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RAINFED AGRICULTURAL INTENSIFICATION

INTEGRATED RAINFED FARMING SYSTEMS RESEARCH--

KHON KAEN UNIVERSITY

Report by the USAID/KKU RAI Design Team

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LIST OF ABBREVIATIONS

ADAB	Australian Development Assistance Bureau
AI	Artificial Insemination
ASEAN	Association of Southeast Asian Nations
AVRDC	Asian Vegetable Research and Development Center
CIAT	International Center for Tropical Agriculture
CIDA	Canada International Development Agency
CIMMYT	International Maize and Wheat Improvement Center
CMU	Chiang Mai University
CSP	Croppig System Project
DLD	Department of Land Development
DOA	Department of Agriculture
DOAE	Department of Agricultural Extension
DOF	Department of Fisheries
DOLD	Department of Livestock Development
DPOT	Dairy Promotion Organization of Thailand
EAPI	Environment and Policies Institute
EEC	European Economic Community
EGAT	Electric Generating Authority of Thailand
FSR	Farming System Research
GTZ	West Germany Assistance Agency
H	High
HDO	Health Development Officer

ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDRC	International Development Research Center (Canada)
IFS	International Foundation of Science
IITA	International Institute of Tropical Agriculture
IRFSP	Integrated Rainfed Farming System Project
IRRI	International "Rice" Research Institute
JSPS	Japan Society for Promotion of Science
KKU	Khon Kaen University
KU	Kasetsart University
L	Light
LDC	Livestock Development Center
LDU	Livestock Development Unit
M	Medium
MCM	Million Cubic Meter
MCP	Multiple Cropping Project
MOAC	Ministry of Agriculture and Cooperatives
NBRDC	National Buffalo Research and Development Center
NELDP	Northeast Livestock Development Project
NERAD	Northeast Rainfed Agricultural Development
NESDB	National Economic and Social Development Board
NIDA	National Institute of Development Administration
NRC	National Research Council
NRC/SSRC	NRC/Social science Research Committee
NSRTC	national Swine Research and Training Center

NV	NERAD Village
OLDP	Office of Livestock Development Project
ONA	Office of Northeast Agriculture
OUA	Office of University Affairs
PSU	Prince of Songkhla University
PV	Project Village
RAI	Rainfed Agriculture Intensification
RFD	Royal Forest Department
RID	Royal Irrigation Department
RTG	Royal Thai Government
SEARCA	Southeast Asia Regional Center for Agricultural Research and Graduate Studies
U	University
UPLB	University of the Philippines at Los Banos

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In preparing this report we have drawn heavily on the research reports of the KKU-Ford Cropping Systems Project, particularly An Agroecosystem Analysis of Northeast Thailand (edited by Terd Charoenwatana et.al). Dr. Terry Grandstaff , USAID Behavioral Science Advisor, generously supplied the Team with copies of his unpublished papers on farming systems in the Northeast.

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Bangkok
16 May 1982

EXECUTIVE SUMMARY

Participation of Khon Kaen University in the Rainfed Agricultural Intensification (RAI) Project provides a unique opportunity to utilize the skills of an exceptionally well trained agricultural faculty and an emerging social science faculty to focus on the problems of farmers who must cope with the vagaries of the weather as they scratch out a living under rainfed conditions. Drawing together the knowledge about the climate, soils, crops, livestock and the socio-economic environment in which the farm family lives, the KKU scientists will focus on specific villages to investigate ways farmers can increase the productivity of their environment and improve their standard of living from the increased income. Much is already known about cropping systems, but still considerable refinement must be made in adapting various cropping patterns to a specific locality. Agricultural researchers are much less sure about farming systems that include crops and livestock as well as the social environment in which farmers live.

More important than outlining a series of specific research projects, this project component establishes an interdisciplinary working group composed of both social and natural scientists to look for solutions to the problems confronting farmers tilling the soil under rainfed conditions. It is a problem solving group capable of observing the dynamics of a specific farming system; then scientifically analyzing the events occuring and identify those interventions that might immediately alleviate the problem or may need further research. As a starting point for the research, a number of "key" questions have been listed to start the analytical process. These key questions have been developed from farming systems workshops held at Chiengmai and Khon Kaen Universities.

The principle objectives of this project activity are:

1. To improve the quantity, quality and relevance of the research activities carried out by KKU staff particularly as they relate to rainfed farming systems in the Northeast.

2. To improve KKU's ability to provide basic and applied research assistance and support to help RTG research and development agencies especially those of MOAC.

3. To improve the quality of graduates from KKU by ensuring they are exposed to "real world" problems of rainfed farmers and by immersing them on a program with heavy emphasis on farming systems research methodology.

The principle geographic area of concern will be an area known as the Korat Triangle (the points of the triangle are Korat, Ubon and Udon). Khon Kaen is centrally located within this triangle and it is an areas in which many of Thailand's poorest farmers reside. Two tambons will be selected within this area--one near the University and one in either Roi Et or Chaiyaphum. Within these tambons, 3-4 villages will be selected for more detailed study at the mini-watershed, village, farm and field plot levels. Other related and support research will be conducted as needed in university facilities.

