two tambons in Si Sa Ket are adjacent and can be served by one station.

At each site a local recorder will be chosen from government officials or interested farmers. Those chosen will be given basic training in weather data collection at Meteorological Department in Bangkok.

Land Use Planning Maps

A general reconnaissance soil survey has been conducted, and soil maps which classify soil capabilities suited for rice and upland crops have been printed by the DLD for all provinces in the Northeast. For all of selected area (8 tambons) more detailed soil classification maps (scale 1:10,000), contour maps (scale 1:10,000 and 1 m. interval), land suitability maps (scale 1:10,000) and land use planning maps (scale 1:10,000) will be prepared during the first part of project implementation. During the soil survey, specific reservoir sites will be located. The suitability of these sites for reservoirs (both natural and impounded) will be recorded.

Soil Testing

At the present time fertilizer use is one of the more profitable methods of increasing crop production available to the farmer. 1/ The need and value of fertility needs to be constantly before the farmer and the professional recommenders. An increased emphasis on soil testing and field trials is proposed. A reconnaissance soil fertility survey should be carried out by the local extension official, in order to make himself and the farmers aware of the fertility status of different soils, effects of cropping systems and fertility management. Farmers should be encouraged to soil-sample fields on a systematic basis in order to identify soils with a potentially high return for fertilizer use and in order to understand problem fields, the basis of soil fertility, and the need for a balanced fertility program. This would also help the farmers and professional recommenders understand the need for the use of proper fertilizers -- a fact which was pointed out as a problem in the site survey report.

Soil samples for the reconnaissance survey will be collected by TEA and contact farmers after training by project staff. Sampling sites will be precisely located on aerial photographs so that they can be identified as to soil type. Farmer samples

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1/ Possibilities of Agricultural Production Increase Through the Use of Chemical Fertilizers, Office of Agricultural Economics, Ministry of Agriculture and Cooperatives, Bangkok, 1980.

will be callected by TEA, project staff and farmers in conjunction with demonstration trials or extension trials or during investigations of problems in the field. Samples will be analyzed at the NEROA laboratories.

Projected samples to be analyzed are:

Year	Reconnaissance Samples	Farmer Samples
1	800	200
2	800	400
3	800	600
4		800
5		1,100
6		1,200
7		1,500
Total:	2,400	5,800

I - ECONOMIC STUDIES SUPPORT

In this very abbreviated project design activity there is included a micro-economic analysis to find the economic consequences of proposed changes in farming systems. Obviously, this will be a very limited analysis owing to both limitations of time and of data. Data about the specific soil, water, cost, input response, demand and resource supply situation of the individual tambons would be required for a reliable analysis. Several months of professional time would also be required. But as experience in both developed and less-developed countries demonstrates, "It is very important to achieve an immediate impact which will give the farmers confidence in the extension agents and agents confidence in themselves." 1/ And this implies a high degree of certainty that the recommended changes will prove profitable (or otherwise beneficial). It also requires that they are feasible within the resource constraints of individual farms or groups of farms and of managerial capacities.

The agricultural economics component of the NERAD program is viewed as a part of a more general farming systems program. One of its roles is to help with the preliminary identification of those activities which appear to have potential for increasing the productivity and income of farmers. A second is that of analysing in a rigorous manner, based on data from on-farm experiments for major classes of resource situations, their economic feasibility as a part of a general farming system. A third role is that of identifying and, where possible, proposing means for removing constraints to productivity increases, such as those of market, input supply, credit, tenure, and other institutional constraints.

Economic Feasibility Analysis As A Line Activity

The foregoing considerations suggest that before any "major change" 2/ in enterprises or cropping sequences is

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1/ Daniel Benor and James Q. Harrison. Agricultural Extension: The Training and Visit System. Washington, D.C. : World Bank, May 1977.

2/ A "major change" is defined as one which requires significant additional capital, a change in size or input levels of other enterprises or one which importantly increases risk to the farm family's means of substestance including loss of landownership. Direct seeding of rice, animal vaccination, low cost pest control measure and use of "improved" varieties on a small proportion of paddy land would not be regarded as major changes.

suggested to farmers in a tambon that it should first be submitted to preliminary feasibility analysis based on expected biological performance, expected prices, and typical resource and management levels in that specific tambon. The more definitive analysis would follow on-farm field testing under site-specific, price, management, resource, and farming system conditions.

Market Feasibility - Present Market Performance

The seasonal variability of supply and intra-season elasticity of demand for specialty crops such as vegetables, watermelons and tree fruits are of special importance. These commodities are usually produced in a highly seasonal pattern, are, mostly, highly perishable. Hence their markets are not nationally or internationally integrated. Therefore, there is a high probability that prices will fall to very low levels if local output significantly expands.

An additional problem is that watermelons and several fresh vegetables are produced mainly as off-season crops to utilize residual supplies of soil water following the main season rice harvest. Thus the marketing feasibility of some of these commercial enterprises depends on the timing of planting and readiness for harvest relative to other producing areas. For these enterprises, seasonal availability of soil moisture may be no more important than seasonal variability of commodity supplies and hence of prices. For this reason, a general reconnaisance market feasibility survey of markets for watermelons, major classes of fresh vegetables and tree fruits is suggested. The information generated will provide an important basis for designing cropping systems which are geared to market realities, and, hence, are likely to be profitable.

Actions to Remove Market Constraints

A second purpose of such market surveys would be to form a partial basis for exploring the possibilities of group action for removing these market constraints. If it is found that some markets have limited supplies of these commodities at times when other areas have market surpluses, group shipment from surplus to deficit areas may remove this constraint if assembly and transportation costs do not exceed price differences.

Unfortunately, field visits to a small number of cooperatives and Cooperative Promotion Department offices suggest that expertise for analysing market possibilities and organizing effective group marketing systems is not presently available at local or regional levels. Exploration of possibilities for technical support of this type has not been undertaken at the regional offices or national offices of the Cooperative Promotion Department. A report on "A Comprehensive Plan for the Development of Agricultural Cooperatives" (1979) by NESDB suggests that a regional cooperative training center will be developed which may upgrade capabilities of management. However, provision for technical assistance to local societies or farmers' groups with interests in cooperative marketing is scarcely mentioned. It is relegated to one of the 13 categories of services to be provided by the National Training Institute and no detailed plan is provided. Other than this, the report mentions only "developing a close working relationship with the DAE (now OAE)" (P. 29).

The fact that the recommended action in the NESDB report has been, reportedly, rejected, leads to a regretted but inevitable conclusion. Technical assistance for group marketing ventures, for feasibility analysis as well as organization and management, will have to be provided internally by support staff or solicited from the Office of Agricultural Economics and/or business and economics faculty at local universities. Further, it is a type of assistance which is absolutely essential to the success of this project. Without it, serious risks of economic losses to those who attempt some of these speciality crops activities are inevitable. And such losses are likely to diminish farmer acceptance of other innovations for long periods thereafter, even when they would be genuinely useful.

The functions of the marketing and marketing organization support staff person would include identification of genuine market malfunctions.1/ In addition, they will include an assessment of alternative means to remove any serious malfunctions.

The appropriate means for solving a marketing problem may be in some cases a very informal arrangement such as hiring a truck to transport produce to an existing market or arranging

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1/ By malfunctions is meant situations in which (1) market price differences exceed the cost of movement between geographic locations, (2) in which prices at different points in time exceed the cost of storage, or (3) prices of raw and processed commodities differ by more than the cost of processing.

a contract between farmers and a buyer. In still others it may turn out that a wholesale merchant or some small group may be paying exploitatively low prices. In such cases a cooperative or cooperative-like organization either to bargain collectively with the buyers or to perform the marketing functions of these tradesmen may be advisable.

If cooperative action is the most feasible solution, assistance in setting up the formal organization (charter, by law, etc.) will be required and selection of a manager and training on the legal, financial and membership relations responsibilities will be important. These types of training and assistance can be supplied by the Department of Cooperative Promotion. Legal assistance and training facilities for these purposes already exist and should be used. However, we would emphasize that the legal and organizational structure should be coordinated with the economic requirements for effective market performance. Therefore, participation in setting up the organizational structure should include both those with knowledge of cooperative law and philosophy and those who recognize the specific market situation and the actions which will be required for economic success. Training of management should include training in basic business management and economic analysis, and technical assistance may be required in these areas. The marketing staff should be equipped to supply it.

In view of these factors, it is proposed that decisions on whether to solicit the services of the Cooperative Promotion Department in forming cooperative marketing or purchasing activities follow a thorough evaluation of the problem and alternative solutions by the marketing specialist on the NEROA support staff. Further, we suggest that qualified marketing personnel be involved in organization and management training activities as well as cooperative specialist personnel.

Input Market Performance Evaluation

The markets for fertilizers were observed on the site visits. Animal feed, pesticide, animal medication and equipment markets were not observed, owing to difficulties of identifying relevant types and qualities, and to insufficient time. However, prior experience in Thailand suggests that some of the other input markets are subject to very serious malfunctions such as adulteration, misleading or false labels, and noncompetitive pricing.1/ This means that more detailed

1/ Feeds and vitamin supplements purchased by the Northeast Agricultural Center during the 1967-69 period were found to be mislabelled and adulterated in some cases.

reconnaissance of these markets and possible group action may be required to assure dependable low-cost supplies of these goods. However, fertilizer markets were observed and appeared to be adequate in the two tambons of Nakhon Phanom.

Within Changwats Chaiyaphum, Si Sa Ket, and Roi Et, pricing of fertilizer is extremely uniform, usually with a margin of ฿10 per 50 kg. bag between retail and wholesale. Private dealers are fairly numerous. Several indicated that they could obtain supplies of formulations not in stock within a period of not more than two weeks and one said as little as four days. Retail prices of ammonium phosphate (16-20-0) in all but Nakhon Phanom mainly fell in the range of ฿250 - ฿260 per 50 kilogram bag.

Prices at cooperatives were, of course, ฿30 - ฿40 less, but delivery was reported to be seriously late in most years. Whether this will be true in the future in view of recent attempts by the Marketing Organization for Farmers to speed the process of bid-letting remains to be seen. While this somewhat subsidized fertilizer is obviously preferred by farmers if delivered on schedule, the 12 - 16% lower price charged by cooperatives is not essential to profitable fertilizer use. Both experimental information 1/ and unpublished survey data for Tambon Taket (Si Sa Ket) suggest that yield responses are sufficient to cover more than four times the cost of fertilizer. Thus, fertilizer is an extremely profitable input at either the private dealer or cooperative price schedule.

The situation in Nakhon Phanom is one of a very "thin" market. The level of application of fertilizer to rice is only about ฿5.7 worth which is equal to 1.1 kg. of 16-20-0 at a price of ฿5.0 per kilogram. Associated with this are very high retail prices in both Amphoe Na Wa and Amphoe Ban Phaeng. However, Tambon Na Thom is closer to another Amphoe town, which time constraints did not permit us to visit. However, according to our present incomplete information, most formulations appear to be nearly ฿80 above wholesale. Partly because of transportation costs, wholesale prices in Nakhon Phanom are about ฿10 higher than in Roi Et and Si Sa Ket.

1/ Office of Agricultural Economics, Bangkok

The situation in these two tambons is one which probably will require direct action. The very poor laterite soils are probably much less responsive to rice fertilizers than the sandy loams and clays of the other tambons, possibly less than half as large an increase in yield per unit application of fertilizer. This, plus severely overpriced fertilizer, may combine to restrict fertilizer use to the present low levels. The cooperative in Amphoe Na Wa distributed only 20 tons of fertilizer last year to farmers in Na Ngua. This was about 20 kilograms per farm or two kilograms per rai. Whether more could have been sold is not clear.

If delivery has usually been late or if the cooperatives supplies of fertilizer have been exceeded by demand, group purchase from wholesale sources in Nakhon Phanom (for Taket) or Sakon Nakhon or Udorn (for Na Ngua) is probably justified as an extension activity. However, this should be explored with cooperative officials to verify the nature of the present situation.

Production Credit

Bank for Agriculture and Agricultural Cooperatives

BAAC: General policies to further expand agricultural credit offered through B.A.A.C. have been announced in the press. This will, presumably, make more credit available in these and other tambons. But two factors should be recognized in this connection.

The first of these factors is that the BAAC credit, especially that channeled through cooperatives and farmer groups, is heavily subsidized. At present it is being offered at 12.0% per annum, at least 6.0% below "prime" rates on secure loans of major lenders. The "prime" rates constitute the opportunity costs of money. A second is that collection on BAAC direct loans to farmers and, especially, through cooperatives and farmer groups, have been far below amounts due and payable. Arrearage on short term loans have been between 21% and 25% of loans matured in recent years for BAAC direct loans and more than 50% for those loans extended through cooperatives.1/

Data on BAAC operating expenses are not immediately available. The reported rate of disbursement was ฿ 99 million ($000,000) per BAAC Officer, in 1978. This would add 4.0% to

1/ Bank for Agriculture and Agricultural Cooperatives. Annual Report 1978, Bangkok (undated).

the cost of credit extended if total salary travel, clerical and other non-interest costs were equal to only ฿80,000 per year ($4,000) per officer. (We judge that the true figure is more than double this amount.)

What proportion of these arrearages will eventually be collected is a matter of speculation. However, the fact that the weighted average age of arrearages was 1.4 years in 1979, 1/ means that the real cost of money loaned by BAAC is equal to not less than 1.29 times its opportunity cost. Thus the real cost of money, exclusive of operating cost, is at least double the 12.0% interest charge. 2/ If 5% of loans outstanding are never collected, the real cost of money closely approaches the interest cost on merchant credit. For loans through cooperatives the real cost would probably be in excess of 50%.

We have only fragmentary reports on loan arrearages in BAAC financed loans in the specific amphoes in which pilot tambons are located. These appear to be much higher than national averages. Legal actions to recover loans were few.

BAAC reports legal action against only 2,339 clients with delinquent payment in 1978, out of a total of 209,096 medium and short-term loans to individual farmers in arrears. 3/ However, one Changwat BAAC Officer reports about 37 cases being currently prosecuted involving several group loan accounts, one of which has over 20 members.

Commercial Banks

Commercial banks provided 46.2% of combined BAAC and commercial bank credit to Thai farmers in 1978. 4/ However, BAAC loans to many more farmers than do commercial banks. Direct and indirect loans numbered 1,746,000 and 293,000, respectively, in 1978. Average size loans of commercial banks were ฿26,898 as compared with BAAC's ฿5,255. 5/ Associated

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1/ Ibid. Table 5, p. 26.

2/ Assuming, 21% of loans in arrears an average of 1.4 years, and a prime rate of 18%, real money cost = .18 + (.21 x 1.4 x .18) = .25 or 25%.

3/ BAAC, op. cit., p. 53.

4/ BAAC, op. cit., p. 51.

5/ BAAC, op. cit., p. 52.

with this difference is a probable large difference in overhead service costs per baht loaned.

The rate of arrearage reported by the one commercial bank queried was miniscule. This amphoe branch bank had over 1,600 loans and three loan officers for agricultural credit. It reported delinquent accounts of less than 25 individuals, all of which were judged to be collectable.

Personnel of both commercial banks expressed the view that they were quite interested and willing to support with credit enterprises of farmer-clients working closely with extension on the contemplated pilot program. The impression given was that they felt that these were more secure loans (and possibly, required less policing of the use of loan funds) than those to less progressive farmers. One was sufficiently interested to propose a meeting with the branch executive staff which our schedule did not permit.

Conclusions on Production Credit

One conclusion that emerges from these fragments of information is that adequate quantitative supplies of production credit from institutional sources will probably be available at relatively low cost.

Even the commercial banks have systems which allow the farmer to either pay interest for only the actual amounts used and for the period of actual use or to get a partial return on amounts not yet spent by holding them in a special savings-type account. Thus, a farmer who negotiates a loan in May, using half of it for fertilizer and transplanting labor and half for harvesting labor, may actually pay interest costs of less than 8% of the principal amount at 22% per annum.

The problem group, as always, will almost certainly be the severely impoverished, especially those who are tenants and those with insecure titles, both of whom often have heavy loads of pre-existing debt which tie them to input suppliers and market outlets. It might be possible through very intensive work with a small number of such clients to upgrade their productivity enough to make them reasonably safe loan prospects. However, there appears to be no obvious way to do so with presently expected personnel and institutional resources except by sacrificing most of the productivity gains which would make this project economically feasible.

As a matter of general developmental strategy, it seems prudent to avoid insofar as possible confusion between welfare and productivity objectives. As now administered, the programs of BAAC and, especially, cooperative production credit, appear to be subject to this confusion. This encourages some farmers to feel little responsibility for either productive use of these funds or repayment on schedule. Therefore, in a pre-implementation phase or early implementation period, tambon agents and project management staff might properly request that these agencies announce and attempt to make loans primarily on the basis of productivity and repayment capability criteria, rather than the criterion of "need" alone. In this way credit can be distinguished from outright grants.

This, it appears, should be the basis for all loans, whether from BAAC or commercial banks. Otherwise the tone of the present cooperative and BAAC programs, that of "government help" rather than "self-help" through improved farming, is likely to spill over into their view of the NERAD program. And this is likely to adversely affect motivation to achieve program objectives.

Comprehensive Credit: Refinancing

In all areas, but particularly in Chaiyaphum tambons, some problems of endangered tenure owing to the "vicious circle" of credit tied to exploitative "green rice" sales exist. Those already operating as tenants and landless laborers are, in general, a seriously disadvantaged group.

BAAC Operations

BAAC long term (10 year) loans for the purpose of real estate repurchase or complete refinancing were outstanding to a small number of farmers in 1978 (approximately 7,100) with principal outstanding of ฿174 million. 1/ of these, 148 were in arrears on payments. However, one of the Changwat BAAC officers visited reported that most of the refinancing loans

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1/ BAAC, Op. Cit., p. 34

in his changwat were severely in arrears on interest and principal payments. It was his belief that very intensive retraining and close supervision of farming operations would be required if these types of loans were to be repaid. He indicated that the clients tended to view these as gifts or welfare payments. This view held by farmers was, apparently, completely valid. No action had been taken to foreclose mortgages on the delinquent loans, several of which were several years in arrears.

From all indications the concept of supervision in the so called 'supervised credit" does not extend to the level of management supervision. The loan case load per loan officer of 400 : 1, 1/ any intensive management supervision would be precluded with current staffing.

Office of Agricultural Land Reform

According to the Land Reform Act of 1975, agricultural land reform is defined as the improvement of land rights through allocation of state-owned and private land, purchased or expropriated from large landholders, to farmers with no or insufficient land. Farmers may hire-purchase, rent, or utilize the allocated land and will receive agricultural devlopment services from the Government. Land reform areas of both public and private types are established by Royal Decree, which requires a Cabinet decision. Such areas are designated on a district basis, and land reform programs are to be completed in three years. There is to be no transfer of land during this period without the approval of the Agricultural Land Reform Committee.

It is the policy of the Office of Agricultural Land Reform (ALRO) that for private land to be declared a Land Reform Area, priority will be given to areas where tenancy is greater than 40% and agricultural yields/rai are low; for public areas yields/rai must be low, squatters must occupy more than 50% of the area, the land must be suitable for cultivation, and land holdings should be continguous and not more than 150 km. from the provincial capital city. Special consideration will be given to areas which are subject to communist insurgency.

Therefore, ALRO has no legal means for addressing tenure problems within NERAD Project tambons.

1/ Based on an assumed 3 officers per amphoe served, a reported 780,514 total branch clients and 528 amphoes served. See BAAC (op. cit.) Table 1, p. 18.

Conclusion

The problem of severe debt load and the growing incidence of expropriation of owners by mortgagees are problems. The solutions to these problems is beyond the capabilities of existing agencies and, clearly, beyond means of tambon extension agents. Hence, no activity which is specifically addressed to the problems of over-indebtedness and land tenure is proposed in this project.

The plight of these farmers is worthy of government attention. Retraining-refinancing programs for those who are young enough and who are capable of learning improved farm management may be justified in some cases. In others, preparation for productive careers in off-farm work using retraining programs and subsistence grants may be desirable. But this is clearly beyond the capability of a generalized program which aims to improve farm incomes through increased productivity. Incremental farm productivity will almost certainly be miniscule relative to costs in these programs.

Resource Development Activity Evaluation and Planning

A significantly large group of potential activities proposed in this project relate to soil and water resource development and utilization. By definition, activities related to large-scale water resource (irrigation-flood control-power) projects are excluded from consideration. However, small-scale ground water and surface water projects are not. Neither are land shaping and other land resource development activities of small scale.

The technical feasibility of these projects will, of course, be evaluated by the soils and engineering personnel who plan the physical structures and select the sites for them. However, as the very unsatisfactory levels of utilization of most large-scale irrigation projects illustrate, meeting technical feasibility criteria is not a sufficient basis for making a satisfactory contribution to farm family productivity and incomes. It is, therefore, important that economic analysis be applied to the selection of such investment activities through (1) realistic projections of the profitable utilization of these resources once they are developed, and (2) concurrent estimates of benefits and costs among these activities. In addition, socio-cultural and legal or institutional factors determining the level of utilization and distribution of benefits among income classes should be carefully assessed. In particular, attention should be given to land tenure, including (1) the present situation on privately owned lands, and (2) the basis for title transfer from public to private ownership, credit for purchase and development, and

the processes by which secure titles may be granted for lands now part of the national domain (public lands).