The proposed budget for this Integrated Rainfed Farming System Research at Khon Kaen University is for a total of $3.8 million over a five year period ($3.2 million USAID and $0.6 million RTG). Most of the funds are for the support of professionally competent researchers at KKU and to help fill some of the technical deficiencies through short-term consultancies and staff participation in professional conferences, workshops and seminars. Only one foreign professional is planned, a social scientist with experience in farming systems research, to augment the fledgling social science faculty at KKU.

The farming system research conducted by KKU will be shared with the traditional departments of the Ministry of Agriculture and Cooperatives for dissemination as appropriate. The long term benefit of this research will be the knowledge, attitudes and skills learned by the students, for solving problems with farmers that will give them the confidence to tackle more difficult problems of increasing agricultural productivity in the future.

INTEGRATED RAINFED FARMING SYSTEMS PROJECT

Introduction

In the past two decades Thailand has exhibited rapid economic growth. This growth, however, has created another problem; regional inequalities. During the first three Five-Year Plans (1961-1976) the emphasis was placed primarily on national economic growth, although, in the Third Plan (1976-1976) there was some attempt to increase the income of people in rural areas. Regional inequalities were felt and were recognized by economists before the completion of the Third Plan. In the Fourth Plan (1977-1981), narrowing the income gap of people in different sectors of the economy and different regions of the country was stated as the main objective. That the problem is a serious one is indicated by the fact that in 1978 the average income of people living in Bangkok was about six times greater than that of people living in the Northeast while in 1960 it had been only 5 times greater. In terms of regions, the Central Region, which includes Bangkok, had an average income 2.4 times higher than the Northeast in 1960. This rose to 3.5 times more in 1978

Therefore, when the Fifth-Plan (1982-1986) was developed it had as a primary focus the intent to address the imbalanced development between various production sectors, regions and target groups. Specifically, there is a stress on the alleviation of poverty in particularly backward areas of the country by including such areas more actively in the production process and national development activities

The Fifth Plan proposes to bring relief to poverty areas in 37 identified provinces of the North, Northeast and South In the Northeast, which contains the majority of these backward areas, almost all the identified provinces are dependent upon rainfed agriculture. Farmers,

particularly those operating under rainfed conditions (estimated at 90 percent of the producers in the Northeast), continue to use traditional agricultural practices with little or no adoption of modern technologies. In order to improve conditions in these poorer districts it is necessary for farmers to intensify their production from the existing land resource base.

In order to systematically understand the complex range of problems associated with the intensification of agricultural production in rainfed areas of Northeast Thailand, the Northeast Rainfed Agricultural Development (NERAD) Project has been developed. This project, funded by USAID and operating through the MOAC, has developed a specialized organizational and operational methodology that recognizes the broad agroecological conditions existing in the Northeast. By year two of NERAD certain technologies suitable for broader application throughout the areas not served by NERAD will be identified. The Rainfed Agricultural Intensification (RAI) Project, the second major step in the process of development of rainfed agricultural areas, will strengthen the capacities of national programs and agencies for the efficient replication of both presently available and NERAD identified agricultural technologies. RAI will also serve to provide the capability to develop the second generation of appropriate technologies as NERAD reaches the limits of existing technologies.

As rainfed agriculture encompasses a number of different technical areas, single function organizations find it difficult to properly integrate their activities to meet the wide range of needs of rainfed farmers. RAI will have a number of components, most of which are the responsibility of single function organizations such as DOA, DLD, DOLD, and DOAE. However, there is a significant role that can be played by an organization like Khon Kaen University (KKU) as it, through its administrative structure and cropping systems research program, has the ability to organize and carry out multi-disciplinary and inter-disciplinary research. The University is located in the center of the Northeast and is thus well situated to provide

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both basic and applied research support in order to respond to research problems identified in NERAD. Improved rainfed farming system practices can be developed and the information disseminated to MOAC and other government agencies.

In order to address the needs of Northeast rainfed farmers KKU recognizes that it needs to expand its cropping systems research program to include livestock and to incorporate a stronger social analysis component. The University has decided to call this work, "Integrated Farming Systems" both to emphasize the inclusion of all agriculturally related activities including livestock and to differentiate it from their previous cropping systems research. The purpose of this document is to describe how these new activities will be organized and to detail their relationship vis-a-vis NERAD and other RAI projects. The initial section presents an overview of the physical, social and cultural background of Northeast Thailand. This is followed by a section that describes present research constraints in rainfed agriculture in the Northeast and the role that the Thai universities can play in helping to overcome these constraints. The third section provides an institutional analysis of Khon Kaen University with a detailed description of agriculture and social science staff and research activities. The fourth section reviews on-going MOAC rainfed cropping systems research in the Northeast and also contains a historical review of KKU's Cropping Systems Project. This section establishes a frame work for the proposed integrated farming systems research project by presenting an overview of a complex agroecosystem analysis of Northeast Thailand recently completed by KKU staff. The fifth section contains details of the proposed project including budget requirements and needed outside assistance while the sixth section discusses implementation and linkage of the project with MOAC and other concerned agencies including other Thai universities. The final section offers suggestions for evaluation and also raises some issues that need further exploration before the project can be finalized.