Some very crude assessments of potential activities and their benefits and costs (internal rate of return) are included in other documents appended to this Project Paper. Further screening and evaluation will be essential during the implementation phase. Planned access to economic planning and project evaluation capability is a logical requirement for program effectiveness. Moreover, this planning activity should logically be coordinated with more general agricultural development and infrastructure planning at regional and local levels.

G - TECHNICAL ANALYSIS - ENGINEERING FEASIBILITY

Construction Activities

1. Water Resources Development

A major component of the Project will be the development of water resources. In general, activities apply simple techniques for utilizing local resources and man power.

Site surveys, engineering design and construction monitoring will be the prime responsibility of Department of Land Development (DLD). The DLD has demonstrated its competence in providing such engineering services. In 1980, DLD constructed 367 water impoundments, 221 done through force account and 146 by contract. For 1981, DLD will implement 437 water projects and approximately 60% will be located in the Northeast. Recent RTG water resources development policy (September 1980) states that DLD will be the primary agency responsible for small scale water impoundments including survey, design, and construction of farm ponds, embankment dams, weirs, pit ponds and swampy area deepening. The DLD Engineering Division has 19 engineers on board and has been allocated positions by the CSC allowing recruitment of 8 more engineers. In addition, there are more than 30 technicians (surveyors, draftsmen, etc.) and over 100 mechanics. However, to ensure that proper site selection, design standards and supervision of construction are realized for the Project, a senior consulting engineer will be hired to work under the direction of the Project Manager to assist in survey, design and monitoring the performance of DLD and the construction contractors. Following completion of each water facility, DLD will assist in establishing water management and maintenance systems.

All the construction materials such as cement, steel, boulders, gravel, sand and wood can be easily secured at the sites or within a reasonable haul distance and at comparatively reasonable prices. Experienced and competent local contractors for the construction can be found throughout the Northeast. They usually hire available local skilled labors and workers and therefore reasonable prices can be expected.

Cost estimates for water improvement/construction were based on average anticipated site conditions and visits by DLD and USAID engineers. Cost estimates reflect recent

USAID supported project costs and present construction costs in the Northeast in accordance with guidelines for RTG agencies with construction experience (ARD, DLD, and DOLA). It is proposed that the ARD and DLD standard detail drawings and general construction specifications for water resources development projects be used. Detailed plans will be required for all activities before implementation except well improvement which will be done by the people themselves. For shallow well improvement, ARD's shallow well standard drawings and guidelines will be used (See Section 4 below for examples of cost derivations.)

2. Office Buildings

For the office center building, RTG standard/typical engineering plans and unit cost per square meter area ($95/m^2) was applied.

3. Design/Construction Process

In year one of the project DLD will provide a survey and design team which will start field studies and design work on water improvement activities throughout the Project area. All design work will be accomplished at a central office in the Project area.

Finished design specifications and contract documents will be forwarded to DLD Bangkok for review/approval by the central office and then to USAID for final approval by USAID. After the documents are approved they will be sent back to the Project area for bidding/contracting through the Provincial Governors Office.

The design contracting effort can be completed in three years by the design team.

Starting in year two, the first construction season, DLD will provide one construction supervision team plus two additional construction inspectors. This quality control group would be in charge of all construction activities financed under the Project. The team would do the control layout work and inspect critical construction elements as the work is undertaken. The two inspectors would be roving inspectors and would perform scheduled and unscheduled site inspections of Project construction. This level of effort is expected to maintain good quality control of construction for years two through four of the Project which is expected to be the period when construction will be carried out.

The senior engineer for DLD will coordinate with and work under the guidance of the Project Manager. Both the DLD and Project senior engineers will be intimately involved in the design/construction effort, and they will backstop both teams, (design and construction) as required.

The DLD central office in Bangkok can be called on to consult on engineering problems as can the Engineering and Science and Technology Office in the USAID which will be monitoring the infrastructure components of the Project.

The organization of the engineering services for the Project provides the proper level of control necessary to assure appropriate professional engineering standards are incorporated into all infrastructure activities, and to assure that construction is carried out to meet the planned needs within the project implementation time-frame.

The personnel supplied through DLD will all be temporary hires excepting the senior engineer. It is expected that those who perform well will at a later time become permanent employees of the DLD. All of these temporary employees will be paid for from Project funding. In addition, one temporary senior engineer will be hired to work with DLD on other DLD activities and will be paid for under the Project. This will allow DLD to assign a "proven" senior engineer from their regular staff to the Project (paid by DLD) for four years as mentioned above. He will reside in the Project area during the four years.

DLD can hire the required staff from the Thailand professional and sub-professional labor market. This Project will extend DLD's engineering staff to a field location for a four year period, and it is expected that the success of this Project will result in a further move toward decentralization of these services into other rural areas, in accordance with current RTG policy toward decentralization.

4. Cost Estimates for Construction Components

Cost estimates showing expected average costs for wells and filter systems are attached to indicate how costs were derived. An illustrative schedule of water resource components showing unit costs is also attached.

A. Cost estimate for water-filter system

Mean depth of shallow-well (for drinking)	=	4.00	m
Standard diameter of drinking well	=	Ø1.20	m
Volume of earth excavation $\frac{\pi}{4}$ $(1.50)^2$ (4)	=	7.00	m^3
Labor cost for earth excavation 45฿/m^3	=	315	฿
Distance of drinking well from village pond ±	=	10.00	m
Diameter of concrete-pipe for filter materials (1.00 long)	=	Ø0.30	m
Depth of embeded concrete-pipe for filter material	=	3.00	m
Volume of earth excavation (0.5 x 3 x 10)	=	15.00	m^3
Labor cost for excavation 45฿/m^3	=	675	฿
Labor cost for earth-fill and compaction 35฿/m^3	=	525	฿
Unit cost of concrete pipe Ø1.20 m x 1.00 m long x 0.044 thick	=	100	฿/ea.
Number of concrete pipes required	=	10	ea.
Cost of concrete pipes	=	1,000	฿
Filter materials x 1.30 swelling:			
- Find sand 0.4 m^3 x 200฿/m^3	=	80	฿
- Course gravel 0.4 m^3 x 200฿/m^3	=	80	฿
- Active carbon 0.2 m^3 x 500฿/m^3	=	100	฿
Cost of skilled labor for filling filter material and embedding	=	300	฿
Number of concrete rings for drinking well (Ø1.20 x 0.50)	=	9	ea.
Cost of concrete rings 140฿/each	=	1,260	฿
Volume of concrete apron on top 0.10 x $\frac{\pi}{4}$ $(2.2^2 - 1.2^2)$	=	0.3	m^3
Unit cost of reinforced concrete	=	2,200	฿/m^3
Cost of concrete apron (included labor)	=	660	฿
Total cost for water-filter system	=	4,995	฿
Say		5,000	฿

B. Cost Estimate for Shallow Wells

Mean depth of shallow well	=	6.00 m
Standard diameter of shallow well	=	Ø1.20 m
Volume of earth excavation $\frac{II}{4}$ $(1.50)^2 x$ (6)	=	10.60 m^3
Labor cost for earth excavation 45฿/m^3	=	480 ฿
Standard size of concrete rings use Ø1.20 m x 0.05 thick x 0.50 depth		
Number of concrete rings required	=	12 ea.
Unit cost of concrete ring include profit and transport	=	140 ฿/ea.
Cost of material (concrete rings)	=	1,680 ฿
Total cost for a shallow well (480 + 1680)	=	2,160 ฿

C. EXAMPLES OF RECENT WATER RESOURCE MODIFICATION CONSTRUCTION PROJECTS

No.	Province	District	Storage Capacity (M^3)	Surface Area (M^2)	Total Cost ($)
1	Udon Thani	Nong Bua Lum Poo	53,000	35,330	28,130
2.	Sri Saket	Rasri Salai	17,990	8,000	18,950
3.	Roi Et	Suwanna Phum	27,300	14,218	20,500
4.	Surin	Chumpholburi	150,000	18,200	27,430
5.	Nongkhai	Phon Phisai	600,000	400,000	24,000
6.	Chaiyaphum	Ban Thaen	52,500	35,000	25,000
7.	Nakhon Ratcha-sima	Khong	446,700	297,800	48,200
8.	Nakhon Phanom	Tha Uthen	119,500	79,660	20,300
9.	Yasothon	Pa Tiu	47,750	31,830	24,930
10.	Yasothon	Maha Chanachai	12,450	3,860	20,400
11.	Ubon Rajcha-thani	Det Udom	54,000	36,000	20,000
12.	Ubon Rajcha-thani	Sena Nikhom	20,000	6,250	15,090
13.	Sakhon Nakhon	Waritchaphum	44,000	29,300	33,750
14.	Sakhon Nakhon	Phannanikhom	176,400	117,600	49,940
				Average cost/unit	26,900

Remark: Those above projects are random examples picked up from a hundred of water resource development activities in North-east of Thailand

Annex VI Economic Analysis

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Price Used in Analysis

With the exception of non-glutinous rice, actual farmgate prices are good estimates of project economic input and output prices (see, e.g., Trent Bertrand, Thailand: Case Study of Agricultural Input and Output pricing, the World Bank, April 1980). This is true under the assumption that the exchange rate accurately reflects the economic cost of foreign exchange. However, as noted earlier, even if the baht is overvalued, the adjustments on prices would probably change the overall economic internal rate of return but little, perhaps making it slightly more attractive.

Given the foregoing, the same unit input costs are used for the economic as for the financial analyses and respective unit output prices are the same except for non-glutinous rice.1/ The following farmgate prices were used:

	Baht
Paddy, glutinous (฿/kg)	2.5
Paddy, non-glutinous (฿/kg)	3.0/3.7
Fertilizer (฿/kg)	6.0
Farm labor, hired, (฿/day)	27.5
Cassava root (฿/kg)	0.45
Vegetables (with project) (฿ rai)	1850-2000
Mung bean (฿/kg)	5.2
Kenaf (฿/kg)	2.7
Groundnut (฿/kg)	4.8
Fish (฿/kg)	20.0
Raw silk (฿/kg)	600
Mature cattle (฿ each)	7500

1/ At least in the past, the depressed price of rice (due to government intervention) may have also depressed the market price of farm labor.

Farm Budget

Farm budget estimates for an average farm "without" and "with" the project are presented in the table immediately following. The "without project" estimates are based on the NERAD Socioeconomic Survey with prices adjusted to reflect 1980/81 levels. The "with project" estimates are for the year that the formal project ends, assumed to be 1988[1/]. Net farm income represents the return to household labor and to land.

There is a wide diversity in cropping patterns from farm to farm within the project area and the reader is warned that the "average farm" would be representative of only a small number of farms empirically. The farm budgets do show, however, some of the important trends the project intends to generage. These include a small decrease in the area planted to rice, as land unsuited to rice production is placed under other crops; a growth in the area cropped to mung bean (or other short/medium maturity crops, generally legumes); and an increase in the intensity of land use. The area under cassava and kenaf is projected to remain about constant but yields are to grow. The cropped area per farm increases some and yields per rai and net income from crops increase significantly. Net income from non-crop enterprises (sericulture, large animal, native poultry, fish production, tree nurseries) increase sharply, the largest single contribution coming from improvements in the production of native poultry. This activity requires very little investment outlay and net benefits accrue almost immediately.

Under the Cropping Systems category, there are a relatively large number of interventions proposed. This inventory was developed because of the flexibility and diversity required of agriculture in the project area as farmers adapt to the characteristics of their individual farms and to changing year-to-year climatic conditions, mainly the amount and timing of rainfall.

1/ Adjustments are projected to continue to take place, and net farm income continue to rise, over the 20 year economic life of the project.

Farm Budget, Estimates of Cropped Area (by crop), Production, and Gross and Net Farm Gate Value of Output, Without Project & At Formal End of Project.

		Average per HH[a]	
		Without Project[b]	With Project[c]
1.	Farm size (rai)	31.1	31.1
2.	Cultivable Area (rai)	29.9	29.9
3.	Cropped are (rai)	24.3	26.6
	- Paddy	20.9	20.5
	wet season	(20.8)	(20.4)
	dry season	(0.1)	(0.1)
	- Mung beans	0.1	0.8
	- Cassava	0.9	0.7
	- Kenaf	1.1	1.1
	- Vegetables/fruits	1.1	1.9
	- Other[d]	0.4	1.6
4.	Production (Kgs)		
	- Paddy	3842	4550
	wet season	(3790)	(4493)
	dry season	(52)	(57)
	- Mung beans	12	76
	- Cassava	1890	1966
	- Kenaf	159	194
	- Vegs/fruits (฿)	780	2643
	- Other (฿)	254	1286
5.	Gross value crops (฿)	12658	18176
	- Paddy	10283	12443
	- Mung Beans	62	395
	- Cassava	850	885
	- Kenaf	429	524
	- Vegs/fruits	780	2643
	- Other	254	1286

		Average per HH[a/]	
		Without Project[b/]	With Project[c/]
6.	Production Costs (฿)[e/]	2102	4338
	- paddy	1293	1984
	fertilizer	(599)	(1006)
	hired labor	(454)	(554)
	- other	809	2354
	fertilizer	(337)	(789)
	hired labor	(215)	(432)
7.	Net Income Crops (฿)	10,556	13,838
8.	Other Farm Income, net (฿)[f/]	2,187	3,512
9.	Net farm income, total (฿)	12,743	17,350

Notes to Table

a/ 9744 HH is project area

b/ Based on survey data

c/ Seventh year of project, assumed to be 1988

d/ Or other short/medium maturity crops

e/ Includes farm investments costs

f/ Includes large animals, poultry, fish production, Sericulture tree murseries and value of water to HHs.

CROPPING SYSTEMS MODIFICATIONS

There are 14 different activities under this project category:

I. Deep water rice

II. Short maturity crop before flooding

III. Improved production of vegetables/truck crops

IV. Less-care legume after rice

V. High yielding rice varieties

VI. Field crop after rice

VII. Short Maturity field crop prior to transplanting rice

VIII. Direct seeded rice

IX. Drought tolerant rice

X. Double cropping of field crops

XI. Monocropping field crops

XII. Intercropping cassava with legumes

XIII. Improved practices, cassava

XIV. Improved practices, kenaf

The estimated financial benefit-cost ratios are:

Activity	Financial (Farm) B/C
I	2.8
II	3.0
III	2.9
IV	2.3
V	2.3
VI	1.6
VII	1.7
VIII	3.0
IX	2.2
X	2.0
XI	1.8
XII	2.2
XIII	2.0
XIV	1.9
Total	2.1

The lowest benefit-cost ratio (1.6) is fieldcrops after rice and the next to the lowest (1.7), short maturity fieldcrops before rice transplanting. The two highest activities are the the seeding of mung beans before flooding on fallow and flood prone land, and the direct seeding of rice. The overall B/C ratio is 2.1. Since the assignable project costs are low related to joint costs, no IRRs are shown for the individual activities. The overall internal rate of return, all costs, included, is 19%.

The projections of increased fertilizer and hired labor use due to this component of the project are:

Project Year	Cost (฿ Millions) Fertilizer	Cost (฿ Millions) Labor	Tons Fertilizer a/	Man-Years Labor b/
1	-	-	-	-
2	-	-	-	-
3	1.0	0.27	162	35
4	2.3	0.60	388	76
5	3.7	0.94	613	120
6	5.0	1.28	839	163
7	6.4	1.62	1064	206
8	8.1	2.05	1352	262
9	9.8	2.49	1639	317
10	11.6	2.92	1927	373
11	20.2	5.10	3367	650
12	27.9	7.02	4654	1171

a/ at ฿6/kg

b/ 285 work-day years; average wage rate: ฿27.5/day

Cropping Systems Project Component, I :imates of incremental costs and benefits, by activity and farmer adoption rates.

Activity	Baht per Rai Financial	Economic
I. Deep water rice		
1. Gross incremental value of output	390	480
- 130 kgs at ฿3.0/3 .7		
2. Incremental costs	160	160
- insecticide ฿50		
- seed ฿42		
- hired labor ฿61		
- supplies ฿ 7		
3. Net Incremental Returns	230	320
4. Adoption rate		
- years 4-7, 300 rai annual increases		
- years 8-20, 400 rai annual increases		
- 6300 rai in t20		
II. Short maturity crop before flooding		
1. Gross value of output	520	520
- Mung beans: 100 kgs at ฿5.2		
2. Costs	160	160
- seed ฿36		
- insecticide ฿60		
- hired labor ฿30		
- supplies ฿34		
3. Net Returns	360	360
4. Adoption rate		
- years 4-7, 80 rai annual increase		
- years 8-20, 100 rai annual increase		
- 1600 rai in t20		

Activity		Baht per Rai Financial	Economic
III. Improved prodution of vegetables/ truckcrops			
1. Gross value of output		970	970
2. Costs		340	340
- fertilizer	฿180		
- insecticide	฿ 40		
- hired labor	฿ 50		
- supplies	฿ 10		
- other	฿ 60		
3. Net returns		630	630
4. Adoption rate			
- years 3-7, 400 rai annual increase			
- years 8-20, 700 rai annual increase			
- 10,900 rai in t20			
IV. Less-care legume after rice			
1. 50 kgs mung bean at ฿5.2			
2. Costs		115	115
- seed	฿60		
- hired labor	฿25		
- supplies	฿30		
3. Net returns		145	145
4. Adoption rate			
- years 5-7, annual increases of 600 rai			
- years 8-20, annual increases of 850 rai			
- 13,500 rai in t20			
V. High yielding rice varieties			
1. Gross value of output		750	925
- 250 kgs at ฿3.0/3.7			

	Activity		Baht per Rai Financial	Economic
	2. Costs		385	385
	- fertilizer	฿240		
	- insecticide	฿ 50		
	- seed	฿ 26		
	- hired labor	฿ 70		
	3. Net return		365	540
	4. Adoption rate			
	- years 3-7, annual increase of 3000 rai			
	- years 8-20, annual increase of 3600 rai			
	- 59,200 rai in t20			
VI.	Field crop after rice			
	1. Gross value of output		685	865
	- 180 kgs groundnut at ฿4.8			
	2. Costs		525	525
	- seed	฿270		
	- fertilizer	฿120		
	- pesticides	฿ 60		
	- supplies	฿ 30		
	- hired labor	฿ 35		
	3. Net returns		340	340
	4. Adoption rate			
	- years 3-7; annual increases of 1200 rai			
	- years 8-20, annual increase of 1700 rai			
	- 26,700 rai in t20			
VII.	Short maturity fieldcrop prior to transplanting rice			
	1. Gross value of output		520	520
	- 100 kg mung bean at ฿5.2			

Activity	Baht per Rai Financial	Baht per Rai Economic
2. Costs	305	305
- seed ฿36 - fertilizer ฿90 - pesticide ฿50 - supplies ฿24 - hired labor ฿35 - land preparation ฿70		
3. Net return	215	215
4. Adoption rate		
- years 4-7, 500 rai annual increases - years 8-20, 700 rai annual increases - 10,700 rai in t20		
VIII. Direct seeded rice		
1. Gross value output	240	295
- 80 kgs paddy at ฿3.0/3.7		
2. Costs	80	80
- seed ฿24 - fertilizer ฿42 - hired labor ฿-36 - insecticide ฿50		
3. Net return	160	215
4. Adoption rate		
- years 4-7, 1000 rai annual increases - years 8-20, 1350 rai annual increases - 21,600 rai in t20		

Activity	Baht per Rai Financial	Economic
IX. Drought tolerant rice		
1. Gross value of output	210	260
- 70 kgs at ฿3.0/3.7		
2. Costs	95	95
- fertilizer ฿42 - insecticide ฿53		
3. Net returns	115	165
4. Adoption rate		
- years 3-7, 900 rai annual increases - years 8-20, 970 rai annual increases - 16,100 rai in t20		
X. Double cropping of field crops		
1. Gross value of output	1015	1015
- 100 kg sesame at ฿8.0 - 120 kgs mungbeans at ฿5.2 - less 70 kg paddy at ฿2.5 and 525 kg cassava root at ฿0.45		
2. Costs	505	505
- fertilizer ฿216 - seed ฿29 - insecticide ฿130 - land preparation ฿55 - supplies ฿34 - hired labor ฿41		
3. Net returns	510	510

Activity	Baht per Rai Financial	Economic
4. Adoption rate		
- years 4-7, 600 rai annual increases - years 8-20, 730 rai annual increases - 11,900 rai in t20		
XI. Monocropping field crops		
1. Gross value of output	690	690
- 210 kg peanut at ฿4.8 - less 45 kg paddy at ฿2.5 and 460 kg cassava root at 0.45 baht		
2. Costs	375	375
- seed ฿215 - fertilizer ฿ 90 - pesticide ฿ 60 - land preparation ฿10		
3. Net returns	315	315
4. Adoption rate		
- years 4-7, 600 rai annual increases - years 8-20, 730 rai annual increases - 11,900 rai in t20		
XII. Intercropping cassava with legumes		
1. Gross value of output	930	930
- 1000 kgs cassava root at ฿0.45 - 100 kgs peanut at ฿4.8		

	Activity	Baht per Rai Financial	Economic
	2. Costs	425	425
	- seed ฿140 - fertilizer ฿180 - pesticide ฿ 30 - supplies ฿20 - land preparation ฿25 - hired labor ฿30	505	505
	3. Net returns		
	4. Adoption rate		
	- years 4-7, 200 rai annual increases - years 8-20, 250 rai annual increases - 4000 rai in t20		
XIII.	Improved practices, cassava		
	1. Gross value of output	450	450
	- 1000 kgs at ฿0.45		
	2. Costs	230	230
	- fertilizer ฿120 - supplies ฿ 30 - hired labor ฿ 80		
	3. Net return	220	220
	4. Adoption rate		
	- years 4-7, 250 rai annual increases - years 8-20, 330 rai annual increases - 5300 rai in t20		
XIV.	Improved practices, kenaf		
	1. Gross value of output	380	380
	- 140 kgs at ฿2.7		

Activity		Baht per Rai Financial	Baht per Rai Economic
2. Costs		200	200
- fertilizer	฿120		
- pesticide	฿ 30		
- other	฿ 50		
3. Net returns		180	180
4. Adoption rate			
- years 4-7, 350 rai annual increases			
- years 8-20, 540 rai annual increases			
- 8400 rai in t20			

WATER RESOURCES MODIFICATIONS

General

Six activities comprise this project component:

- Swamp rehabilitation
- Submerged dike construction
- Embankment structure construction
- Shallow well construction
- Water filter systems installation
- Other (such as pit ponds and weirs)

Estimated quantified benefits arise mainly from crop production (vegetables/high value crops, rice seed beds and a very small amount of dry season paddy) but also from the use of water by households and livestock, and for fish production.

About half of the fish production activity within the "Other farming Systems" component of the project is planned for the bodies of water which will be renovated/developed under the "Water Resources" component. Consequently, half of the benefits and costs of the fish production activity are allocated to the Water Resources component. The annual overall allocation, in ฿1000s, is:

	฿ 1000 by Project Year						
Costs/Benefits	1	2	3	4	5	6-7	8-20
Assigned project costs	111	212	337	337	294	294	-
Household costs	25	56	110	215	419	447	741
Total benefits	0	0	800	1600	2340	2340	2340

These costs and benefits are in turn allocated to four Water Resources activities -- swamp rehabilitation, submerged dikes, embankment structures and other modifications --, the respective proportions being 0.424, 0.221, 0.339 and 0.017.

Surface water for household and livestock use is valued the same as for the Village Fish Pond project -- ฿3,375 annually per body of water.

Annual assignable, joint and total project costs for all Water Resources activities, including the allocation from Other Farming Systems, are estimated as (฿ Millions):

Costs	1	2	3	4	5	6	7	Total
Assigned	1.85	14.52	18.54	6.92	0.92	0.33	0.29	43.37
- Water Resources	(1.74)	(14.30)	(18.20)	(6.59)	(0.63)	(0.04)	(-)	(41.49)
- Other Farming Systems	(0.11)	(0.21)	(0.34)	(0.34)	(0.30)	(0.30)	(0.29)	(1.88)
Joint	1.89	2.89	2.16	2.27	1.68	0.89	0.71	12.49

Financial benefit-cost ratios for households and economic internal rates of returns are estimated as:

Activity	HH B/C Ratios a/	Economic IRR, Joint Project Costs Excluded	Economic IRR, Joint Project Costs Included
Swamp rehabilitation	2.6	13	-
Embankment structures	2.7	18	-
Submerged dikes	2.9	16	-
Other modifications	2.6	17	-
Shallow wells	2.1	90	-
Filters	b/	66	-
Combined	2.4	23	18

a/ Cost benefit steams discounted at 14%

b/ No HH costs

Since practically all the construction costs are assumed by the project, the benefit-cost ratios for participating households are high; all are greater than 2:1. However, the economic internal rates of return (excluding joint project costs) vary substantially among activities, two being very high with the remainder being in the low to medium range. The unit cost of impounding a cubic meter of irrigation water varies substantially from one reservoir type to another. Thus, it is estimated that the provision of a cubic meter of swamp water for irrigation will cost more than twice that of submerged dikes, the basic explanation for the low IRR for swamp rehabilitation. And the main reason the IRR for submerged dikes is not higher is because it seems likely that a substantial proportion of the irrigating water will be used to produce dry season paddy. Per rai, the latter requires about 12.5 times the water that is needed for vegetables/high value crops; the water required to irrigate the estimated 68 rai of paddy to be planted would irrigate 850 rai of vegetables or other high value crops, with evan a greater expansion in net farm income.

By year 7, an additional 8220 rai of vegetables/high value crops (about 0.85 rai/household) are expected to be cultivated because of the project. Fertilize use will grow by almost 330 (product) tons and hired labor by about 190 man-years.

WATER RESOURCES -- ESTIMATES OF INCREMENTAL CHANGES DUE TO PROJECT

1. Surface water available for irrigation, assigned project costs & unit costs

Activity	Water Available for Irrigation (cubic meters)	Assigned project costs (฿1,000)	Unit Cost (฿/M^3)
Swamp Rehabilitation	571,200	16,866	29.5
Embankment Dams	746,400	13,640	18.3
Submerged Dams	360,000	4,431	12.3
Other Modifications	222,160	3,399	15.3
Total	1,899,760	38,336	20.2

2. Irrigation water utilization rates, surface water storage

Year	Utilization of Water Available for Irrigation		
	Vegetables/ High Value Crops (%)	Rice Seed Beds (%)	Dry Season Paddy (%)
Year of storage construction	20	0	0
First year following	35	20	25
Second year following	65	50	65
Third year following	85	85	85
All following years	85	85	85

3. Adoption Rates -- area planted, fertilizer used & labor hired by farmers

Project Year	Rai Planted			Fertilizer Used		Labor Hired	
	Vegs/ Truck	R.S. Beds	D.S. Paddy	(฿1,000)	MT	(฿1,000)	Man-Years[a]
1	-	-	-				
2	427	-	-	102	17.1	77	9.8
3	1599	96	6	384	64.0	288	36.7
4	3479	378	25	835	139.2	626	79.9
5	5923	785	50	1422	236.9	1066	136.0

a/ ฿27.5/day; 285 work days annually

Project Year	Rai Planted: Vegs/ Truck	Rai Planted: R.S. Beds	Rai Planted: D.S. Paddy	Fertilizer Used (฿1,000)	Fertilizer Used MT	Labor Hired (฿1,000)	Labor Hired Man-Years a/
6	5923	785	50	1422	236.9	1066	136.0
7	8220	1129	68	1973	328.8	1480	188.8
8-20	8240	1129	68	1978	329.6	1483	189.2

4. Production Costs, Crops, ฿/rai

	Vegs	D.S. Paddy
Fertilizer (฿6/kg)	240	270
Insecticide	50	50
Hired labor	180	60
Seed	280	30
Power, equipment	90	70
Other	60	150
Total	900	630

There are no production costs for rice seed beds over current costs.

5. Gross value of crop output -- vegetables/high value crops: surface water irrigation, ฿2,000/rai; shallow well irrigation, ฿1,850/rai; rice seed beds: economic, ฿700/rai; financial, ฿570/rai; paddy: economic, ฿1,700/rai (460 kgs at ฿3.7); financial, ฿1,380/rai.

6. Costs: Assigned project costs, joint project costs and household costs (฿1000)

Project Year	Assigned Project Costs: Water Resources Sub-Project	Assigned Project Costs: Allocation from other F. Systems	Assigned Project Costs: Total Assigned	Joint Costs Allocated to Water Resources	Household: Water Re-sources	Household: F. Systems	Household: Total
1	1736	111	1848	1840	13	25	38
2	14303	212	14516	2830	453	56	509

Project Year	Assigned Project Costs: Water Resources Sub-Project	Assigned Project Costs: Allocation from other F. Systems	Assigned Project Costs: Total Assigned	Joint Costs Allocated to Water Resources	Household: Water Resources	Household: F. Systems	Household: Total
3	18199	337	18536	2130	1560	110	1670
4	6586	337	6923	2120	3312	215	3527
5	626	294	920	1630	5473	419	5892
6	36	294	330	880	6994	447	7441
7	-	294	294	710	7441	447	7888
8-19	-	-	-	-	7459	741	8200
20	-3799	-	-3799	-	7459	741	8200

7. Gross Incremental Benefits (฿1,000)

Project Year	Vegs.	Crop Production: Rice Seed Beds Econ.	Rice Seed Beds Fin.	DS Paddy Econ.	DS Paddy Fin.	Total Crops Econ.	Total Crops Fin.	HH Water	Fish Production: Filter System	Other F. Systems	Total Fish	Grand Total Econ.	Grand Total Fin.
1	-	-	-	-	-	-	-	-	-	-	-	0	0
2	842	-	-	-	-	842	842	81	-	-	-	923	923
3	3119	67	55	10	8	3196	3182	215	14	800	814	4226	4211
4	6748	265	215	43	35	7056	6998	320	32	1600	1632	9009	8950
5	11443	550	447	85	69	12078	11959	434	40	2340	2380	14894	14773
6	14868	751	612	109	88	15729	15568	492	40	2340	2380	18601	18440
7	15813	790	644	116	94	16720	16551	492	40	2340	2380	19593	19423
8-20	15850	790	644	116	94	16757	16588	492	40	2340	2380	19630	19460

8. Economic Internal Rate of Return & Household Financial Benefit Cost Ratio

	Costs (₱10^6)				Benefits (₱10^6)			Benefits (₱10^6)	
					Economic			HH Financial	
Year	Joint Cost Allocated to Water Resources	Assigned	Project Total	Household	Total	Net a/	Net b/	Total	Net
1	1.89	1.85	3.74	0.04	-	-1.89	-3.78	0.00	-0.04
2	2.89	14.52	17.41	0.51	0.92	-14.10	-17.00	0.92	0.41
3	2.16	18.54	20.70	1.67	4.23	-15.98	-18.14	4.21	2.54
4	2.27	6.92	9.19	3.53	9.01	-1.43	-3.71	8.95	5.42
5	1.68	0.92	2.60	5.89	14.89	8.00	6.40	14.77	8.88
6	0.89	0.33	1.22	7.44	18.60	10.83	9.94	18.44	11.00
7	0.71	0.29	1.00	7.89	19.59	11.41	10.70	19.42	11.53
8-19	-	-		8.20	19.63	11.43	11.43	19.46	11.26
20	-	-3.80	-3.80	8.20	19.63	15.23	15.23	19.46	11.26
				IRR		23	18	B/C 2.4	

a/ Excluding joint project costs
b/ Including joint costs

Swamp Rehabilitation Estimates

1. Construction schedule: 10, 11 & 4 swamps renovated in years 2, 3 & 4 respectively.

2. Water available for irrigation: 571,200 m^3

3. Crops to be irrigated and potential area

   - 1856 rai vegetable/truck crops

   - 300 rai rice seed beds

   - 2156 rai total

4. Area planted, incremental farm production costs & value of crop output (฿1000)

Year	Rai		Farm	E. Benefits		F. Benefits	
	Vegs	R.S.Bed	Costs	Total	Net	Total	Net
1	-	-	-	-	-	-	-
2	148	-	133	296	163	296	163
3	423	24	381	863	482	860	479
4	827	86	744	1714	970	1703	959
5	1266	178	11[illegible]	2657	1518	2634	1495
6	1518	238	1366	3203	1387	3172	1806
7-20	1577	255	1419	3333	1914	3300	1881

5. Other incremental costs benefits & totals for swamp modification (฿1,000)

	Costs			Benefits		Total					
	Assigned Project		HH	HH		Assigned Project	HH	Economic Benefits		Financial Benefits	
Year	Fish	Crops	Fish	Water	Fish	Costs	Costs	Total	Net	Total	Net
1	47	665	11	-	-	712	11	-	-723	-	-11
2	90	6647	22	34	-	6737	155	330	-6562	330	175
3	143	6970	45	71	339	7113	426	1273	-6266	1270	844
4	143	2584	87	84	678	2727	831	2476	-1082	2465	1634
5	125	-	172	84	992	125	1311	3733	2297	3710	2399
6	125	-	178	84	992	125	1544	4279	2610	4248	2704
7	125	-	178	84	992	125	1597	4409	2687	4376	2779
8-19	-		302	84	992	-	1721	4409	2688	4376	2655
20	-	-1478	302	84	992	-1478	1721	4409	4166	4376	2655
							IRR		13	B/C	2.6

Embankment Structure Estimates

1. Construction schedule: 7 in years 2, 10 in year 3 & 3 in year 4.

2. Available water for irrigation: 746,400 M^3.

3. Crops to be planted

   - 750 rai of rice seed bed

   - 1978 rai of vegetable/truck crops

4. Estimated adoption schedule, crop production cost & benefits (฿1,000)

Year	Rai		Farm Costs	E. Benefits		F. Benefits	
	Vegs	R.S. Bed		Total	Net	Total	Net
1	-	-	-	-	-	-	-
2	138	-	124	276	152	276	152
3	440	53	396	917	521	910	514
4	855	207	770	1855	1085	1828	1058
5	1335	434	1202	2974	1772	2918	1716
6	1622	599	1460	3663	2203	3585	2125
7-20	1681	638	1513	3809	2296	3726	2213

5. Other costs, benefits (฿1,000) and totals

	Costs			Gross Benefits			Totals					
	Assigned project		HH		HH		Costs		Economic Benefits		Financial Benefits	
Year	fish	Other	fish	fish	water	total	Assigned project	farm	total	net	total	net
1	38	538	8	-	-	-	576	8	-	-584	-	-8
2	72	4716	18	-	24	24	4788	142	300	-4630	300	158
3	114	6422	36	271	57	328	6536	432	1245	-5723	1238	806
4	114	1964	69	542	68	610	2078	839	2465	-452	2438	1599
5	100	-	137	793	68	861	100	1339	3835	2396	3779	2440
6	100	-	142	793	68	861	100	1602	4524	2822	4446	2844
7	100	-	142	793	68	861	100	1655	4670	2915	4587	2932
8-19	-	-	242	793	68	861	100	1655	4670	2915	4587	2932
20	-	-1226	242	793	68	861	-1226	1755	4670	4141	4587	2832
								IRR		18	B/C	2.7

Submerged Dike Estimates

1. Construction schedule: 4, 6 & 3 dikes in years 2, 3 & 4 respectively

2. Water available for irrigation: 360,000 M^3

3. Crops to be irrigated and potential area

   - 400 rai vegetables

   - 80 rai dry season paddy

4. Planted area (rai), farm production costs and value of output (฿1,000)

Year	Vegs	Paddy	Farm Costs	E. Benefits Total	E. Benefits Net	F. Benefits Total	F. Benefits Net
1	-	-	-	-	-	-	-
2	25	-	23	50	27	50	-
3	80	6	76	170	94	169	93
4	163	25	162	369	207	361	199
5	257	50	263	599	336	583	320
6	322	64	330	753	423	733	403
7-20	340	68	349	796	447	774	425

5. Other costs, benefits (฿1,000) and totals

	Costs			Benefits			Totals					
							Cost		Economic Benefits		Financial Benefits	
Year	Ass. project fish	Ass. project other	HH fish	HH fish	HH water	total	Assigned project	farm	total	net	total	net
1	25	175	6	-	-	-	200	6	-	-206	-	-6
2	47	1347	12	-	14	14	1394	35	64	-1365	64	29
3	74	1927	23	177	34	211	2001	99	381	-1719	380	281
4	74	982	45	354	44	398	1056	207	767	-496	759	552
5	65	-	90	517	44	561	65	353	1160	742	1144	791
6	65	-	93	517	44	561	65	423	1314	826	1294	871
7	65	-	93	517	44	561	65	442	1357	850	1335	893
8-19	-	-	158	517	44	561	-	507	1357	850	1335	828
20	-	-426	158	517	44	561	-426	507	1357	1276	1335	828
									IRR	16	B/C	2.9

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Other Modifications Estimates

1. Expenditure schedule (assignable costs), ฿1,000: 135, 1123 & 2141 in years 1, 2 & 3 respectively (total = 3399).

2. Storage capacity for irrigation: 222,160 M^3, 35% of which is to be developed in year 2 and 65% in year 3; 60% of the water will be used to irrigate vegetables/truck crops and 40% rice seed beds.

3. Crops to be irrigated and potential area

- vegetables/truck crops, 520 rai
- rice seed beds, 278 rai

4. Estimated adoption schedule (rai), crop production costs & benefits (฿1,000)

	Rai		Farm	E. Benefits		F. Benefits	
Year	Vegs	RS Beds	Costs	Total	Net	Total	Net
1	-	-	-	-	-	-	-
2	36	-	32	72	40	72	40
3	132	19	119	277	158	275	156
4	236	85	212	532	320	521	309
5	375	173	338	871	533	849	511
6-20	442	236	398	1049	651	1018	620

5. Other costs, benefits & totals (฿1,000)

	Costs			Gross Benefits			Totals					
							Costs		Economic Benefits		Financial Benefits	
year	Ass. fish	Project other	HH fish	HH water	HH fish	total	Assigned project	farm	total	net	total	net
1	2	135	-	-	-	-	137	-	-	137	-	-
2	4	1123	1	3	-	3	1127	33	75	-1085	75	42
3	6	2141	2	10	14	24	2147	121	301	-1967	299	178
4	6	-	3	10	27	37	6	215	569	348	558	343
5	5	-	7	10	40	50	5	345	921	571	899	554
6	5	-	7	10	40	50	5	405	1099	689	1068	663
7	5	-	7	10	40	50	5	405	1099	689	1068	663
8-19	-	-	12	10	40	50	-	410	1099	689	1068	658
20	-	-284	12	10	40	50	-284	410	1099	973	1068	658
								IRR		17	B/C	2.6

Shallow Wells Estimates

1. Construction schedule, years 1-7; number of wells:

   - water for irrigation: 40, 202, 336, 478, 324, 20 & 0 (1400)

   - water for HH use: 2, 13, 25, 40, 20, 0 & 0 (100)

   - totals: 42, 215, 361, 518, 344, 20 & 0 (1500)

2. Irrigation capacity: each well will provide supplementary irrigation of 4 rai of vegetables/high value crop.

3. Utilizaiton: it is assumed that 50% of a well's capacity will be utilized for irrigation in the year following construction and 75% in the following years.

4. Production cost is assumed to be ฿900/rai and value of output ฿1850

5. Wellas dug for consumption are assumed to yield the same net benefits as wells used for irrigation, i.e., ฿950 x 4 x .75 = ฿2850 per well annually less cost of construction (hired labor).

6. Estimates of planted area (rai), incremental farm costs and value of output (฿1000)

		Costs				Benefits				Total			
	Rai	Construction for		Pro-	Farm	Total				Costs		Benefits	
year	years	irrigation	HH use	duction	total	crops	HH use	total	net	project	farm	total	net
1	-	13	1	-	13	-	-	-	-13	223	13	-	-236
2	80	65	4	72	141	148	6	154	13	448	141	154	-435
3	524	108	8	472	588	969	43	1012	424	712	588	1012	-288
4	1398	153	13	1258	1424	2586	114	2700	1276	1045	1424	2700	231
5	2690	104	6	2421	2531	4977	228	5205	2674	626	2531	5205	2048
6	3816	6	-	3434	3440	7060	285	7345	3905	36	3440	7345	3869
7	4180	-	-	3762	3762	7733	285	8018	4256	-	3762	8018	4256
8-19	4200	-	-	3780	3780	7770	285	8055	4275	-	3780	8055	4275
20	4200	-	-	3780	3780	7770	285	8055	4275	-385	3780	8055	4660
							B/C	2.1				IRR	90

Water filter systems

1. Construction schedule: 4, 5 & 2 units in years 2, 3 & 4 respectively

2. Expenditure schedule (assignable costs), ฿1,000: 22, 27 & 11 in years 2, 3 & 4 respectively.

3. Fish production: 33,000 m^2 = Total Pond Surface Area = 3.3 ha

   - yield: 600 kg fish/ha surface
   - yield/pond: 600 x 0.3 = 180 kg average

4. Value of output: ฿20/kg = ฿3600/pond x 11 ponds = ฿39,600

Year	Output (฿1,000)	Assigned Cost (฿1,000)	Net
1	-	-	-
2	-	22	-22
3	14	27	-13
4	32	11	21
5-20	40	-	40
		IRR	66

OTHER FARMING SYSTEMS MODIFICATIONS

This project component consists of 5 different activities:

I. Sericulture

II. Large Animal (cattle, buffalo)

III. Poultry (native chickens)

IV. Fish Production

V. Tree Nurseries (fruit, forest)

Benefit cost ratios and internal rates of return (IRR) are estimated as:

	Financial--Farm B/C Ratio	IRR--Economic Assigned Costs only
Sericulture	1.30	22
Large Animals	1.53	18
Poultry	2.39	508
Fish Production	3.92	131
Tree Nurseries	1.45	57
All Activities	1.95	45

I. Sericulture

Seventy-four villagers will be trained in mulberry and silk production and will be provided demonstration materials for improved silk production. The project will also encourage other villagers to produce silk and provide guidance to the participants.

1. Projected adoption schedule

   - annual increases of 50 households (one rai each) beginning in year 2, reaching a total of 550 in year 12 and maintaining that level in years 13-20.

2. Gross value of production: ฿6,000/rai

   - average production of 10 kg. silk/household at ฿600/kg. beginning the year following planting of trees.

3. Production costs per household

   - land (one rai) and water at ฿1,000/year
   - 1,600 mulberry plants at ฿2 each = ฿3,200; 12 year life
   - rearing room trays, ฿2,000; 12 year life
   - supplies and maintenance, ฿2,000 annually

4. Assigned project cost (฿1,000)

   - year 1-7: 0, 106, 365, 365, 180, 180 and 180

II. Large Animals

This activity is composed of two components, one of which is improved pasture and the other, animal health. Assignable project costs, years 1-7 are projected at 0, 465, 610, 815, 1083, 1227 and 1227 thousand Baht respectively. For years 8-20, the annual project cost is estimated at ฿127 thousand which would be borne by the villages.