1. DESCRIPTION - NORTHEAST THAILAND

Topography

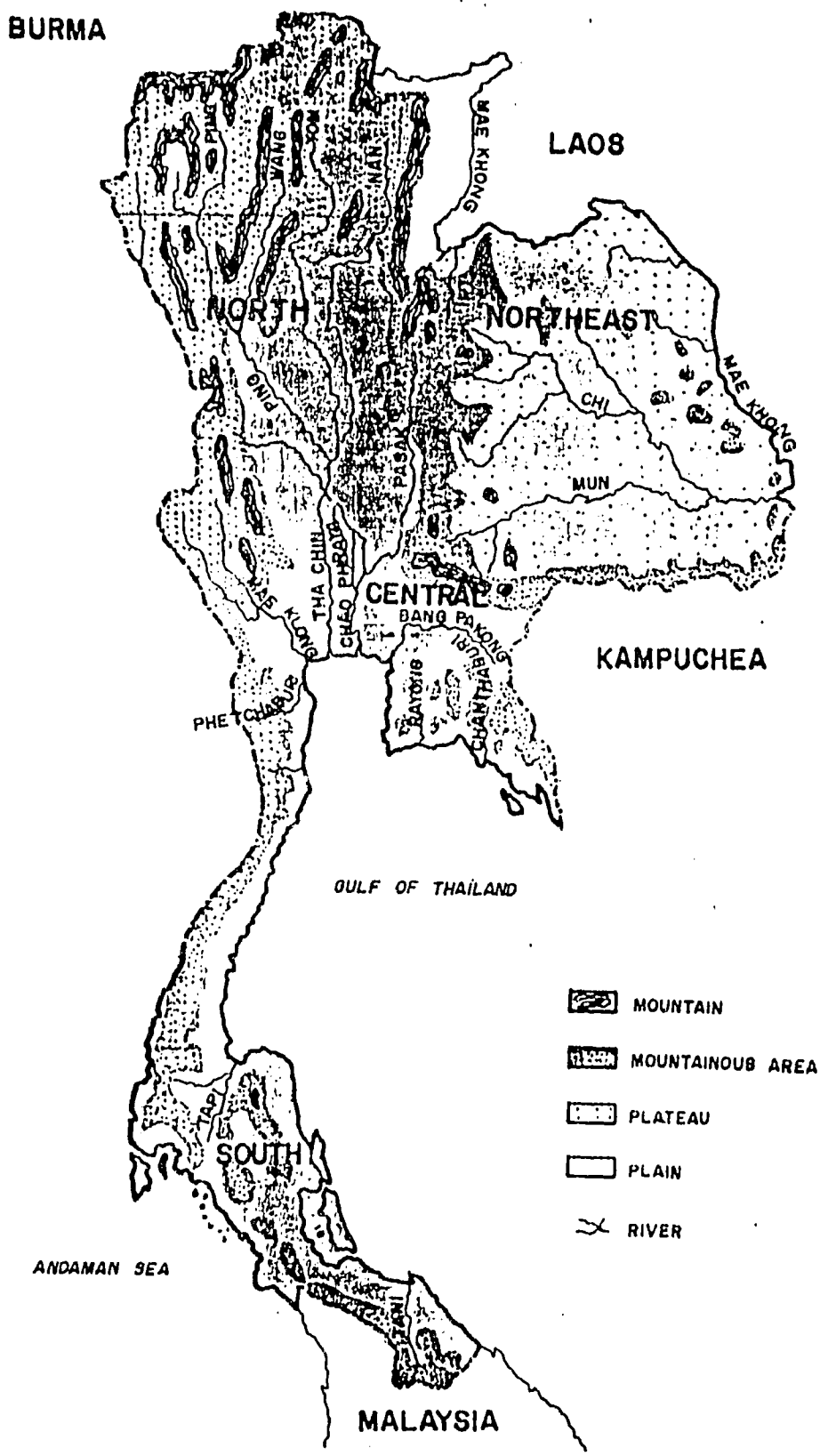
Northeast Thailand is the largest region in the Kingdom covering more than 170,000 km^2. The region is separated from the Central Plain by the edge of the Korat Plateau which rises about 300 meters above the plain and then gradually slopes to the Southeast. To the North and East the region is divided from Laos by the Mekong River, while directly to the West high hills divide the Northeast from Northern Thailand. Also to the South, hills define the boundary between Northeast Thailand and Kampuchea. Runoff from monsoon rains is drained by the two major rivers, the Chi and Mun, that join near the Laos border after which the Mun flows into the Mekong River across the border in the Kampuchea (Figure 1-1).