A. Improved Pasture

The wet season forage supply is reported to be the single most important constraint to increasing cattle/buffalo production in the Northeast.*

1. Carrying capacity of pasture (mature male buffalor equivalents)

- unimproved (native) pasture, 0.55 per rai; improved, 0.825 per rai; and increase of 0.275 animal units/rai

- pasture area estimated at 6,720 rai; if improved, carrying capacity could be increased by 1848 animal units (mature male buffalo equivalents)

2. Reproductive unit

- reproductive rates average about 60%; calf mortality rate is about 7%, for a net reproduction rate of about .56

- production of one surveying calf requires maintenance of 1/.56 = 1.79 brood cows plus approximately 0.3 bulls and an additional 3 animals 0-3 years old have to be fed for body maintenance

- one reproductive unit = 3.58 animal units, i.e., 1.79 + 0.3 + 1.49

  - requires 4.34 rai of improved pasture per reproduction unit and 6.51 unimproved, an additional output of 516 3-year old animals from the 6,720 rai if improved

3. Gross incremental return

- valuing each 3-year old at ฿7,500, incremental gross returns from 6,720 rai of improved pasture totals to ฿3,870 thousand annually, once herd size is built up, or ฿576/rai or ฿560 net of a 3% death loss

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*E.C. Price, Jr., Aggregate Bouvine Supply in Northeast Thailand, Ph.D. Dissertation, University of Kentucky, 1973

4. Incremental farm costs

- seed: 2 kgs. S. Hemata seed/rai at ฿56/kg. = ฿112/rai

- land preparation and seeding: ฿400/rai

- additional livestock inventory required

  - 0.0768 reproductive units/rai

    - 1.79 brood cows at ฿7,500 each

    - 0.30 bulls at ฿7,500 each

    - 3.0 0-3 year olds, ฿7,500 total

  - or 3.09 x ฿7,500 x 0.0768 = ฿1780/rai when herd is built up

5. Projected implementation schedule

- 1,344 rai of additional improved pasture seeded in each of years 2-6, reaching a total of 6,720 rai in year 6.

B. Animal Health

Improvement in animal health will increase the reproductive rate and also reduce death losses.

1. Animals affected

- estimated at 15,000

2. Gross incremental benefits

- 10% increase in output per reproduction unit or ฿2,250 thousand for 15,000 animals

3. Incremental costs (farm)

- ฿68.33/head of livestock or ฿205 thousand/year/3,000 head for vaccines and supplies

4. Projected implementation

- years 2-6: 3,000 additional animals in each year, reaching 15,000 in year 6.

III. Poultry

A. Existing Situation--average per household

1. 3 hens, 1 male bird

- 10 chicks raised to 1 kg/birds

2. Egg production: 3 x 48 = 144/annually

- for hatching: 100
  - hatch rate: 70% = 70 chicks
  - chicks saved (85% mortality) = 10

3. Feed requirement

- adults: 4 x 8 = 32 kgs paddy equivalent
- chicks: 10 x 6 = 60 kgs paddy equivalent
  - total 92 kgs
    - scavenged = 80 kgs paddy equivalent
    - paddy fed = 12 kgs at ฿2.5 = ฿30.0

4. Gross returns

- 10 chicks at ฿36 each	=	฿360
- 44 eggs at ฿1.5 each	=	฿ 66
Total		฿426

5. Net returns: ฿426 = ฿30 = ฿400 (approx.)

B. Improved Management and Disease Control

1. Egg production

   - 3 x 78 = 234

     - for hatching: 75

2. Chick production

   - 48: hatch rate, 0.8; survival rate, 0.8

3. Feed Requirement

   - adult birds: 40 kgs paddy equivalent

   - chicks: 48 x 6 = 288 kgs

     Total = 328 kgs

4. Feed cost

   - scavenged: ฿260 kgs paddy equivalent

   - paddy: 48 kgs at ฿2.5/kg = ฿120

   - supplement: 24 kgs at ฿6 = ฿144

     Total ฿264

5. Other costs

   - vaccine and medications

     - ฿4/bird = ฿208/family/year

   - chicken coops: ฿150/family

     - 4 year life

   - repair/maintenance: ฿34/family/year

6. Implementation schedule

   - 1,000 families annually beginning in year 2 reaching 7,000 in year 8

7. Gross returns per family over present practices.

- improved practices
  - 160 eggs at ฿1.5 each = ฿ 240
  - 48 chicks at ฿30 each = ฿1440

  Total ฿1680
- present practices
  - 44 eggs at ฿1.5 each = ฿ 66
  - 10 chickens at ฿36 = ฿360

  Total ฿426
- difference per family: ฿1,254/year
  - economic incremental costs (farm)
    - coop construction (฿150/family)
    - increased feed cost: ฿234/family
    - vaccine & medications: ฿208/family
    - other (repair, maintenance): ฿34/family

8. Assigned project costs are projected at 112, 203, 268, 244, 100, 60 and 35 thousand Baht, years 1-7.

IV. Fish Production

1. Projected implementation schedule, existing and reservoirs to be constructed.

   - production of 80, 160 and 234 metric tons, years 3, 4 and 5-20 respectively

2. Gross incremental revenue

   - output price: ฿20/kg

3. Incremental costs (farm) (฿1,000)

   - Hatchery fry at ฿0.3/fry, totalling 50, 106, 210, 410, 809 and 837 in years 1, 2, 3, 4, 5 and 6-20 respectively.

   - manure at ฿220/ton for totals of 0.0, 5.5, 9.9, 19.8, 28.6 and 57.2 in the years 1, 2, 3, 4 and 5-20 respectively.

4. Projected assigned project costs (฿1,000)

   - 222, 424, 674, 674, 588 and 588 in years 1-7

   - Village is expected to support project in the amount of ฿588 years 8-20. Cost is assigned to villagers.

5. Half of all costs and benefits are assigned to the water resources category.

V. Tree Nursery

This activity will assist the private sector in developing 20 tree nurseries--fruit and forest--as a source of tree stock for farmers. The project cost is estimated (in ฿1,000) at 0, 64, 124, 64, 24, 24 and 24 in years 1-7.

1. Gross incremental revenue

   - total sales (฿1,000) are projected at 0, 120, 200, 600, 1,000 and 1,200 in years 1, 2, 3, 4, 5 and 6-20 respectively.

2. Incremental costs (฿1,000), economic, enterprise

   - land and water: 0 in year 1 and 60 in remaining years

   - labor: 0 in year 1 and 100 in remaining years

   - supplies 0, 60, 140, 300, 500 and 600 in years 1, 2, 3, 4, 5 and 6-20 respectively.

Annex VII

SOCIAL ANALYSIS

A. BENEFICIARIES: SOCIO-ECONOMIC CHARACTERISTICS

The beneficiaries of this project are 9,744 families with some 64,860 inhabitants living in 8 tambons* (101 villages) located in four provinces in Northeast Thailand. The majority of these people are Lao, or Isan, but within the selected areas there are also several cultural groups such as ethnic Chinese and Vietnamese descendants, Yo, and Phu Thai. The identification of each group remains well recognized by the people themselves. The relationship among them was at one time fairly strained but at present they are to some extent integrated and, moreover, intermarriage is not uncommon. At the village level, all villagers have in common their association with a village Wat (Buddhist temple-monastery) and a shrine to a village tutelary spirit (phi puta) for religion and cult; and, on the other hand, a village headman for local administration.

Occupationally, the beneficiaries are overwhelmingly rainfed agriculturalists (over 95% of the households), virtually all of whom plant rice as their main crop. Only 5% of the households have anyone employed full-time in non-farm work, but another 60% rely on part-time off-farm labor to supplement their farm earnings, averaging about 2 man-months per household per year in such employment. Only 40% of the households have upland fields but 60% planted at least some cash crops. The average holding is 30 rai, 29 of which are cultivable (25 rai of rainfed paddy land, 3 rai of upland, 1 rai misc.). The average household plants 22 rai in the wet season, 20.5 of which are in rice, 1.5 in cashcrops. In the dry season average area planted is 2 rai, in cashcrops.

The majority of household heads (90%) are male. Female household heads are due to deceased husbands and, in a few cases, to separation or divorce. A female headed family, unless relatively wealthy, usually faces various difficulties. The family system emphasizes matrilocality (groom takes up residence in the bride's home or family) and matrilineality (property, especially farmland, is passed on from mother

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* (Tambon = subdistrict, the level above village and below amphoe).

to daughter). In this regard, the woman's role in family affairs is rather great and her opinion carries considerable weight in family decision-making. The official average household size is 6.6 persons. Nuclear families (parents and children) are predominant. Family Planning is at present widely practised due to the successful campaigns on birth control. The villagers are now conscious of family size and therefore the rate of population growth in the Northeast has declined from 2.3 percent in 1977 to 1.9 percent in 1979.

The beneficiary population speaks the northeastern dialect in their everyday lives but all are able to understand and 89% can read and write central Thai -- the official language being taught in village primary schools throughout the country since 1921. At present, 5% of household heads have education beyond traditional compulsory four year and a number of youngsters now earn secondary and higher level certificates. The villagers also receive supplementary non-formal education and news from outside, as over 90% of the households have a radio. A few villagers own television sets in electrified villages. TV ownership is a recognized indicator of a high household economic status. Daily newspapers reach some villages under a program of the Department of Non-formal Education but only a few villagers benefit from such materials since they usually remain at a local leader's house. However, another mode of communication is through personal channels, especially in village meetings and among kinsmen, faction members and neighbors. This personal communication is the most influential source of information and is of the greatest importance in helping poor farmers to decide to adopt an innovation.*

The selected tambons are not isolated since they are reached by public all-weather roads. Only the two in Nakhon Phanom are relatively difficult to commute to but roads are being built by ARD. Overall, households average 7 visits per month outside the home village (lowest tambon average is 4 in both of the Nakhon Phanom tambons and in Kwangjon). In addition, like many northeasterners, the villagers possess the unique characteristic of being "mobile people" hence, by and large, migration to other

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*Damrong Thandee 1978 The Role of Communication in Occupational Development of Rural Inhabitants: A Re-study of a Village in Thailand. Research report No. 1, Ramkhamhaeng University p. 46.

rural and urban areas is quite common especially among young people. Such migration is primarily (95%) temporary, usually on a seasonal basis. About 30% of the NERAD households had someone out of the village for a month or more during the year surveyed, almost always to do temporary wage labor. Of these about 20% went somewhere else in the same province, 15% elsewhere in the Northeast, 35% to Bangkok and 30% to other regions of the country.

At the village level, there are several formal organizations, for example, Wat, school and village development committees. The function of each committee is rather specific, mainly public works, while the groups organized by the Agricultural Extension Agents including farmer housewife, farmer youth, and contact farmers, function as occupational associations. At the sub-district level, the Tambon Council is the legal entity responsible for general public work and administrative affairs while Farmer Associations (established in all sub-districts except Nong Kaew of Roi Et) and Agricultural Cooperatives (none in Chaiyaphum) concentrate on agricultural activities such as the provision of education, techniques and finance. All in all, over 40% of the household heads surveyed belonged to at least one of these formal groups.

The Phuyaiban (village headman) and Kamnan (tambon man) are the local administrators at these levels. They are assisted by their deputies in their work and receive technical help from the Community Development worker, the agricultural agent and from officials at the district level. School teachers, temple abbots and rich farmers are often influential persons and usually serve as community council members*. They play crucial roles in village decision-making. However, in some communities, these people compete with each other for political-economic domination and usually draw upon informal entourages on the basis of either kinship or patron-client relationships. Such competition for power takes the form of factionalism. It is, however, an inherent attribute of popular participation and serves the function of stimulating more public accountability by those who hold local level offices.

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*Charles Keyes 1970 Local Leadership in Rural Thailand Local Authority and Administration in Thailand, edited by F. R. von der Mehden and D.A. Wilson. Academic Advisory Council for Thailand, p. 100.

During these recent years, the attempt to strengthen local self government at the tambon council level has been promoted by various activities including the Rural Employment Generation Programs and several development projects by the Community Development Department. This evokes political consciousness, both within their community and at the national level, among villagers.

As has been briefly discussed in earlier project documentation*, the economic conditions in the Northeast are, in general, poorer than in other regions of Thailand. More specific description of the economic situation in the selected tambons will help to understand the villager's economic concerns. In the recent study in the project areas**, it was found that socioeconomic characteristics are highly differentiated within villages, among villages as well as among the tambons. We will discuss each here. Differentiation among villages is likely determined by duration of the establishment of that village. For instance, a village which has long been set up in the area tends to be better off economically because the older generations could clear good quality large areas of virgin lands for cultivation. On the contrary, a poor village which has recently been established usually consists of poor migrants mostly from other rural areas in the Northeast. The villagers of such communities usually have smaller and/or poorer quality land holdings and often earn their living as wage earners. Table 2 shows the number of villages and percentage of population in 3 hierarchical categories, based on local opinion and anthropological field investigation. The pattern of "poorer" villages among the tambons is similar to computer-sorting of the household survey data, confirming the anthropological observations.

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* Damrong Thandee and Pit Sompong 1980. Village Level Survey for Northeast Rainfed Agricultural Development Project. Submitted to USAID/Thailand.

** From the Household Survey for the NERAD Project conducted by OAE during August-October, 1980

However, differences among villages are only part of the picture. The field estimates of "poorer" villages in Table 2 account for only 18% of the population, but Figure 1 shows that the percent of poverty in these areas is actually much higher, with an overall average of 54% of the households below the poverty line.* Further, not all villagers in these poorer villages are below this line. In recent villages (less than 20 years establishment) average income is a good deal lower. About 5 to 10% of the NERAD population live in such villages and probably the vast majority are below the poverty line, but this still leaves the majority of poor to be found in the older, more established villages, where they are perhaps less visible among their better-off neighbors.

Differentiation within villages is apparent in the NERAD areas. In many villages, a minority of households control significantly more of the wealth than their neighbors, especially apparent in terms of land holdings. Unfortunately, intra-village data in the NERAD survey is predominantly not of large enough sample size to draw numerical conclusions (e.g. gini coefficient) about intra-village inequality, but by comparing Table 2 with Figure 1 one can at least state that the majority of poor do not live in easily distinguishable "poorer" villages. For example, Lahan (TB5) has, by any measure, very few people living in poorer villages (Table 2 shows 3.6% while computer sorting of NERAD data showed about 10%), yet it has the third highest percent of poverty in the NERAD tambons (63%, Figure 1). This means that a sizeable amount of Lahan's considerable income inequality, and the majority of her poor (See Figs 4 and 5) exist <u>within</u> the less-poor villages of the tambon. In Kwangjon (TB6), income is not as unequally distributed as in Lahan (see Fig. 5) but here too the majority of poor do not live in "poorer" villages (local estimate from Table 2 is 30%, computer figure by mean village income is 18%, but actual % of households below poverty line is 58%).

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* Poverty Line Projected from World Bank (1980) data of $99/cap. in 1976. Using inflation factor of 1.23, 1979-80 poverty line is approx. ฿2,400/capita ($120).

It can be seen from the above that poverty in the NERAD tambons is primarily an intra-village phenomenon, although significant "pockets" of poor villages are also evident in some tambons. In particular, a comparison of Figure 1 with Table 2 shows that in some tambons one might expect to reach perhaps half the poor by targetting on "poorer villages" in the tambon (in Kwangjon, Na Muang and Nong Kaew), but in the rest the project would have to adopt an intravillage focus to insure benefits reach the poor.

Inter-tambon data is also revealing. The most obvious conclusion from Figures 1 and 4 is that, at the tambon level, the richer the tambon the fewer poor it tends to have, although this is somewhat tautological given the high percent of poor in these areas (gini coefficients would have to be very high indeed for this not to be the case). On the other hand, income distribution within the tambon bears little or no relationship to the wealth of the tambon (Fig. 4), although when grouped by province surprising associations occur (Fig. 5). In Chaiya Phum, for example, clear differences in inequality exist at roughly the same mean tambon income levels, whereas in Roi Et the reverse is true. The apparent shifts in income and its distribution that appear in the bottom part of Figure 5 are a result of (per person) poverty occuring more frequently in large households. Also, a tambon like Taket (TB1) is actually wealthier on a per capita basis than it appears, due to its smaller household size (5.8 see Table 1).

What all this suggests is that poverty in the NERAD areas is likely to be a very complex phenomenon. It is not primarily a matter of inter-village differences within the tambon, but it does bear some relationship to tambon and province location (Fig. 1). But it is also very much an intra-village phenomenon. On the whole, then one should examine the causes of poverty in terms of locational factors above the village level (perhaps the primary characteristics of the province and the tambon), relationships within the village, and the individual characteristics of the poor households themselves. What then are some of these characteristics?

Due to natural environmental factors agricultural production suffers in two out of three years in most tambons. On top of that, the soil is generally poor in plant nutrients and crop productivity is quite low. Nontheless, most villagers try hard to get the best possible productions. Rice is the staple crop - non-glutinous rice being predominant in Tambon Taket, Tae and Lahan, with glutinous rice predominant in the other tambons. Most fields are planted with traditional varieties. Rice is also the major source of household income in all areas except Lahan, which has a scarcity of rice fields (see figure 3 and Table 3).

Cashcrops are another source of income but crops planted vary from tambon to tambon. The villagers of Nong Kaew grow watermelon, tobacco and onion in the dry season on the rice fields. The same is true, to a lesser extent, in tambons Tae and Taket of Si Sa Ket province, where various kinds of vegetables including chinese cabbage, onion, parsley and dill, string bean, large cucumber and watermelon are grown and sold to nearby amphoes and provinces. These three tambons have similar geographical conditions in relation to limited arable land and no more virgin land to be brought into cultivation. Fortunately, ground water is relatively high so that villagers can grow second crops in the dry season.

Cashcrops are a major source of income in Lahan because villagers cultivate vegetables including cucumbers, string bean, chilli, squash and pumpkin on the edges of the of 20,600 rai public swamp during the dry season. Lahan, like the other tambons of Kwangjon, Nathom, Na Ngua, and Na Muang have large public land where villagers cultivate cassava and kenaf. Fruit trees including mangoes, annona, papaya, banana, jackfruit, coconut and sour tamarind are grown around their houses. Usually farmers utilize no pruning, fertilizing or spraying and production is mainly for consumption.

The availability of public land of such tambons also provides grazing places for buffaloes and cattles - mainly native breeds, but there are some American Brahman crossbred animals. It is, however, found that only the richer farmers own 10-50 cattle and/or 10-20 buffaloes. Crossbred and

native pigs are also widely raised. The main problem is the high price of feed and the farmers' lack of knowledge regarding proper feeding and management. Local merchants collect pigs for marketing. Native poultry - chicken and ducks are raised by most families and are provided some waste rice by-products for feed. Farmers lack knowledge in disease control hence 90% of young poultry is lost.* Sale of animals usually fail after rice and cash crops as a source of income but is quite important in some areas, such as the project tambons in Nakhon Phanom.

The farmers, however, do not enjoy equal benefit from such activities, as cited earlier. The structure of net household income, shown in Figure 3, illustrates that on average the "poorer" household earns only one fifth as much as the "richer". Although the proportion of off-farm income is similar between the two groups, the "rich" earn more per day than the poor since the former engage in occupations such as local school teachers, civil officials and shop owners while the latter are mainly wage earners (ratio being 15:65 baht per day). Moreover, a number of poor farm family members travel extensively to seek wage employment outside their own communities, in both rural and urban areas.**

Such temporary migration largely results from limited means of production, especially cultivable land. Some villagers (10-20%) of tambon Kwangjon and Lahan, in particular, have lost their properties to local money lenders and merchants in nearby towns. The reasons are that, firstly, their crops suffered from drought several years in a row and they therefore had to keep borrowing more money and eventually were unable to pay it back. Secondly, the urgent need for cash makes farmers sell their crops before harvest time at a cheaper price (for "green" rice or "green" kenaf). Over half of the rice production of small landowners is sold by this system while the remainder cannot cover family consumption needs for the year. The villagers have to borrow money by putting up their land for

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* Northeast Regional Office of Agriculture, NERAD - Site Survey Report by MOAC Technical Specialists. November 1980, P. 90-103.

** Damrong and Pit, 1980 op.cit.

collateral. It is reported that 70% of the villagers in "poorer" villages of Kwangjon and Lahan tambons and to lesser extent other tambons, are in this debt circle. It should also be noted, however, that this practice of selling "green" crops also can help reduce farmer risk due to a late crop failure and can lower interest payments by allowing an earlier loan pay-back.

Public financial sources are presently available such as BAAC, and agricultural cooperatives, and they provide credit for a number of farmers (34%). However, the farmer's previous debt burden, in addition to the demands for credit for other family purposes, dilutes the attempt of such programs and the farmers are still in debt to private lenders.

The average farm size varies from tambon to tambon (see table 4). Those villagers of tambons in Nakhon Phanom (Nathom and Na Ngua) and Chaiyaphum (Lahan and Kwangjon) have larger land holdings than those in the other four tambons, but, unfortunately, the soil is relatively poor in Kwangjon and Na Ngua while 35% and 15% of land in Lahan and Nathom, respectively are subject to flooding. For those tambons in Si Sa Ket and Roi Et provinces, land holdings are relatively small but a larger proportion is also cultivated in the dry season. The renting of cultivable land appears in Kwangjon and Na Muang. There are about 2-5% of landless farmers in every village.

The average net household income is 17,529 baht and net household income per capita is 3,039 baht (See Table 5). The farmers of Nong Kaew enjoy more income than the other because of access to markets and more villagers involved in second cropping during the dry season. The opposite is true in both tambons in Nakhon Phanom, Nathom and Na Ngua, where their lands are less appropriate for cropping and their communities are located a long distance, 50 and 30 km. respectively, from major market places.

B. PROJECT'S SOCIO-CULTURAL FEASIBILITY

The project is deemed socio-culturally feasible in all aspects. By and large, the farmers are operating at a high degree of efficiency under their existing resources and constraints. The major problems encountered by the villagers are water and low fertility of soil. In the tambon of Roi Et and Si Sa Ket, farmers are able to manage the use of

water for second crops whereas other tambon, especially those in Nakhon Phanom, have far less access to water in the dry season. In such latter cases, the villagers have to travel a kilometer or so to find water from shallow wells and use small water tanks for household as well as animal consumption. There is an informal concensus among villagers of the utility of public wells and water tanks, especially those dug by themselves. However, the attempt to improve the fertility of soil is rather limited since the villagers' knowledge is minimal except for the use of manure. Many also use some fertilizer, but at very low application rates and often incorrectly. However, the villagers are receptive to any soil and water development programs.

In the project areas, it is found that the villagers have been using local technology in agriculture activities, and the use of modern techniques is rather limited. Mechanical power (tractors, hand-tractors, water pumps and electric tools as well as trucks) and chemical fertilizers, insecticides and herbicides are widely used by some progressive farmers. The method of using them is, however, somewhat inappropriate and they are often underutilized. The small farmers on the other hand tend to use more human and animal power. When they occasionally use modern technology, their methods are far less correct and efficient. The farmers need to be trained on how to use and manage such methods in the most appropriate manner. Training and demonstrations of appropriate and safe use of pesticides is especially needed. Moreover, they need to know how to utilize, conserve and improve their agricultural land as well as improved seeds and new-breeds of animals.

In order to achieve its goal successfully, the project aims at drawing upon more participation from the beneficiaries using existing local institutions. Problems and solutions suggested by the farmers to improve their situation will be taken into consideration in the project implementation. At present, a majority of villagers have already been involved in development project activities (table 6) but the level of participation is relatively minimal, especially for poor farmers. Due to a feeling of inferiority, they will speak up only when necessary. Moreover, the participation in agricultural projects is far less than it might be due to a shortage of extension personnel and a lack of demonstration materials. These cause the extension projects to be limited to only a small number of farmers.

The project will increase participation of the poorer sector by decreasing the number of farm families per TEA and provide more materials for agricultural demonstration projects. Therefore each TEA can work with more individual families with special emphasis on the poor farm families. Each TEA will also be assisted by the Co.F. who perform as leaders in test and demonstration projects and as agents of information for 10 farm families.* In present program of DOAE, the Co.Fs have selected one leader but the project will organize them into a group and its leader will become one of the Tambon Agricultural Development Committee members (TADC).** Apart from planning for agricultural development programs of the tambon, the committee will be involved in regular meetings with Nai Amphoe and his deputy, BAAC officials, and merchants at the amphoe level for amphoe agricultural development programs. Moreover, TADC includes responsibilities for subsidy schemes to the poor, storage facilities, etc. The essential role of this committee is to plan, implement, monitor and evaluate any agricultural development activities of the tambon during and after the life of the project.

With respect to the extension demonstration scheme, the poor will be able to prove to themselves the merits of new technology on their own land. The farmers will initially have cash inputs provided for a small (usually 2 rai) demonstration plot. Such programs will certainly assure the sense of ownership among farmers and the willingness to pursue the use of new technology for their agricultural occupation after the conclusion of the project.

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* Co.F. are the farmers's representatives who have been selected in each village. They are those whom the extension agents will concentrate his effort in transferring practical agro-technology through the mod farm or the demonstration plots established in each unit of the community. (See Vorasak Pakdee 1980 Agricultural Extension in Thailand, DOAE).

** TADC is a new committee for agriculture development proposed in this project. Its members compose of a leader of Co.F. from each village, members of Tambon Council, CD worker and TEA being as a secretary. This TADC will plan for agricultural development programs of the tambon and will regularly meet with Nai Amphoe and his deputy, and merchants at the amphoe level, as discussed in the previous section. (TEA = tambon agricultural extension agent).

Mobile units and mass media including radio farm forum programs and printed materials will back up technical assistance to the target area beneficiary. Radio seems to be the most effective channel of communication since nearly every household possesses a radio for daily entertainment as well as information acquirement. The regular circulation of the proposed newsletter on agricultural news (for example, price of fertilizer, insecticide, and other input materials), exchange news among farmers and description of successful farmers, and the like, will benefit the beneficiary in two ways. Firstly, they have access to information and knowing what is happening outside of their communities concerning their occupation. Secondly, such media, which is rather unavailable to many households in rural areas, will certainly help the villagers' literacy as well. The project will emphasis two-way communication among the project administrators and the villagers with special emphasis on the feed back of the latter.

The project covers the whole range of agricultural activities in the target areas where, in all cases, household income disparity is somewhat great. Therefore the benefit from the project may not be equally shared. Over 80% of total households control only half of the community wealth and over half of the population are living under "absolute poverty" conditions. The project aims at helping the poorer sectors and will facilitate the flow and equitable distribution of benefits. To achieve this objective, the local workers will concentrate on and arrange special programs for the poor by virtue of partial input subsidy schemes. Moreover, they will operate agricultural demonstration on small farmers' land, and recognition will be provided for those TEA and Co.F. who successfully provide benefits to as many more poor families as possible. By doing so, the method will in effect narrow the economic gap between the rich and the poor. On the other hand, most sub-project facilities are made available to all. In this regard, the villagers have equal access to such facilities whether they are poor or not. The merit of this method is that a particular group will not have a feeling of discrimination by the project. On the whole, the combination of these two methods will result in the most appropriate output in the project areas.

In comparison with farmers of other regions, Northeast farmers normally earn less income and are regarded as the poorest peasants in the Kingdom. If the project enhances farm family income and eventually helps to alleviate the poverty of the region, the equity among farmers of different regions of Thailand will also be promoted.

C. THE IMPACT OF THE PROJECT

The project intends to use area-based development with special emphasis on agricultural activities by developing the most appropriate method of development in each of the project tambon. The prime focus will be to enhance behavioral change in the various groups of people concerned, farmers, officials and merchants, who can work cooperatively through the proposed project design, in order to achieve the project purpose. During the first stage of the project, heavy agricultural development activities, including both technical inputs and direct interventions, will assist the beneficiaries. Two systems are primarily expected to improve: first, the cooperation among departments concerned with the management (delivery) system; and secondly, the ability of local organizations and villagers concerned with receiving/utilizing the assistance. Not only will the latter thereby be capable of absorbing improved technical inputs in their agricultural and related occupations, but they will also have the capability to enhance their level of living. Toward the end of the project, the enhanced assistance will gradually fade out while villagers and regular officials take up more and more responsibility for project activities. After the conclusion of the project the villagers will continue all beneficial activities.

It is expected that the beneficiaries will enhance farm family income through the improvement of their technical inputs and farm management skills built into the project through research and training. It is also expected that the value of home consumed products will increase.

The poor farm families will get the most benefit from the project through having closer contact with TEA and through obtaining partial subsidy of production inputs for agricultural demonstration plots. The learning-by-doing process is to enable them to utilize new technology for

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production in order to obtain better yields and thereby a better quality of food for home consumption as well as higher value of products sold. Such poor families will also enjoy the benefit of job creation in their agricultural occupation, during and after the project life. The research results on farming system will enable the farmers to improve the productivity of traditional agricultural practices.

The support of better information on use of farmer organizations, the institutional credit system, technical recommendations and inputs, and marketing information and analysis, will motivate the farmers to produce with greater effort since they will have convenient access to and benefit from such production information. In addition, those supports are to be channeled through existing organizations, thereby strengthening such local bodies' capacity to decide for their own community.

The success of the project can be measured in various ways: for example, by the increase of farm income compared to the benchmark data surveyed at the early life of the project and by better nutrition resulting from higher quality of home consumption products. Such success will convince MOAC to expand similar projects to other areas of the Northeast and other regions throughout the country. The MOAC is anxious to know the results of this project and intends to spread such improved methods of rainfed agricultural development to other areas.

Thus far, the foregoing analysis seems to stress the most optimistic impacts of the project. The rural poor will gain great benefits while several socially unfavorable phenomena, for instance migration to work outside their community, un- and underemployment, and the inappropriate manner of exploitation of natural resources will be dramatically decreased during and/or by the end of the project's life. It is, however, necessary to realize that there are several limitations which may influence the success of the project. Due to the fact that the project, by nature, is intended to be implemented through the existing social system, no new legislation on land reform, debt relief schemes, etc. are to be built in. Those who have control over greater means of production will be more able to benefit from the project as opposed to those who are landless, small landowners and/or

very poor. Moreover, those who are already in heavy debt may hardly be expected to catch up with those who are already better off. On top of that, erratic rainfall cannot be controlled hence farm production may be disastrous in any year, although the project attempts to mitigate the effects of poor rainfall. Finally, marketing which is a crucial factor, is somewhat beyond the direct control of the project. Consequently farmers may not always receive an appropriate share of the value of their products. Such above limitations can be major obstacles and may limit the success of the project especially in those activities involving new or expanded production of perishable produce.

In planning for this project, however, these problems have been taken into consideration and several methods have been proposed that will help increase benefit to the poor. First, project will attempt to examine the local marketing and input supply situation and problems of local farmer institutions, including cooperatives, farmer groups, etc., and provide training or other organization and management assistance where appropriate. Also, if market research shows, for example, the price of cassava will dramatically decrease, the project can increase emphasis on, for example, peanut and sugarcane. If the horticulture products are uneconomical due to high input and transportation cost, especially due to the increase of oil price, the farmers will be encouraged to grow other crops or to turn to other activities, e.g. livestock or fishery, which involve lower transportation costs. By doing so, the farmers can learn how to adapt to such changing situations. A major intent of the project is to develop more knowledgeable farmers and a better technical support system which will allow the agriculture sector to better adap to changes.

Second, it is proposed that a full-time anthropologist or rural sociologist be employed in project, whose job it will be to assess socio-cultural feasibility and degree of benefit to the poor and to make recommendations. The project has been designed to provide great flexibility in the type and mix of development actions. The anthropologist can assess these actions, prior to each being adopted for widespread extension, for their social effects, and enough flexibility in component type and mix exists to allow designing for socially beneficial strategies, in just the same way that technical and

environmental feasibility assessment will help design for technically feasible and environmentally sound strategies. CP's and covenants can be built into the project agreement for social feasibility analysis, in just the same way they are to be built in for technological and environmental concerns. The anthropologist should begin by studying the concerns delineated in this annex, and design methodologies and survey instruments to address these concerns on a local basis, in concert with the detailed planning of the project, step by step, area by area with careful attention right down to the intra village level. The anthropologist will also submit periodic reports on the causes of poverty in Project tambons.

D. ROLE OF WOMEN

The family system of the Northeast traditionally emphasizes both matrilocality and matrilineality. With this pattern, women become implicitly predominant in the control of property and, in fact, they are the household treasurer and always consulted in all family affairs. Thai women, moreover, have been regarded as hard workers because they work both in the family and outside. Apart from housework, they also feed and look after poultry, pigs and buffaloes.

In agriculture, the division of labor is relatively minimal since such work can be done by both men and women. Generally, men do the ploughing and carry things regarded as heavy work, while women plant and harvest. However, either sex can do any job if necessary. Women are heavily involved in marketing activities by carrying agricultural products such as poultry, vegetables, and fruit to sell both within their communities and in market places; men are more apt to have a major role in selling rice, kenaf, cassava, etc.

On the whole, women have an important role in Thai society and mothers are considered as goddesses who give life and sacrifice themselves for the welfare of the family. There is no socio-cultural barrier against women's involvement in any agricultural activity.

Women will benefit a great deal from the project. They will be trained in subjects in which they are interested and involved in the planning and implementation of various projects and sub-projects, for example silk production, animal husbandry, fishery and agriculture.

E. SPREAD EFFECTS

NERAD focuses on specific small areas of the Northeast so that principal spread effect can occur through replication in other rainfed areas as project processes are proven effective. Tambons were selected to represent the range of Northeast agro-ecological conditions to maximize applicability in this respect. Additionally, however, there are many aspects of the project which will contribute to spread effect, other than through later replication. (1) The project will utilize the agricultural extension structure at province and district levels (the province and district ag extension officers and their staffs). Effective innovations will thus have obvious spread effects throughout the districts of the 4 provinces involved in the project. (2) Many farmers have fields on the edges of tambons or have some fields in other tambons, achieving some degree of geographical spread. (3) All eight tambons are, or soon will be, on major routes, thus project activities will be noticed by many people who are not themselves residents of the target tambons. (4) Local merchants will be involved in the project - if they find project innovations rewarding they will certainly attempt to increase their trading base by spreading them to other areas. (5) The project will utilize radio programs as teaching vehicles. Because the eight tambons are scattered, radio coverage will have to be such that it reaches not just the eight tambons but also most of the Northeast. (6) The monitoring and evaluation system by being closely tied with the national agricultural extension system, will offer an excellent chance for successful applications in particular aspects to be componentially adopted as they are identified, prior to replication of the project itself. (7) Finally, the mix of various types and levels of spread effects discussed above can be expected to have a greater degree of "interaction" potential than would be the case if, for example, all such effects depended upon a particular discreet set of government officials in a single department. For all the above reasons, then, it is expected that the NERAD project will have a substantially greater potential for positive spread effect than would be the case with many area-specific development projects.

F. ENVIRONMENTAL CONCERNS

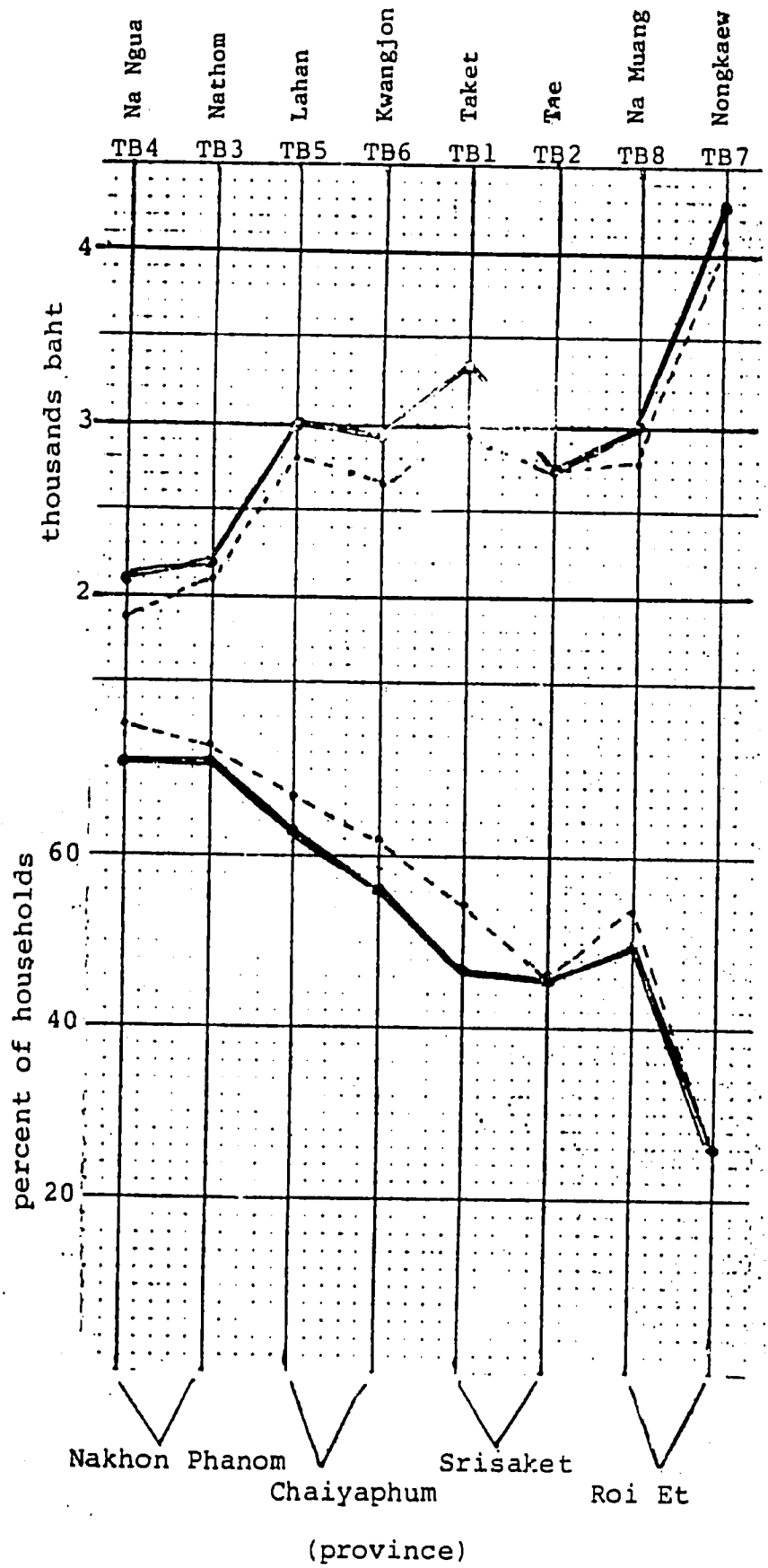
Principal environmental effects or social effects of environmental modification in this project are likely to be in four components of the project: (1) terracing, (2) paddy contouring, (3) water resource development, and (4) pesticides. Both terracing and paddy contouring are environmentally positive in that they promote more rational, economical and long-term sustainable use of environment, but they also are likely to have some difficulty in implementation. The challenge to terracing will be to reduce its cost to the farmer in order to make it attractive, especially on "public" land. The project will have to consider carefully the necessary degree of subsidization in this regard, carefully matched to the local situation. By the time this occurs in NERAD terracing in the Mae Chaem Project (North Thailand) will be well underway and can provide useful lessons. With paddy contouring, the challenge will be to interest the farmers to the extent that everyone in an area to be contoured will want to participate on a cost-sharing basis. Equally important will be to develop a system that insures fairness in any proposed land consolidation and reallocation. The project's proposed strategy (of demonstration contouring to generate interest, villagers' initiation for further contouring, and cost-sharing) is a good one. Project personnel should also carefully study the areas in Thailand where paddy contouring has been attempted and ensure the lessons learned are conveyed to farmers in the project areas.

Effects of pesticide use and water resource development cannot be foreseen at this stage and both will be covered by covenant or condition precedent in the project agreement. The types of water resource development to be employed are generally known but their specific mix and location will be determined by detailed surveying during the first year of the project. At that time environmental analysis will be undertaken prior to any construction taking place. In general no ill effects are to be expected, since in each case the small-scale waterworks envisioned (swamp rehabilitations, embankment dams, submerged dams, water filters and shallow wells) are of a type already built in the Northeast, in most cases of a type already existing in the project areas. Thus if any major unforeseen environmental effects were to occur, they would likely be a result of the number of waterworks in an area rather than the type of water work envisioned.

G. MIGRATION, FERTILITY AND POPULATION

The project should result in greater on-farm employment and thus reduce rural to urban migration for both men and women, but the degree to which this occurs will depend on how attractive rainfed farming becomes. Given the formidable constraints, one could fairly safely predict the project is not likely to start a rush to the countryside nor to the specific project areas.

Effects of the project on fertility within project areas are not foreseeable but no ill effects are expected. In general, the project areas evidence the recent rural success of family planning programs. Over 40% of the households surveyed used some form of birth control and, interestingly, this percent showed no significant variation across income classes, although there is fair amount of variation on a geographical basis. NERAD survey data will be used to study rural fertility and family planning and results will be made known to appropriate action agencies so that reasons for success can be better understand and lagging areas can be targetted.