Geology and Soils

Geologically, the plateau is primarily composed of fine-grained sandstone and shale strata, which are overlain in the valley depressions by alluvium and river terrace deposits. Much of the plateau is underlain by salts. Sandstones in the upper strata formed in the Cretaceous period are highly pervious. There are 35 different soil types in the Northeast but the majority of the agricultural soils fall into one of five great groups:

Great Groups	Series
Ustifluvents	Tamuang, Sanphaya
Tropaquepts	Ratchaburi, Pimai
Dystropepts	Ubon
Paleaquults	Roi Et, Tatum
Paleustults	Korat, Warin, Satuh, Yasothon

FIGURE 1-1. MAP OF THAILAND



Along the rivers lie the recent alluvial soils with the ustifluvents on the natural levees and the tropaquepts and dystropepts on the adjacent flood plain. The former are fine to medium textured, well drained, and slightly acid; they are used primarily for garden crops and vegetables. The latter are fine textured and poorly drained, and are used for rice cultivation. Both the paleaquults and paleustults are terrace soils, with more clay and a finer texture in the lower horizon than the surface. They are used for rice cultivation. The paleaquults have developed on the lower terraces. They are poorly drained and are saturated with water at certain times during the year. The paleustults are on the higher terraces; they have a low water holding capacity and are dry for more than 90 days in the year. Upland crops such as cassava, kenaf, and sugar cane are normally found on these soils.

The distribution of the major four soil great groups are illustrated (very approximately) in Figure 1-2.

It should be stressed that the areas indicated are by no means uniform. The majority of the area, over 65%, is covered by paleaquult and paleustults soils. Much of the land is undulating, forming "miniwatersheds", with paleaquult soils in the depressions and paleastults on the higher land. Only between the Chi and Mun Rivers and south of the Mun River do tropaquepts, paleaquults, and dystropepts form more or less continuous plains. Figure 1-3 contains a schematic cross section of soils and topography that illustrates the non-homogeneous nature of the Northeast.

Climate and Rainfall

Following the Koppen system almost all of the Northeast is classified as a tropical wet and dry zone having a distinct dry season from December to May. The mean temperature of the coolest month is above 18°C and diurnal and annual temperature ranges are moderate. Only in the mountainous areas of Loei provinces in the far Northwest are low temperatures (13°C) found during January.