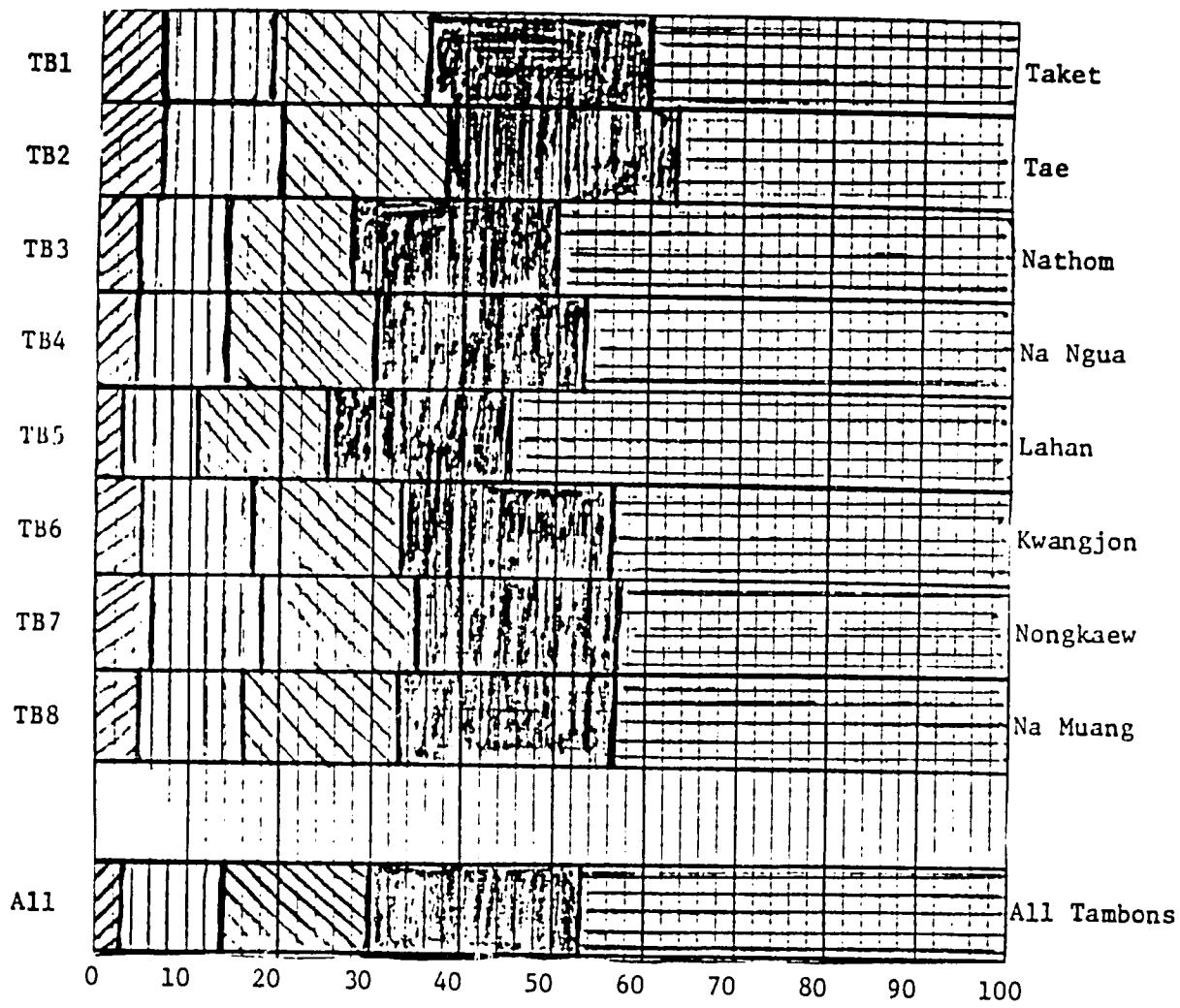


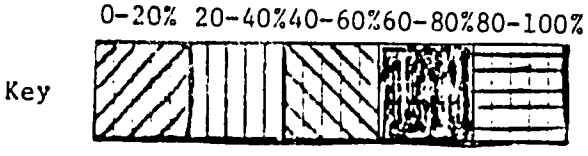
Mean Household Per Capita Income in the Tambon (dashed line is true mean per capita income)

FIGURE 1

Percent of Households Having Per Capita Income Below "Absolute Poverty" Line (dashed line is estimated percent of persons below the "absolute poverty" line)

HOUSEHOLD INCOME IN EACH QUINTILE - FIGURE 2





Population Quintile (% of households)

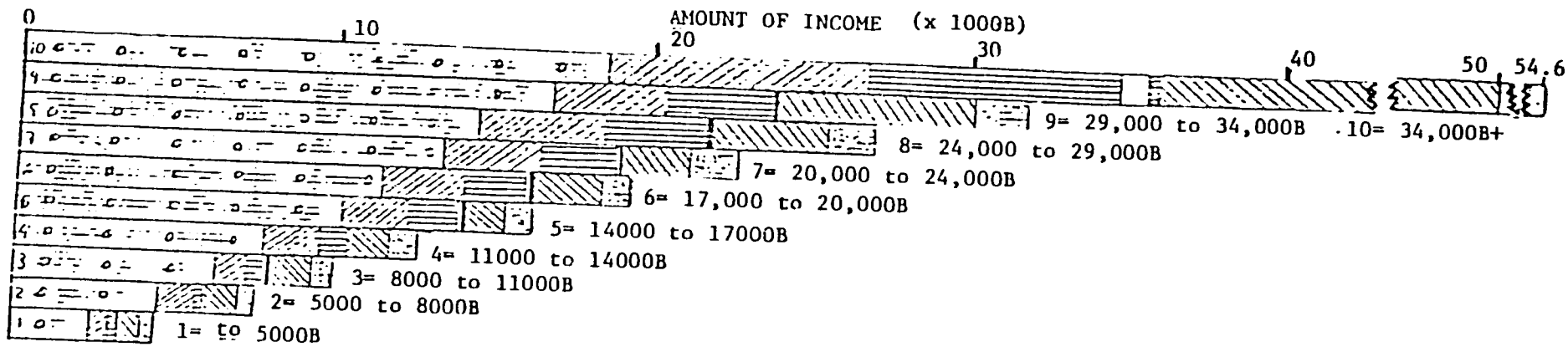


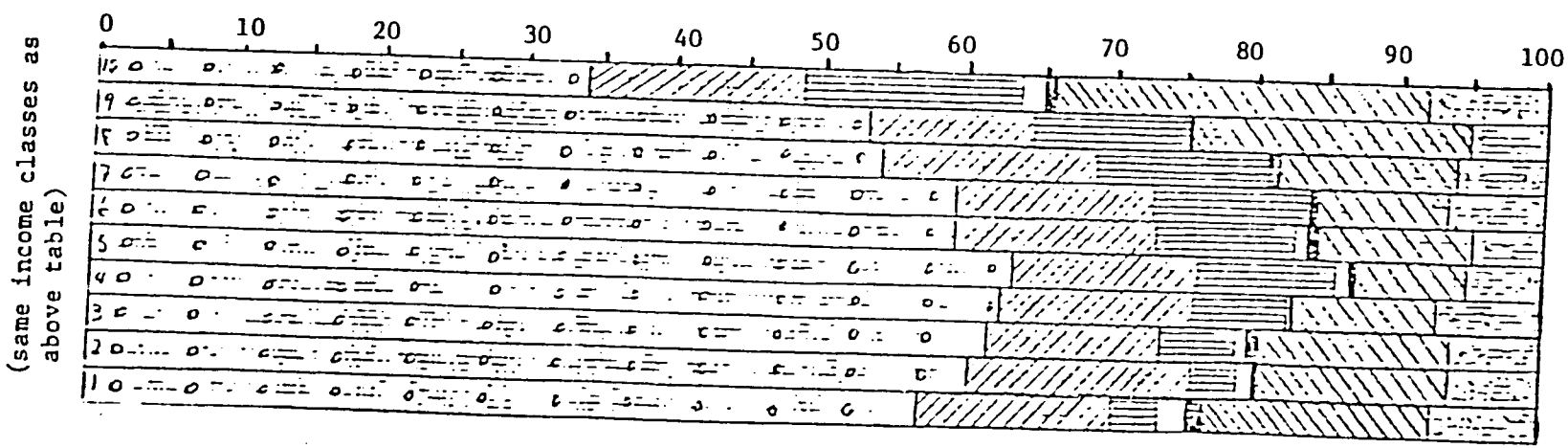
FIGURE 3

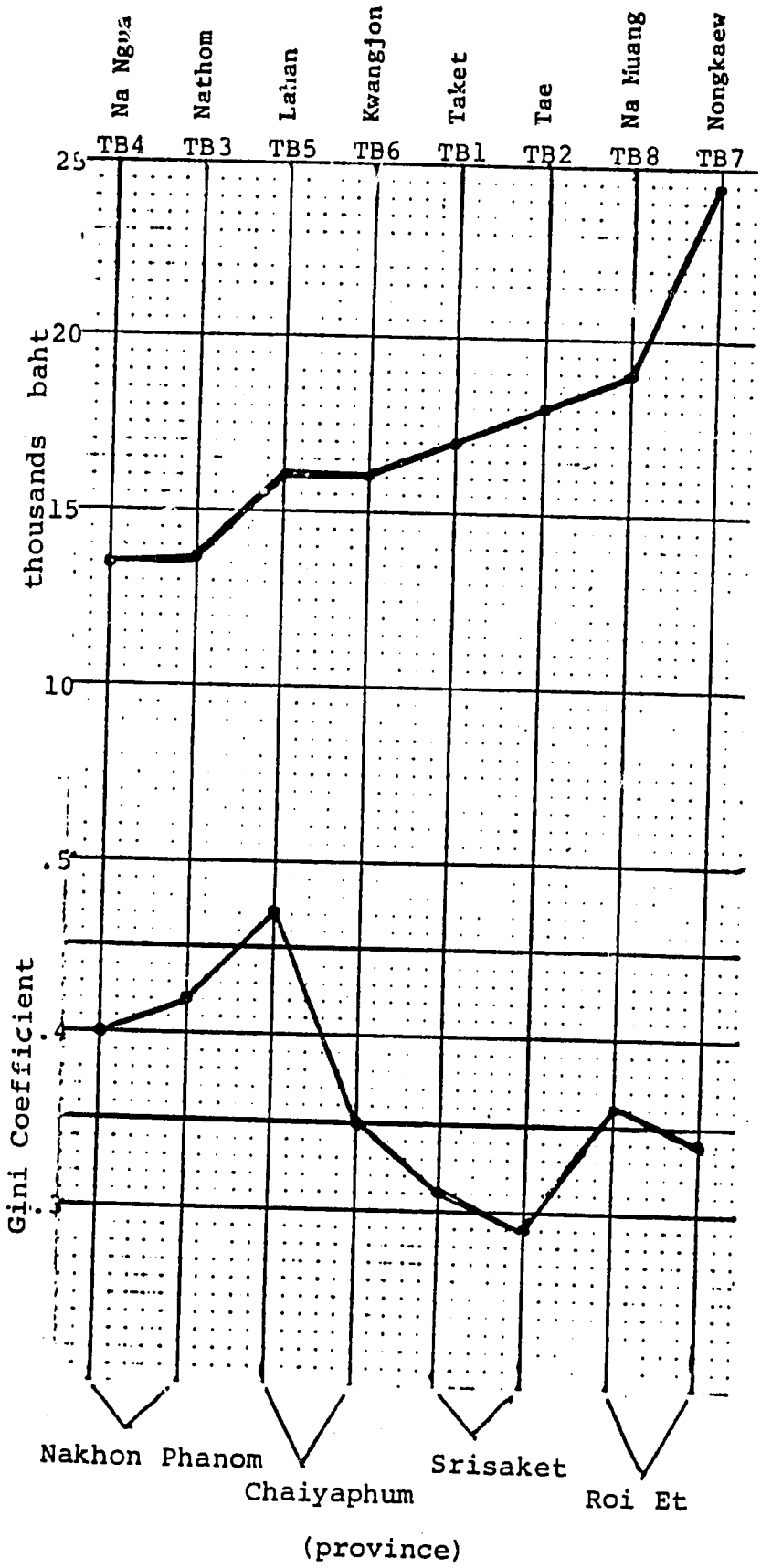
INCOME CHARACTERISTICS OF VARIOUS NET HOUSEHOLD INCOME LEVELS
(all tambons together)

Income Source:

- Net Rice Income
- Net Cashcrop Income
- Net Animal Income
- Rent Income
- Home Industry Income
- Off-Farm Income
- Misc. Income

PER CENT OF TOTAL

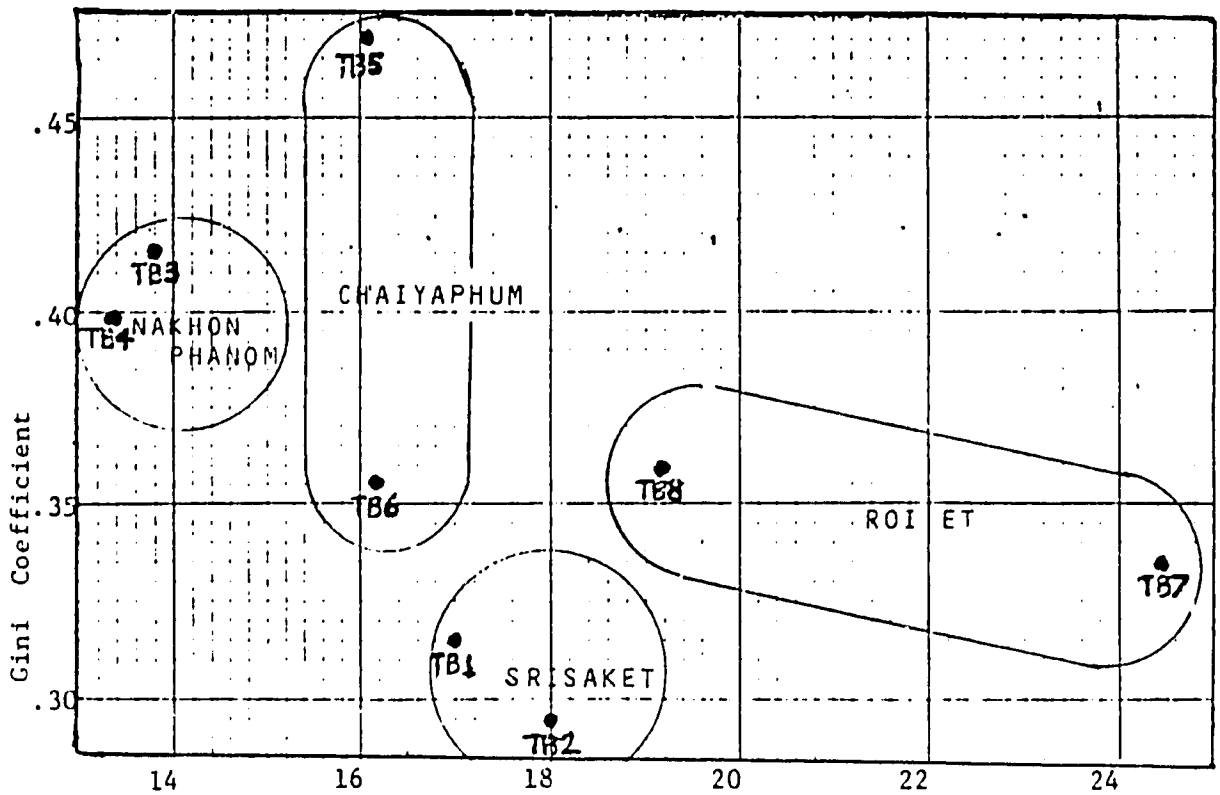




Mean Household Income in the Tambon

FIGURE 4

Gini Coefficient of Household Income in the Tambon



(above: Mean Household Income in the Tambon vs. its Distribution)

Income (thousands baht)

(below: Mean Household Per Capita Income in the Tambon vs. Distribution)

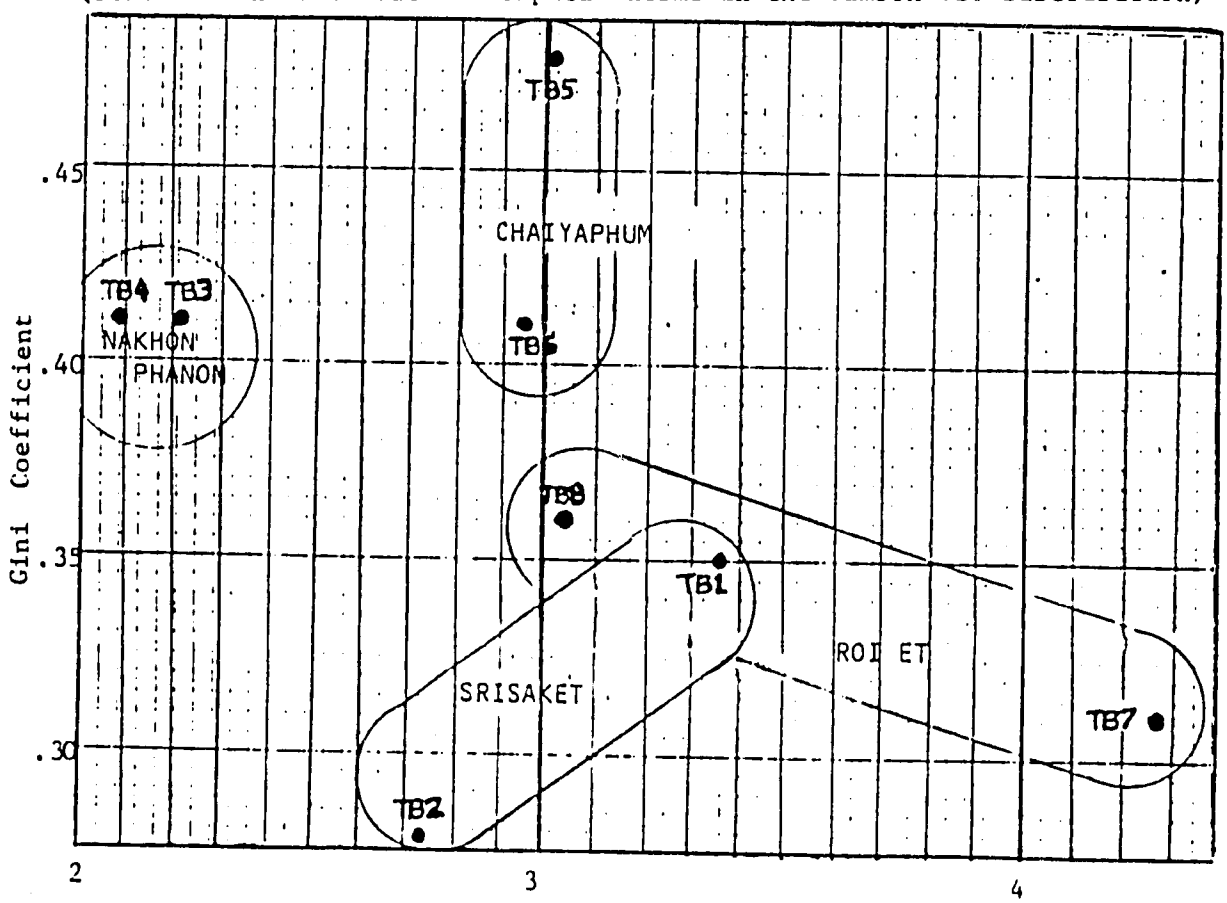


FIGURE 5 (see Figs 1 or 2 for code to tambon symbols)

Table 1. Population Distribution

Province	Tambon	No. of Village	No. of Families	No. of Population	No. of Population per Household*
Chaiyaphum	Lahan	11	1,617	11,183	6.9 (5.8)
	Kwangjon	16	2,564	17,886	6.9 (6.1)
Roi Et	Nong Kaew	21	1,539	8,950	5.8 (6.0)
	Na Muang	14	1,207	8,260	6.8 (6.8)
Si Sa Ket	Taket	12	530	3,428	6.4 (5.8)
	Tae	6	335	2,165	6.4 (6.6)
Nakhon Phanom	Na Thom	9	845	5,257	6.2 (6.5)
	Na Ngua	12	1,107	7,731	6.9 (7.1)
Total		101	9,744	64,860	6.6 (6.3)

* Statistics in this table are from Ministry of Interior and differ from those of the recent household survey. Nos. in parenthesis are from the survey. Smaller household size in the survey may indicate many people still "carried on the books" have actually moved away.

Table 2. Number of Villages and Percent of Population Classified by Estimated Average Household Income*

Villages	Poorer		Medium		Richer	
Tambons	No. of Villages	% of Pop.	No. of Villages	% of pop.	No. of Villages	% of Pop.
Taket	1	12	11	88	-	-
Tae	-	-	3	50	3	50
Nathom	1	16.5	4	20.7	2	62.8
Na Ngua	1	2	6	45	3	53
Lahan	1	3.6	7	51.7	3	44.7
Kwangjon	8	30	4	20	4	50
Nong Kaew	4	22.1	10	22.1	7	55.8
Na Muang	6	30	9	40	3	30

* The classification is largely based on personal observation and villagers' viewpoints on socio-economic differentiation among villages in their tambon. See Damrong and Pit 1980 op.cit. p. 13, 33, 53, 65, 74, 89, 100 and 112-114. The "poorer" category here refers to the relatively poorest village; The "medium" to village roughly equal in socioeconomic status about average for rural Northeast while the "richer" refers to a well-established village.