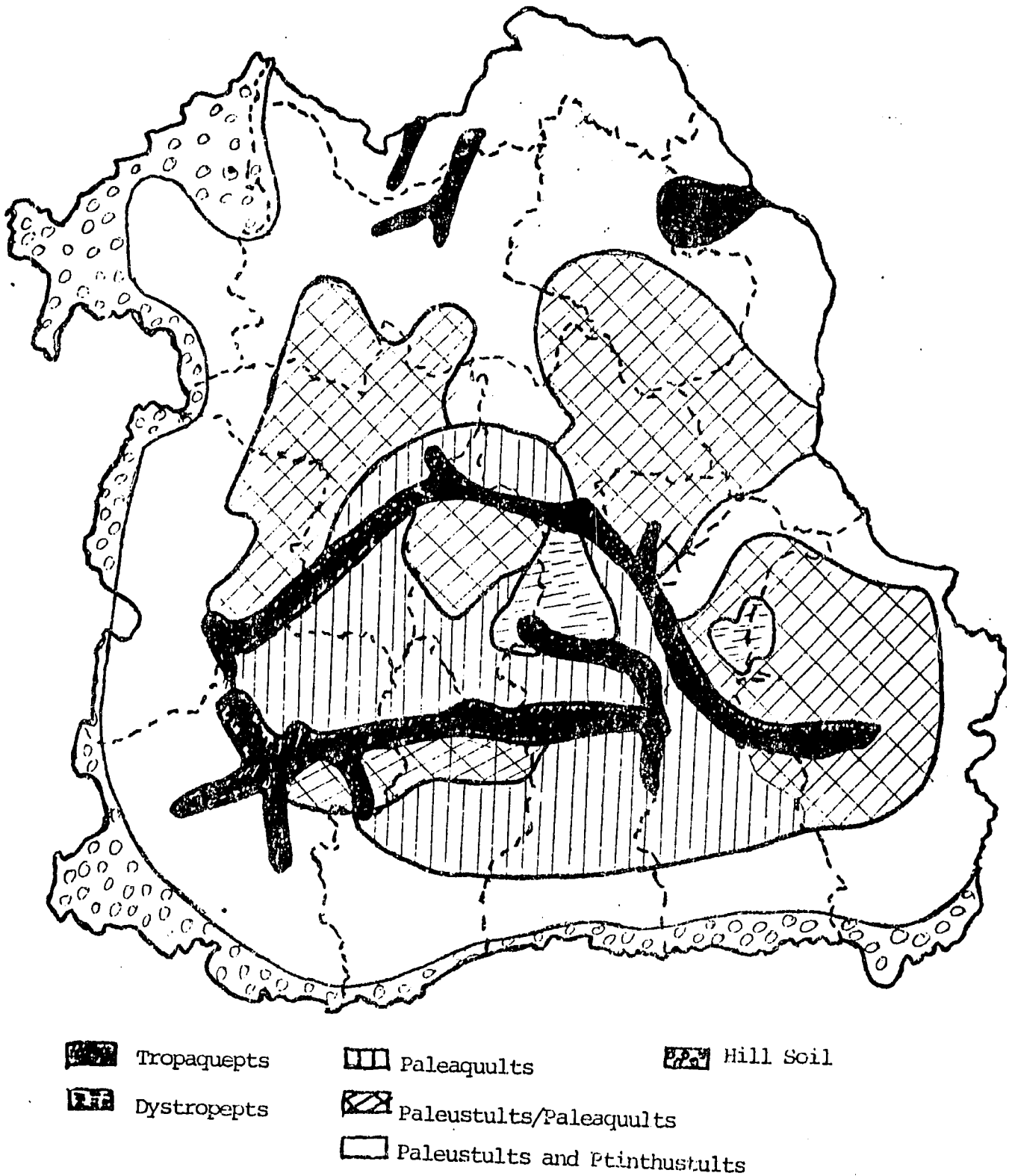


FIGURE 1-2. SIMPLIFIED SOIL MAP OF NORTHEAST THAILAND

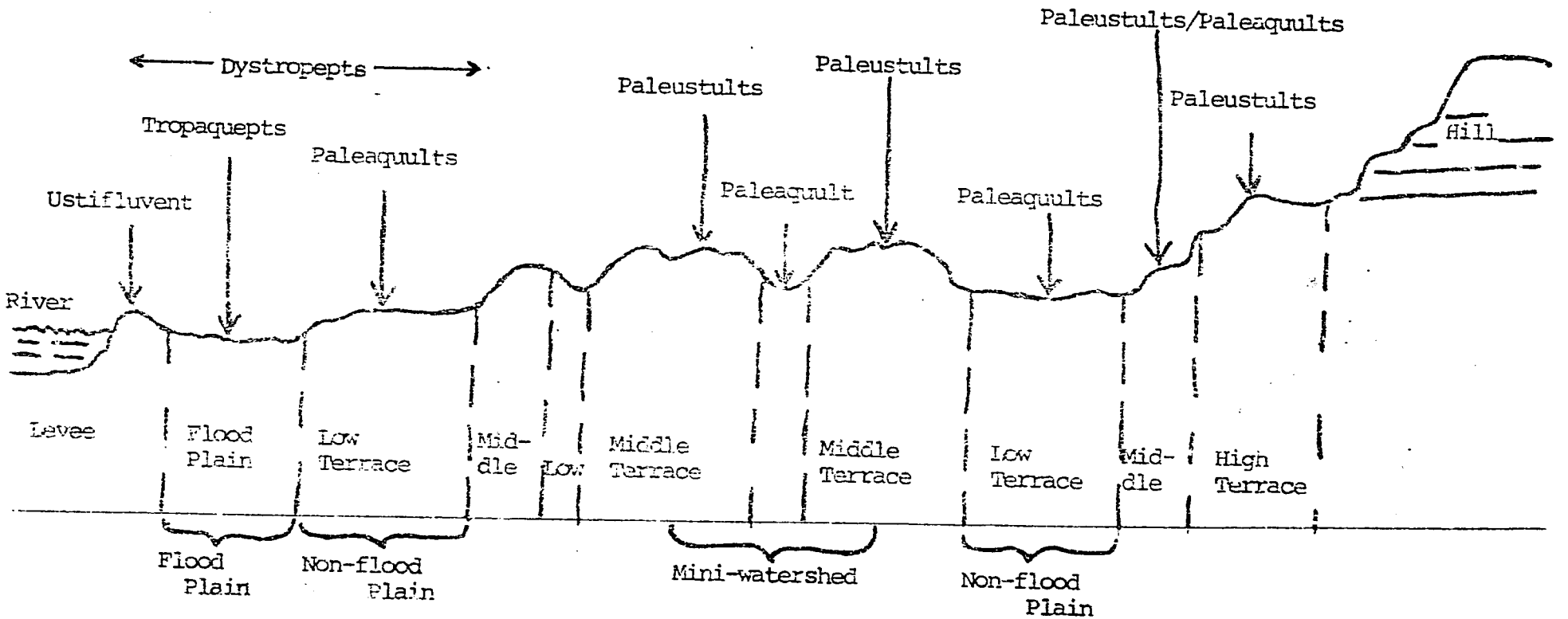


FIGURE 1-3. SCHEMATIC CROSS SECTION OF TOPOGRAPHY AND SOILS IN THE NORTHEAST

Rainfall patterns of the Northeast are, to a great extent, dominated both by the annual southwest monsoon and tropical cyclones which originate over the Indian Ocean and the South China Sea respectively. However, initially light rain from the Andaman Sea arrives during February to April before the main part of the rainy season which occurs during May to October. The southwest monsoon brings heavy rains in the early part of the rainy season while heavy rains during the latter parts of the season tend to originate from tropical cyclones off the South China Sea. Usually by early November the rainy season is finished. The end of the rainy season is much more consistent than is the arrival of the southwest monsoon.