Table 3. Income Sources in Project Tambons by Income Class

	Taket	Primary	Secondary	Tertiary	Fourth
	Richer	rice 50%	off-farm 30%	cashcrops 8%	animals 4%
	Middle	rice 60%	cashcrop 20%	off-farm 11%	animals 4%
	Poorer	rice 60%	cashcrop 18%	off-farm 10%	home industry 3%
2.	Tae				
	Richer	rice 60%	off-farm 25%	animals 8%	animals 6%
	Middle	rice 55%	off-farm 23%	cashcrop 9%	animals 4%
	Poorer	rice 62%	cashcrop 14%	animals 9%	off-farm 6%
3.	Nathom				
	Richer	animals 30%	cashcrop 27%	rice 22%	off-farm 12%
	Middle	rice 65%	cashcrop 15%	animals 8%	off-farm 6%
	Poorer	rice 70%	off-farm 15%	miscellaneous 10%	cashcrop 1%
4.	Na Ngua				
	Richer	rice 40%	off-farm 30%	animal 10%	cashcrop 3%
	Middle	rice 60%	animals 20%	off-farm 20%	cashcrop 5%
	Poorer	rice 57%	off-farm 16%	animals 7%	cashcrop 3%
5.	Lahan				
	Richer	cashcrop 30%	off-farm 28%	rice 20%	animals 15%
	Middle	cashcrop 30%	rice 30%	animals 13%	off-farm 10%
	Poorer	cashcrop 35%	rice 23%	off-farm 20%	animals 7%
6.	Kwang Jon				
	Richer	rice 65%	animals 14%	cashcrop 8%	off-farm 6%
	Middle	rice 70%	cashcrop 10%	animals 10%	off-farm 5%
	Poorer	rice 72%	off-farm 12%	cashcrop 8%	rent 2%
7.	Nong Kaew				
	Richer	rice 50%	cashcrop 20%	animals 11%	off-farm 5%
	Middle	rice 60%	cashcrop 19%	off-farm 4%	animals 5%
	Poorer	rice 50%	cashcrop 18%	off-farm 14%	miscellaneous 10%
8.	Na Muang				
	Richer	rice 48%	off-farm 30%	animals 12%	cashcrop 5%
	Middle	rice 65%	off-farm 12%	cashcrop 9%	animals 9%
	Poorer	rice 66%	off-farm 14%	cashcrop 7%	animals 4%

Table 4. Cultivable Area

(rai)

Tambon	Average farm size rai	Average land owned rai	Farm size classified by three household income groups and % of land area planted in dry season		
			Richer rai	Middle rai	Poorer rai
Taket	21.5	21.1	27 (8%)	22 (12%)	11 (10%)
Tae	21.0	19.5	27 (8%)	17 (8%)	15 (11%)
Nathom	38.1	26.1	50 (10%)	35 (-)	2 (-)
Na Ngua	41.5	32.8	55 (5%)	44 (-)	28 (-)
Lahan	33.1	29.9	47 (10%)	38 (10%)	25 (12%)
Kwang Jon	33.2	25.2	60 (5%)	38 (2%)	21 (2%)
Nong Kaew	25.4	25.4	28 (22%)	23 (20%)	18 (24%)
Na Muang	23.5	14.4	23 (2%)	25 (6%)	15 (10%)

Table 5. Net Income

	Household	Household per capita
	฿	฿
All tambons	17,529	3,039
Tambon Taket	16,969	3,355
Tae	18,040	2,731
Nathom	13,762	2,188
Na Ngua	13,424	2,096
Lahan	16,146	3,012
Kwang Jon	16,160	2,947
Nong Kaew	24,450	4,295
Na Muang	19,188	3,020

Table 6. Participation in Development Projects

	Yes %	No %	No answer %	Missing Data %
Ever participated in development projects	96.5	3.5	-	-
Ever suggested anything for development at a meeting	39.3	60.7	-	-
Ever participated in an agricultural demonstration project	12.1	87.6	0.2	0.2

Source: Household Survey for NERAD Project, during August and September, 1980 by OAE

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ANNEX VIII

PROPOSED INSTITUTIONAL ARRANGEMENTS FOR NORTHEAST RAINFED AGRICULTURAL DEVELOPMENT PROJECT (NERAD)

This proposal has taken into account the desire of the Ministry of Agriculture and Cooperatives to introduce this area-based integrated agricultural development project in the most effective way possible. In doing so it assumes that a streamlined and low-cost model will be most suitable for a developing country, which hopes to replicate this pilot into more areas in the near future. It also assumes an MOAC policy to decentralize some of its functions to the locality insofar as this can maximize benefit to the target population without sacrificing the national interests and the ministerial goal. The format which follows thus would include some innovative ideas which may not have been found earlier in the conventional approach. Thus some strenuous effort will be needed to put them into practice. In performing this function, the proposal is divided into two major parts--the institutional structure and the accompanying procedural requirements.

However before these are presented a background of existing administrative arrangements and management as well as major problems of these will be provided.

A - BACKGROUND AND MAJOR PROBLEM OF ADMINISTRATION

In Thailand the responsibility of agricultural development mainly rests with the Ministry of Agriculture and Cooperatives (MOAC). The ministry is composed of 19 secondary units, whose status are either specialized departments or public enterprises. These units are (1) Office of the Under-Secretary of State, (2) Office of Agricultural Economics, (3) Office of Land Reform, (4) Royal Irrigation Department, (5) Department of Land Development, (6) Department of Agricultural Extension, (7) Department of Fisheries, (8) Department of Livestock Development, (9) Royal Forest Department, (10) Department of Agriculture, (11) Department of Cooperative Promotion, (12) Department of Cooperative Auditing, (13) Marketing Organization for Farmers, (14) Cold-Storage Organization, (15) Forest Industry Organization, (16) Rubber Estate Organization, (17) Office of Rubber Replantation Aid Fund, (18) Fish Marketing Organization, and (19) Dairy Farm Organization.

Some other agencies outside the MOAC are also involved in agricultural development activities, such as Department of Local Administration, Department of Community Development and the Office of Accelerated Rural Development, all of the Ministry of the Interior. The Changwat Administrative Organization, which is a local autonomous body, also provides some funds for agricultural development in the province.

Work initiative and project planning are normally undertaken by separate departments and public enterprises, and in many cases even by their numerous divisional-level units within their own spheres of work. Multi-year development projects have to be reviewed by the Office of the National Economic and Social Development Board, before each year's request for funds is submitted by the respective agencies to the Bureau of the Budget. However, here the line item budgetary procedure is still being used.

After funds are approved by the Bureau of the Budget, they will be controlled by the respective departments or public enterprises. These organizations then distribute them, as they themselves see fit, to their various implementation units in the provinces. Implementation will be carried out by the field units of each department or division, which are located at different levels of provincial areas, (regional, provincial or district). Some departments or divisions have more field units than the others, depending on the volume of work and type of activities which are to be undertaken in each area. The field units report either directly to their respective superior units in Bangkok, or indirectly through the governor, who is the chief executive of the provincial government. The provincial government is a jurisdic body and in principle a unified field unit of the central government, but in fact, many activities are operated by central government units outside of the governor's control. (See footnote of Chart No. 1).

The provincial governor is supposed to be generally responsible for the welfare and well-being of the people in his area. He supervises all the officials appointed to provincial government, such as the agricultural extension officer, the livestock officer, the fishery officer, or the forestry officer, but officers of the Land Development Department or Department of Agriculture are not officials of the provincial government.

A province is divided into several districts and subdistricts, which in turn are further divided into tambons

and villages, respectively. The district officer supervises functional officers at the district and sub-district levels, while there are no government offices at the tambon and village levels. At these two levels, however, there are people's councils and committees, and some government officials are designated to operate in particular areas, such as tambon agricultural extension officers, or community development workers.

Decision-making regarding development strategies, operating procedures and the amount of funds or supporting facilities to be allocated to each area for particular projects rest with the departments or divisions in Bangkok. If problems emerge upon implementation, the field units will have to solve the problems themselves within this resource constraints, or to report them to their superior units in Bangkok in which case resolution usually takes considerable time especially if funds not already budgeted, for example, to replace a major piece of equipment, are required.

This specialized functional approach to development planning and implementation cannot provide adequate stimulus to assist the farmers out of the vicious circle of minimum natural resources, minimum inputs and minimum production, because each agency has a limited scope of responsibility, their projects have limited impact upon the farmers' life as they entitles. For instance, the Department of Agricultural Extension is responsible for crop promotion, the Department of Fisheries for fish-raising and the Land Development Department for soil conservation and water improvement. If in order to increase productivity, these activities should be implemented together as a package, it cannot usually be done because the local field units do not have authority and resources to collectively plan and implement projects. Rather they have to report to their respective headquarters in Bangkok and it is unlikely that the three components would have the same priority at the same time in the three departments.

The highly centralized decision-making structure of the Thai bureaucracy has been found to be inadequate and untime in effectively addressing the environmental conditions and farmers' need which differ from place to place. Attempts to carry out highly dispersed programs with centralized decision-making also overloads the supra-structure with paper work. Elaboration of development strategies and operating procedures as well as resource allocation of each project should be made to suit a particular area. At the

local level intensive and closer contacts for immediate action are needed if achievement is to be evenly or broadly attained.

The Thai government has the policy to decentralize planning and implementation from the center to the region and the locality. More area-based integrated projects, where several departments are required to plan and work together, are being conceived to remedy the situation discribed above.

The Office of the Under-Secretary of State of MOAC has, in addition to some divisions in Bangkok, four regional centers, which are planned to be responsible for overseeing the interests of the Ministry of each region. According to the study carried out by the National Institute of Development Administration, the regional center should be the appropriate agency to handle integrated development projects which require several agencies of MOAC to work together in a harmonized way.

In contrast to the conventional pattern of setting up a special organization at the central level to handle each special project in the regions, the regional centers have been given some role in handling area-based integrated development project. Since this is a new concept there is need for improving the techniques of organizing and managing this kind of projects. Often project management has been unable to effectively coordinate the efforts of the participating agencies, mainly because the project manager does not have enough administrative support and has little authority over financial resources. Funds to be used in the same projects are separately requested and allocated. They are reviewed separately by different personnel in the Bureau of the Budget, each one of whom cannot see the picture of the whole project. Therefore funds received are not granted project-wise, rather they are mixed in the line item budgetary statement of the department and may be used for any of the purposes of such department. Minimum advanced administrative techniques are usually employed. Project personnel have few incentives to work harder than their ordinary manner. There is no agreement of how to measure and reward their performance, and some personnel are not appropriately selected to suit the particular needs of the project.

The institutional arrangements for NERAD will attempt to remedy these problems as far as it is feasible.

B - THE INSTITUTIONAL STRUCTURE

Although it is new in nature, the NERAD Project is one of several development projects of MOAC. It must relate its goal to the overall goal of the agricultural sector of the country, and at the same time it will be implemented at the lowest possible level. The chain of relationships linking both ends should include four institutional levels, namely the ministerial, the regional, the provincial, and the field levels. Their respective functions should be as follows:

The Ministerial Level

This level is needed to provide policy guidelines which include both the development goals and strategies, and the principles governing the management of the project.

The Agricultural Policy and Development Planning Committee is the highest integrative body in the agricultural sector of the country. This committee is chaired by the MOAC Minister, and the Secretary-General of the Agricultural Economics Office is the secretary of the Committee. All the top leadership of MOAC and high-ranking representatives from the planning and resource allocation organizations sit in the committee. Its duty is to review agricultural conditions, analyze problems and recommend development policies as well as major projects. The Rainfed Agricultural Development Policy has to emerge from this committee. This project must be screened and approved by this body. The relationship of NERAD with other projects can be deliberated upon fruitfully in this committee.

An MOAC Committee on Northeast Rainfed Agricultural Development will be established with the Deputy Under-Secretary of State of MOAC as chairman, and high-level representatives of every department in the MOAC as members. This will be the appropriate place to work out the NERAD detailed policy. The committee will be responsible for the guidance of the NERAD operations and the decisions of inter-departmental issues, such as on personnel positions and assignment, budget allocation, division of responsibility and authority and development strategies and techniques. It also has the responsibility of coordinating this project with the other related high-level committees.

Specifically it has to review the project plans--a six-year as well as a one-year plan, substantive as well as administrative contents. Personnel and financial policies

of NERAD will be decided there. The collective responsibility for the successes or failures of the project should be stressed among the committee members. The committee also reviews and acknowledges the operations plan prepared by the project director, since some orders and authorizations may have to be issued by separate members of the committee to their subordinate units for implementation.

This committee however may be enlarged somewhat beyond the MOAC if their role is to be more effective. Additional members which should receive attention are: (1) The Deputy Under-Secretary of State of the Ministry of the Interior, which supervises the provincial governors in development affairs. This action will make this project management comply with the new government policy of decentralization, and will facilitate the cooperation of the provincial authorities in participating full-fledgedly in the project. (2) High-ranking representatives of the BAAC and MOF may also be included as credit and marketing aspects can be assisted by these organizations.

In order to assist in the deliberation over the detailed policy guidelines as well as in reviewing the plans or budget and other requests submitted by the project director a working group should be appointed as a sub-committee of the NERAD Committee. It can be a temporary or a project-life sub-committee as deemed appropriate. In the former case specific assignments may be given to different specific groups, and the secretary of the NERAD Committee is to keep all the deliberation and papers with him, in order to keep things relating to one another without interruption.

The Regional Level

The regional center is an appropriate place to direct the integrated development project in the respective regions, in which several departments of equal status have to participate. The regional center specializes in the region and stands closer in terms of distance and level of administration to the farmers than any organization housed in Bangkok.

The NERAD Project Management Center should be set up as another ad-hoc unit of the regional center. Its responsibilities are to harmonize the works which have to be carried out under the NERAD Project. Basing their functions on the policy guidelines issued by the NERAD Committee, the project

management translates those wishes into concrete action. In this connection it has to prepare the project plan and overall operations plan. It has to calculate investment costs, which are needed to back up the various development activities which will be identified. After these have been assembled, the project management has to pass them to the NERAD Committee to approve and support the project. After the project plan is approved, the project director will assemble the general site-specific operations plans into the overall project operations plan and submitted it again to the NERAD Committee for approval. The NERAD Committee will inform all participating parties of what has to be done by each party under the plan, which has been jointly reviewed. The project manager will keep watch of the operations so that achievement will not deviate from what has been agreed upon.

To undertake these responsibilities a project-directing and management staff has to be appointed, and the following positions are recommended:

(1) A project director as senior as C-7 or C-8 level officer

(2) An associate project director at C-6 or C-7 level

(3) Subject matter specialists, in soil and water development, alternative cropping and farming system, agricultural economics and marketing, planning and management systems, and one or two others. They may be foreigners or Thais

(4) An administrative officer

(5) A financial and accounting officer

(6) A publicity officer

(7) A typist and material reproducing officer

(8) Few auxiliary personnel

With the exception of special contract, all these personnel should work full-time and be stationed at the Northeast Regional Office of Agriculture.

The specialists may be assigned by MOAC departments, or may be individuals or institutions which are contracted by

the project director with the authorization from the NERAD Committee to perform a specific function. They may be hired to work either for a specified period of time or for a particular piece of work. The institutional contract is appropriate for such kinds of economic, marketing or feasibility surveys or researches. Where possible the in-country specialists should be used.

There are however some needs for expatriates in such positions as project coordinator, specialists on management design, economics and farming system research, who will be with the project for a long period of time. It is also likely that some expatriate short-term specialists will be needed to help give the project an initiating spark. This should be agreed upon by the project manager and the NERAD Committee.

While obtaining expatriates is not seen as posing any problem of appointment, past experience with Thai specialists' participation in special projects proved to be the contrary. Those who would best fit the work were either not available or not encouraged to join the project. NERAD requires able Thai subject-matter specialists who would be drawn from different agencies. They should be the ones who have gained sufficient knowledge and experience in those particular fields. This type of personnel is rare. Normally they would be assigned by their superiors to play major roles in their own organizations. As a consequence they will not be easily released by their superiors for a long period of time, if ever. In order to make it possible for NERAD to acquire the service of these well-qualified personnel, it is recommended that these personnel are appointed to work either for a specified period of time or for a particular piece of work. They may work full-time or part-time depending on the opportunities on which both their own agencies and NERAD project's requirements allow.

Specialists who work for the project either for a long or short periods of time are expected to work closely and consistently with one another in the technical office of NERAD. A periodic meeting should be part of the institution, with the project director acting as chairman.

The Provincial Level

The province is an administrative unit of the central government, where a provincial governor has been given the authority to supervise all government officials in the areas. It is the policy of the present government to give to him more responsibility in development activities which would be carried out in each respective province. Although the functional superiors in Bangkok have the most to say in personnel, project and financial decisions, the day-to-day work has to be done under the surveillance of the provincial governor, who can assist in expediting works or in solving problems. The governor also supervises the district administration, the tambon and the village headmen. He is expected to be very familiar with the needs of the loca people.

It is thus proposed that a provincial implementation sub-committee on NERAD be chaired by the provincial govenor or his designate. The committee will have the responsibility to recommend local needs and resource feasibility and assist in preparing the site-specific operations plans, which is the responsibility of the field manager. The provincial committee, however, will review and approve the operations plan before transmitting it to project director. When the plans are approved by the NERAD Committee and the project director, the Provincial Committee will be required to assist in facilitating the operations of the project in accordance with the plans, mainly in mobilizing their available resources to fulfill their respective commitments. It will monitor project performance and assist in solving the provincial level problems. The members necessary to help the governor to take this action effectively should include the provincial treasury officer, the relevant representatives of each MOAC department, and the chief district officers of the target areas. NERAD must provide the secretary of this committee, who will also act as the field manager (FM) in each province. The secretary should be an official of C-6 official grade and both management and technical abilities are expected of him. He will play the key role in pushing to get work done and to convey operations problems which are beyond his abilities to solve to the committee for joint resolution. The governor will have the authority to issue the appointment orders, upon nomination by the project director for provincial level personnel. He may appoint additional provincial officials other than specified, if he sees that these would help to better accomplish the project.

It should be noted that no major changes in the operations plan may be made before being authorized by the NERAD project manager.

In order to intergrate NERAD with other provincial development projects, it is recommended that this committee is to be considered as a sub-committee of the provincial development committee. In this connection it is desirable to have the representative from the provincial planning office as a member or an assistant secretary.

The Field Level

The implementation of NERAD in each province will be directly supervised by the field manager, whose authority comes from the mandate of the provincial implementation committee. He should be assisted by a subject-matter technician drawn from the Provincial Agricultural Extension Office. This is necessary to acquaint the latter with the kind of NERAD work, which has to be taken over by this office once the NERAD project is completed. The field manager and his assistant would be the first line of technical resource over the tambon and district-level personnel before referring the more difficult matters to the subject-matter specialists who will be housed at Tha Phra.

The NERAD project director will nominate the field managers, who are officers of the project, to the governor of each respective province. The governors will in turn make recommendations to the NERAD project director about the performance of the field manager in his province.

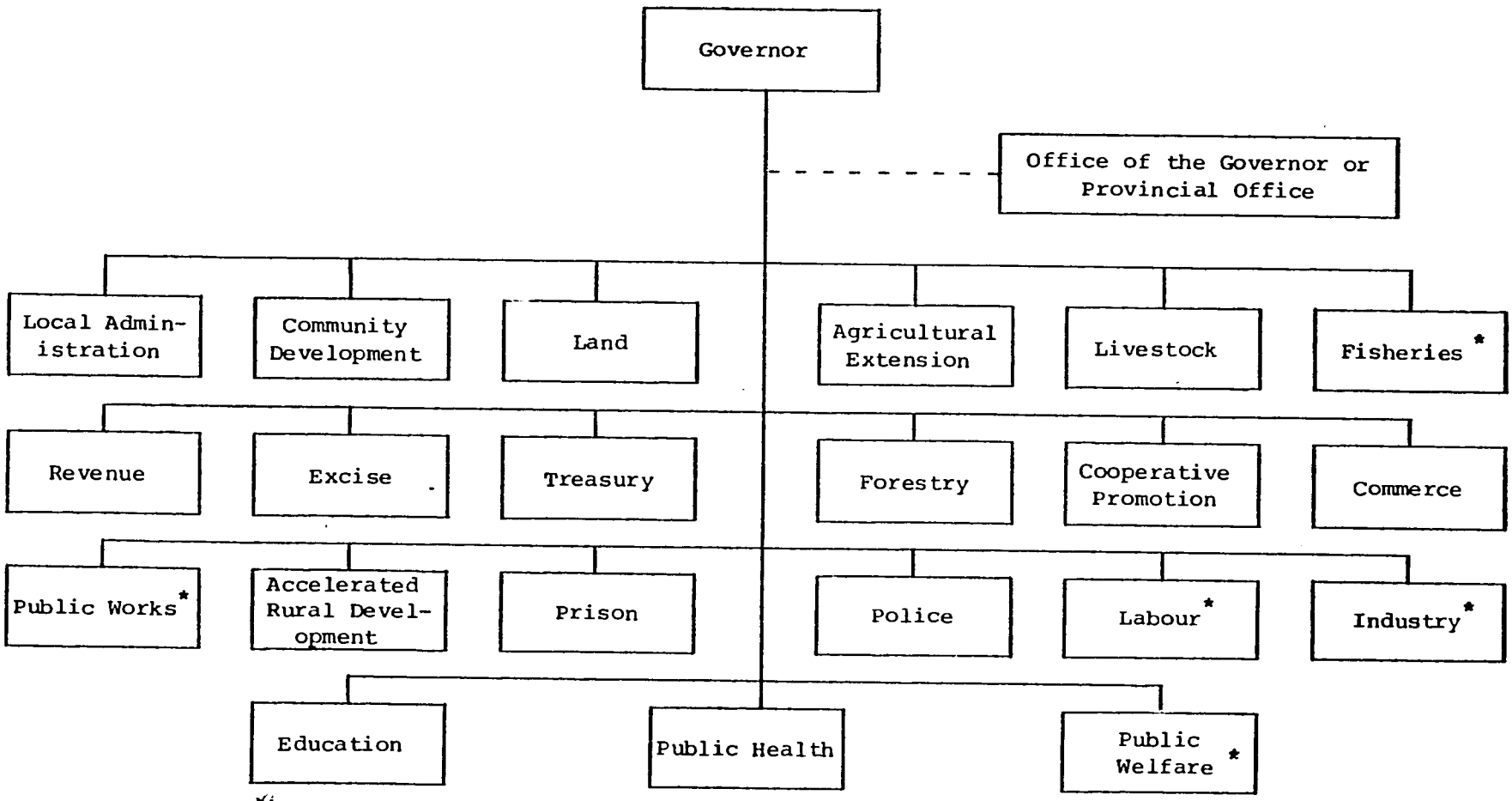
The field manager will coordinate his work closely with the chief district officer, who has extensive authority over all officials at the district level, as well as over the tambon and village headmen. His main responsibilities are to coordinate the activities of the participating agencies, to make sure that the operations plan is implemented, and to prepare the necessary agenda to be discussed monthly by the provincial sub-committee.

The operations personnel at the field level will include the tambon agricultural extension officers, the community-development multi-purpose workers, the designated livestock, fishery, forestry, land development and other officers having responsibilities relating to agricultural development of the province. All these personnel should be assigned specifically by a provincial order.

CHART NO. 1

ORGANIZATION OF PROVINCIAL GOVERNMENT

Provincial Level



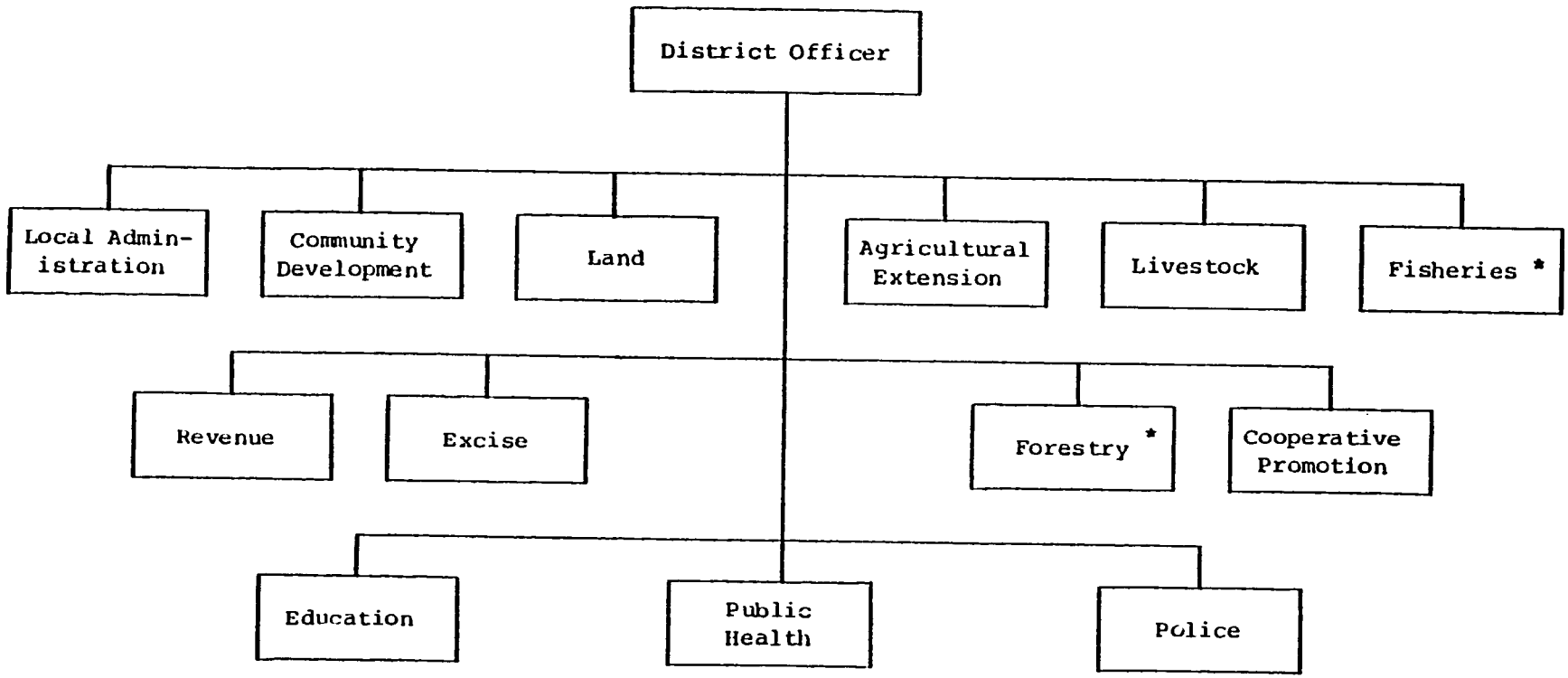
* There are many provinces, which still do not have these field units.

Note: Land Development Centers, Irrigation Units, Experimental Stations, Animal Clinics, Livestock Stations and Fishery Stations are not under the control of the provincial governor.

CHART NO. 2

ORGANIZATION OF PROVINCIAL GOVERNMENT

District Level



* There are many districts, which still do not have these field units.

C - THE PROCEDURAL REQUIREMENTS

The following procedures are expected to be established as necessary components of the institutional arrangements of the NERAD project. They are (1) new working relationship, (2) personnel selection and recruitment, (3) performance-induced incentive system, (4) esprit de corps, (5) working group method, (6) planning-programming-budgeting management, (7) project accounting and performance report, (8) monitoring and evaluation, (9) local participat. n and (10) transfer procedure to normal operations.

New Working Relationship

There must be an understanding and agreement that the area-based integrated approach to development management calls for shared responsibility of the participating agencies in a project environment. It is an environment which focuses on project goal and requirements and on the beneficiary. Everyone is a necessary part of the project organization and each needs the others to help the project achieve its goal.

What these mean are the following:

(1) that members of the two inter-departmental committees at the national, regional and the provincial levels, (the NERAD Committee and the Provincial Implementation Sub-Committee) have common responsibility, and are entitled to fully participate in decision making concerning the project. The operating personnel at the field level also should be made aware of the fact that NERAD is one of their direct assignments--a new one in a new form. The fact that they have a NERAD field manager and his assistant as additional supervisors does not mean that they will be overworked, since the NERAD site-specific operations plan and the field working schedule have been worked out in consultation with the regular line officers concerned before being put into practice. The field manager and his assistant will limit their supervisory responsibilities only within the agreed site-specific operations plan and field-working schedule.

(2) that the highest-level officials in the various MOAC line departments concerned in Bangkok must be willing and sincere in supporting and encouraging such kinds of action by their subordinates, since each of them is sharing partner of NERAD.

(3) that the Office of the Under-Secretary of State, the NEROA, and the project director must also be willing to share their authority and project goodwill with the participating agencies. The division of authority in handling the project depends on the extent to which the responsibility and performance are epxected from the latter.

(4) that other participating agencies must also realize that the project needs unified direction and control in order to ensure accomplishment of set goals and the most effective manner of operations possible. Thus the project director has to play his role insofar as it can assure success and smoothness of operations. At the same time he has to provide sufficient liberty and flexibility within the framework of the operations plan to the implementation management and personnel. The project director will not have any supervisory authority over the provincial implementation sub-committee; rather it is his responsibility to see that the committee works within the formal agreement.

Since dual supervision is necessary at the provincial level and below, the governor, the members of the implementation committee, and the chief district officer have some powers to see that action is taken and the project director has to closely monitor the action in order that it may work according to the plan. Conflicts may arise from difference of opinions, but these should be considered as normal conditions of an integrated project, and should be resolved with goal and efficiency-oriented criteria. The rule of the game appears to be a given-and-take principle. One cannot force others to be responsible or devote their efforts to the fullest extent to the project, or expect a great effort if at the same time they are not given credit for their efforts.

Personnel Selection and Recruitment

NERAD presents another attempt of the MOAC to justify the role of ROA as a center for interdepartmental projects. It has to establish a certain landmark and prestige, whose success depends on efficiency. Thus a personnel system has to be adopted for project specific requirements.

The first consideration concerns the acquisition of specialists other than those available from the Office of the Under-Secretary of State, which in this case is the parent organization. The specialists may be obtained from various MOAC line departments, the Regional Office of

Agriculture, the universities, or abroad, but their participation in the project should be as full as possible. They can be borrowed, if certain agreement is reached at the ministerial-level committee, but their willingness to devote themselves to the project should be reckoned with. Returns to their expected devotion to the project should be sufficiently attractive. If they are government officials, their needs will be salary and grade promotions, and the answer to which has to be set by the NERAD Committee. Prestige for participation in the project and extra monetary reward can be other factors which should be installed in the project. The degree of honor to these personnel will certainly depend on the expectation the policy committee has from the project achievement. They should go hand-in-hand.

Secondly, the project requires full-time project staff, which ranges from the project director to the additional officers in the field. These personnel have to have certain qualities, as follows:

(1) The project director has to be an innovative administrator-cum-specialist, since he has to face a variety of heretofore-never-happened situations and problems, which challenge his pioneering ability. He has to have certain status and experience in order to gain acceptance from both the participating officers and the villagers. He has to work with the provincial governor, members of the governor's committee as well as the officials designated to operate in the field, over whom he has no formal authority to directly supervise or to enforce action. He has to use persuasive arts to get along with these people and convince them to devote their efforts to the work. He has to be an achievement rather than authority-oriented person.

(2) The field manager is a key factor which this project emphasizes at the implementation level, with the expectation that he will be directly responsible for the accomplishment of the operations. The field manager should have a certain level of experience and a university degree in agriculture. He cannot be newly-recruited to be in such a key position. He will be both the manager and the technician. He has to backup the technical knowledge of the personnel at the tambon and district levels. He must also be active and devoted, since the nature of work for which he has to be responsible requires much of such abilities. He must also be able to get along with officials and the people in order to achieve maximum participation. He has to work closely with the chief district officer, having to bend

himself to the CAO as far as possible. The field manager should have a sufficiently senior status in the government service as compared with other officials around him. It is recommended that an official with C-6 grade will be appropriate. Agreement with the Civil Service Commission is required for the new job description of these personnel.

Since these positions are so important and critical that any malperformance may cause success to elude us, a careful system of selection has to be adopted. A working group should be set up to screen the persons willing to join the project, and whose qualifications are consistent with the terms of reference as stipulated.

(3) Other project staff. If the project is to demonstrate how the development activity should be carried out, then every one on the project staff should be achievement-oriented persons who have plenty of ambition. They are expected to set a good example for the other development projects which will come along at a later date.

Performance-Induced Incentive System

The project's introduction of the "contract" method of operations for the specialists, whether they are individuals or institutions, should be an efficient way of obtaining good service if it is performance-oriented. Approach to persons or institutions of proven ability and responsibility is one way, and matching compensation with performance is another. The NERAD Committee should be given the authority to approve the compensation levels as proposed by the NEROA director and the project director, upon assessment of the work performance.

This kind of performance-induced incentive system should also be used with the other project personnel if NERAD expects vigorous participation from them. The Thai salary and welfare system for government officials is not conducive to the high-level performance required by the project. Most officials are accustomed to work in a leisurely way and often demonstrate indifference towards achieving performance or completing work within the most reasonable period of time.

Officials of other agencies joining the NERAD operating fleet should receive recognition of their participation and performance by means of plaques or other appropriate materials.

Esprit de Corps

This will have to be created by innovative design. Many development projects have failed because project personnel have been loosely tied together by spirit and clients turn themselves away from the real objective and the means of operations of the project as well as the suitable role they have to play in them. Members of the project team should be made to see that they are clearly identified with the NERAD project. Project symbol and prestige has to be consciously created by planned design. The project's news, progress and shortfall should get to project participants consistently and punctually, and a system of obtaining their opinions on them should be adopted. This should make the participating officials and the beneficiaries feel that it is their project. Their future depends much on the project success. The greater the harmony in which they can work together, the easier and better the implementation will be. The MOAC, the NEROA and the project director are jointly responsible for the creation of the atmosphere and the feeling of being full participants. In this connection, the project director should be allowed to propose his ideas and plans to the higher bodies.

Each party has its own share in bringing the project to success. This is a pilot project, whose success will justify the approach to the rainfed area agricultural development. The MOAC as an agglomeration of various agencies takes the main responsibility of project direction and management in order to arrive at unity. It has to justify to the Bureau of the Budget and the Cabinet which provide the funds for the project that this project is worth implementation. So it has to exert some degrees of supervision. The provincial and the district officers, on the other hand, have their responsibilities to see that people living in their areas are taken care of adequately. When NERAD is aimed at increasing their ability to help their people, they should take this opportunity and devote their efforts to the tasks. The MOAC will give them liberty and credit to play the role of implementing body. Finally, the project must give the farmers the chance to feel that it is their project also for which they bear joint responsibility to accomplish for themselves. This will be done by the publicity technique of relating of "what they will get" with "what and how much they or we have to do".

Working Group Method

Our position is that in order to integrate government policy and operations, minimum organizations should exist at each level of government. If a new or special project is to be launched, then an ad-hoc task force or working group should be set up temporarily for a certain period of time. This working group will be made of the specialists selected from persons suited to the needs of the particular case. The size can be made more compact and it can be given a specific assignment to work on within the time given.

Thus at the ministerial level, the NERAD committee can set up a working group to help them study and prepare the details of the project policy and guidelines. The project director should set up working groups on planning and on monitoring evaluation and reports as well as on publicity and image-building plans. The same will be true at the regional and provincial levels. The working group as recommended may be abolished once the mission is completed.

Planning-Programming-Budgeting Management

Since an integrated project approach is goal-specific, there will be a commitment to achieve a certain level toward the goal within a specified time period and within the cost estimates. It will take unity and strong command over the use of resources to accomplish maximally the specified goal within a period of time. In order to enlist the participation of various agencies to work in harmony with one another, each one has to know in advance what role he should play, when and how much, so that he will make himself and his resources readily available for the job assigned. Also, to be efficient, a detailed operations plan and time schedule for coordinating personnel, finance and equipment needed to carry out each stage of work have to be prepared.

It is thus recommended that a systematic planning technique be used throughout the project management. That is, firstly, the project management unit is responsible for the total project planning. Secondly, the expenditure required by the project is to be requested jointly by the project director with the names of the spending organizations clearly specified. Except for those items of expenditures which are to be disbursed directly by each participating agency, funds should be put under the authority of the project director in order to reinforce his ability to directly support the implementation of critical areas or at

a critical time. These include travelling expenses, per diem, operating expenses, meeting allowances, and a contingency fund. Thirdly, operations plans have to be made at the project center, at the province, and at the tambon area levels. The operations plans identify the roles of the participating agencies within the time frame and the resources allocated in a programmatic manner. This will facilitate the flow of funds in accordance with the needs. It will also help to facilitate monitoring and control of the project. And fourthly, the field manager should further prepare field working schedules for each individual tambon, distribute it to all the operating officials and use it as a coordinating device.

Project Accounting and Performance Report

The present government accounting system is not intended to mean anything to development administrators and policy makers. Thus in order to justify the project expenditures which utilize government funds which could otherwise be used for other objectives, and which is expected to contribute to the better welfare of the target farmers, a Management Information System and a goal and performance-oriented system of accounting has to be developed. The financial items which have or have not been dispensed in each particular strategy and in major activities at particular period of time, as stipulated in the plan, have to be recorded. This is to enable the management to compare investment costs with results and set targets and to improve his efficiency and ability to achieve the planned goal.

In order to accomplish this task, not only the new project accounts have to be designed, but also the formats of the performance report and the data sheets which each field manager and the project manager have to use will have to be prepared together as a set. This is to make sure that the necessary information will be collected and written in the required manner, so that the project manager understands the status of his project implementation, especially in terms of the outputs in relative to inputs. The project manager then files his meaningful-performance reports with the policy bodies.

Monitoring and Evaluation

The project manager and the responsible policy bodies will not have the chance to know exactly what has been and will be accomplished under the development project that they have conceived; neither do they know how those planned strategies and activities have been carried out, unless a monitoring and evaluation system is designed in conjunction with the project and operations plans. A careful sub-plan on monitoring and evaluation has to be another necessary component of project management. The plan should identify the necessary instruments, the responsible officers, the accompanying expenditures and the timing of monitoring and evaluation. The project manager uses this to diagnose progress of his project performance, and learning of problems in order to take necessary corrective measures to adjust them. The evaluation will not only be on the goal achievement at each phase of operations, but on the malfunctions of the various project components as well.

The task of monitoring will be for the life of the project, while evaluation will be done at certain periods of time either during the project life or beyond. However, post-evaluation should be carried out by the Office of Agricultural Economics of MOAC.

Local Participation

The area-based approach to development implies that the target groups be helped to develop as much as possible on their own initiative. In order to focus on the area problem and situation, specific area bottom-up planning with full participation of the local villagers and officials should be encouraged and carried out.

Thus in planning for development, it is necessary that local people and groups are solicited to express their opinions and needs, which have to be taken into the plan. Also, the target people as well as the implementation personnel should be consulted when the operations plan is prepared in order to avoid some oversights, which may hinder, delay or cause unnecessary problems upon implementation. The Tambon Council should not be bypassed. Rather it should be given the chance to participate either in identifying problems, in preparing the detailed operations plan and in implementing the project. The local council should be involved in monitoring and be made responsible for the continuation of the activities after the project is terminated.

The provincial authorities who will be much involved in implementation should be brought early into the planning process of the project and in the preparation of the operations plans by giving them some assignments to do. Many of them live with the people in the target area, so they should have meaningful experience to share in the project and thus can help to sharpen the project strategies or smooth out operations. Their willingness to cooperate is important in strongly implementing the project. Bottom-up planning should meet with the top-down planning at the provincial level.

In this connection it is recommended that manager's offices should be situated in all the tambon areas in order to promote increased and intensive interaction between the villagers and the project personnel.

Transfer Procedure to Normal Operations

The NERAD will be in existence for seven years, after which funds will be spent; personnel will be called back to their permanent positions; and the project will be closed. This should be made known, since there might be many persons who tend to believe that the project is so significant that it will last so long as to become another permanent organization. One rainfed area agricultural development strategy might be permanent or long-term intensive assistance, but it is not this NERAD project. The decision to transfer the activities in these target tambons to normal operations and regular units has to be considered at the start of the project. Once infrastructure has been set up, the basic problems have been solved, and technology has been amply conveyed to the people, the people themselves and the regular units should have no burden in continuing such activities without the assistance of extra inputs. To stop the project smoothly needs careful planning. The evaluation of project accomplishment during the last year should reveal an appropriate model which can be replicated to the larger numbers of areas or even indicate a need to introduce a second-phased project in the project areas.

The design of this institutional framework has recommended a minimum structure and streamlined operations which can be withdrawn after the project is completed without difficulty.

C. Illustrative Schedule and Costs for Water Resource Modifications

Province	Chaiyaphum													
Tambon	Lahan							Kwang Chon						
Year	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1. Swamp Rehabilitation 1/	-	-	-	-	-	-	-	-	1	2	2	-	-	-
2. Embankment Structure 2/	-	1	2	-	-	-	-	-	1	-	-	-	-	-
3. Submerged 3/	-	-	3	4	3	-	-	-	-	-	-	-	-	-
4. Water Filter Systems 4/	-	4	5	2	-	-	-	-	-	-	-	-	-	-
5. Shallow Wells	-	-	-	-	-	-	-	10	60	96	200	172	-	-

Province	Roi Et													
Tambon	Nong Kaew							Na Muang						
Year	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1. Swamp Rehabilitation 1/	-	2	4	2	-	-	-	-	2	2	-	-	-	-
2. Embankment Structure 2/	-	-	-	-	-	-	-	-	-	2	-	-	-	-
3. Submerged 3/	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4. Water Filter Systems 4/	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5. Shallow Wells	-	44	144	150	72	-	-	-	28	84	168	100	20	-

Province	Si Sa Ket													
Tambon	Tae							Taket						
Year	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1. Swamp Rehabilitation 1/	-	1	-	-	-	-	-	-	1	1	-	-	-	-
2. Embankment Structure 2/	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Submerged 3/	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4. Water Filter Systems 4/	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5. Shallow Wells	6	15	10	-	-	-	-	12	15	10		-	-	-

Province	Nakhon Phanom													
Tambon	Na Thom							Na Ngua						
Year	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1. Swamp Rehabilitation 1/	-	1	2	-	-	-	-	-	2	-	-	-	-	-
2. Embankment Structure 2/	-	2	3	1	-	-	-	-	3	3	2	-	-	-
3. Submerged 3/	-	1	2	-	-	-	-	-	-	-	-	-	-	-
4. Water Filter Systems 4/	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5. Shallow Wells	5	30	15	-	-	-	-	9	25	10	-	-	-	-

Item	Total	Cost/Unit ฿'000	Total Cost ฿'000
1. Swamp Rehabilitation 1/	25	592	14,800
2. Embankment Structure 2/	20	600	12,000
3. Submerged 3/	13	300	3,900
4. Water Filter Systems 4/	11	5	55
5. Shallow Wells	1,800	2.16	3,240
6. Other Improvements — Activities may include pit ponds, weirs, flood control structures, etc.			3,000
7. Engineering Cost — The engineering cost included survey, design, wages, equipment, construction supervision, material and miscellaneous			5,000
---------------- GRAND TOTAL ----------------			11,995
			52,100.00

Remarks:

1/ Assume average depth each swamp will be deepened is 2 meters, average size of swamp to be deepened in Kwang Chon 9 rai, Nong Kaew 10 rai, Na Muang 5 rai. Tae 4 rai, Taket 10 rai, Na Thom 20 rai, Na Ngua 7 rai.

2/ Assume average size of each embankment reservoir is 75,000 m³
Assume average size of dam is 105 m length, 4 m high, 20 m wide at base and 4 m wide at top.
Assume cost of dam construction at 52฿/m³

3/ Assume average size of dam is 2 m high, 15 m wide at base and 3 m wide at top.
Assume dam length to be in Na Thom 500 m, and Lahan 200 m.
Assume;cost to be 55฿ m³ of soil displacement to include a concrete water intake system.

4/ Assume cost for well and filter materials at 5,000฿/well.

5/ Assume average depth of shallow to be 6 - 7 m.
Assume average cost for reinforced concrete ring at 2,160฿/well.