Based on isohyets for mean annual rainfall (Fig. 1-4) boundaries can be drawn that divide the Northeast into 3 distinct regions: 1400 mm. and above to the North and East, below 1,200 mm. to the West, and a central band of 1,200 - 1,400 mm. These divisions, while useful, do not provide all the necessary information as total rainfall, per se, is not the problem. The distribution of rainfall throughout the season and variation from year to year are also extremely critical.

According to International Rice Research Institute (IRRI) scientists, a mean monthly rainfall of 200 mm. represents a critical threshold for rice cultivation in Southeast Asia. From this definition: in the South and Southwest there is only one month (September) with more than 200 mm.; a central fairly narrow land has 2 - 4 months of rainfall over 200 mm. while only in the North and East are there more than 5 months having over 200 mm. (Figure 1-5). If it is assumed that the 100 mm. isohyet defines the threshold for cultivating field crops, the Northeast divides into two zones with monthly rainfall greater than 100 mm. for 5 months in the top zone and for 6 months in the bottom zone (Figure 1-6).

Recognizing that irregularity in rainfall during the rainy season is more important in determining crop yields than mean monthly rainfall quantities, it is necessary to examine the total number of drought days 1/

1/ A drought day is defined as a day during which water depth and available soil moisture are zero.

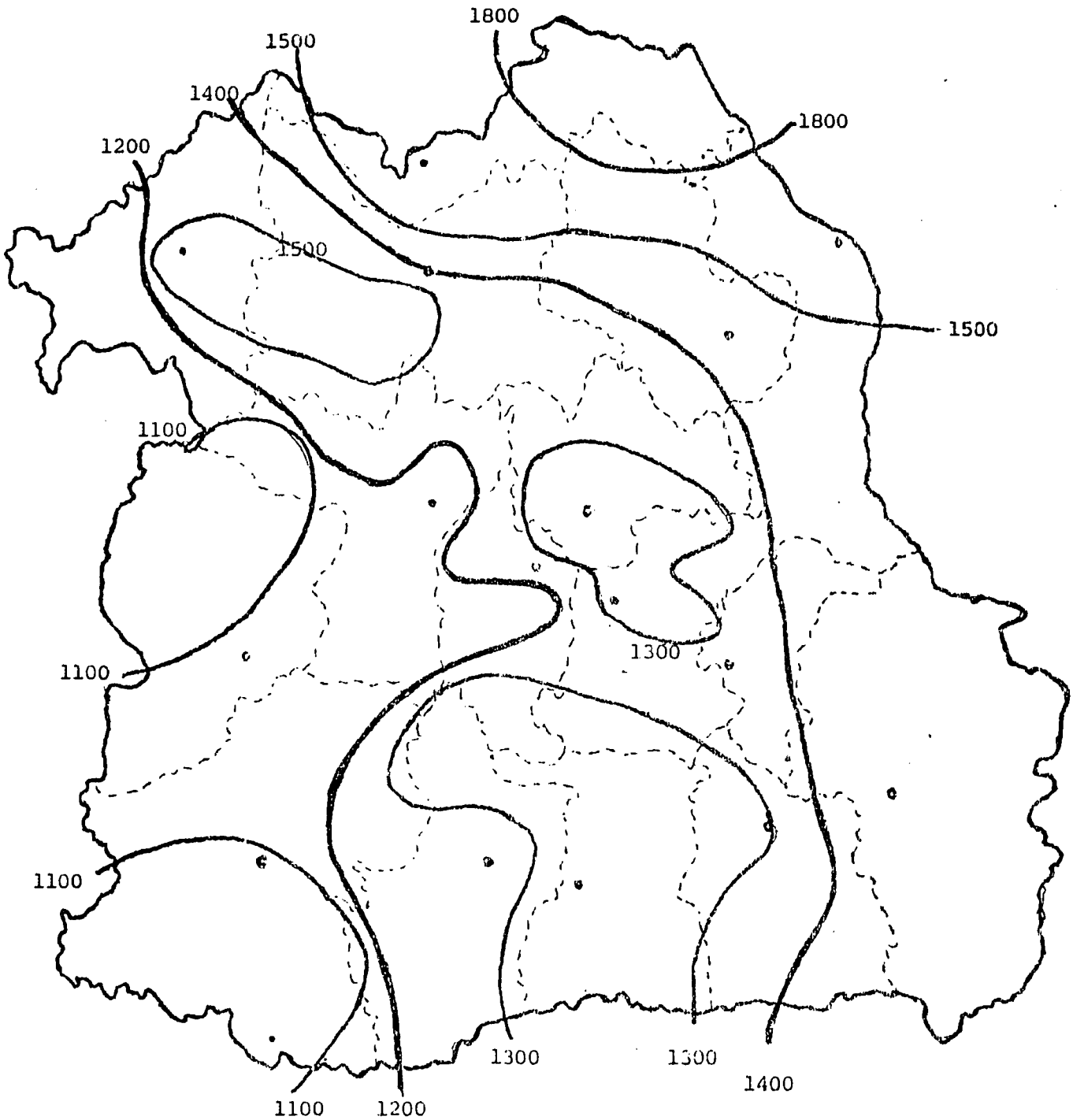


FIGURE 1-4. ISOHYETS FOR THE ANNUAL RAINFALL

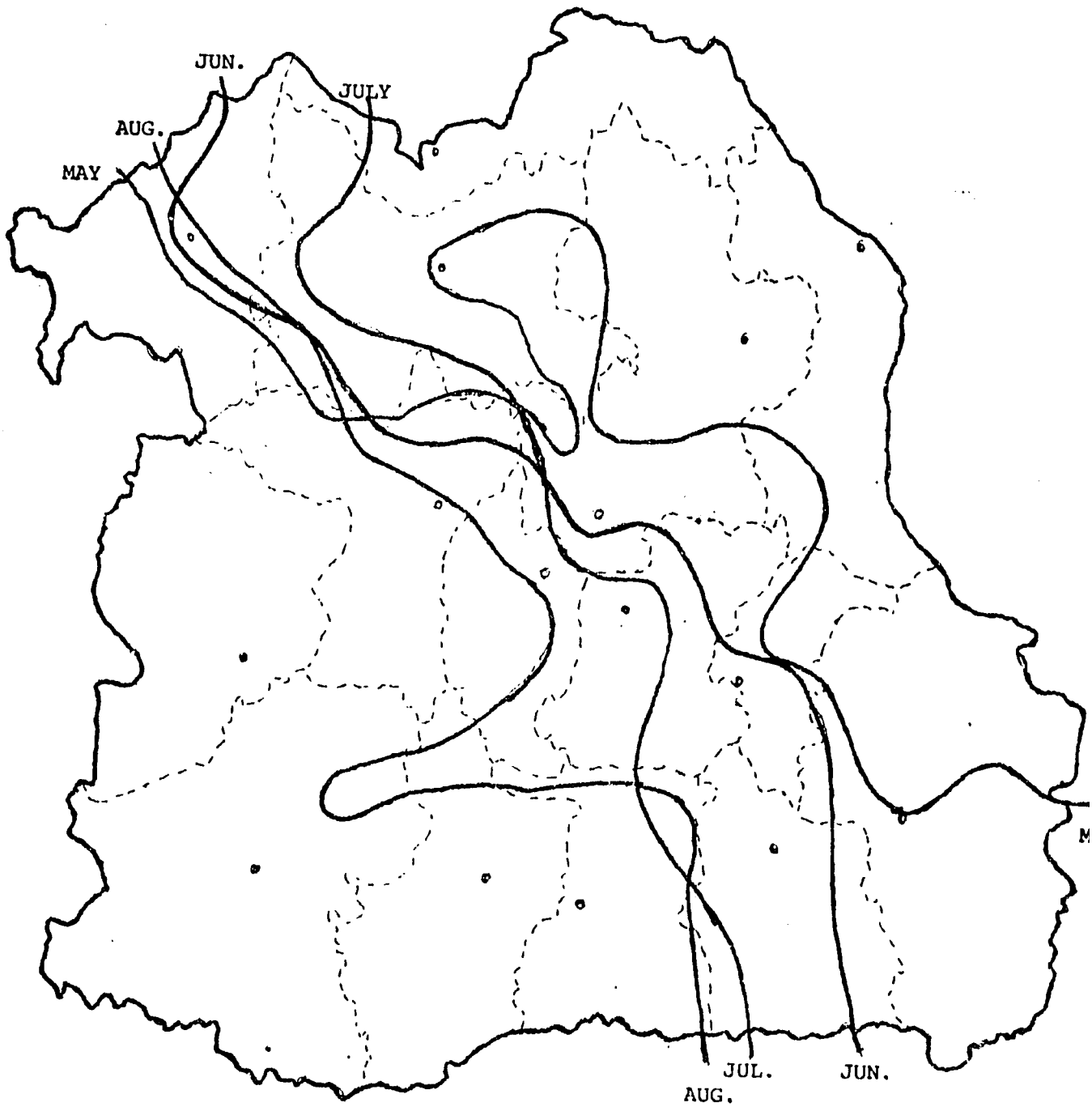


FIGURE 1-5. 200 MM. ISOHYETS FOR THE MONTHLY MEAN RAINFALL

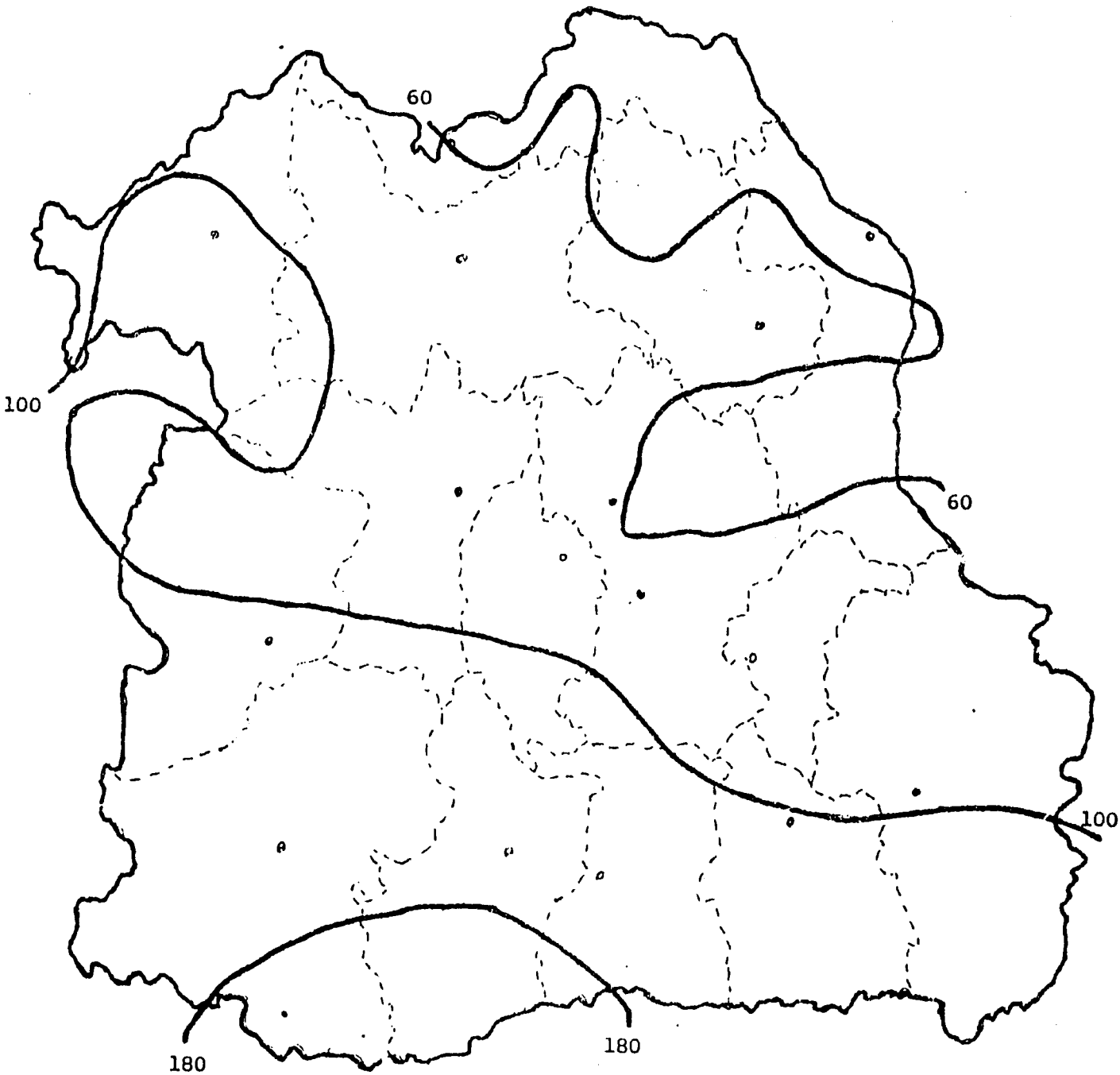


FIGURE 1-6. 100 MM. ISOHYETS FOR THE MONTHLY MEAN RAINFALL

(calculated for paddy production) occurring during the period from May to October. Again, using this technique, there are three distinct zones in the Northeast. As presented in Figure 1-7 the zone in the West has more than 100 drought days, while there is a narrow band in the middle with 80 - 100 drought days and less than 80 days in the area to the North and East. In general, these zones agree with the zones drawn in Figure 1-4. The high incidence of drought in the West is probably a rain shadow effect caused by the hills.

Water Resources

The Mun and Chi Rivers, which drain the Northeast, and the Mekong River which forms its boundary to the north and east, are the major damable water sources. There are no dams on the Mekong but there are dams on tributaries of the Mun and Chi. For all of Northeast Thailand, as of 1978, the Royal Irrigation Department (RID) had completed irrigation projects with surface storage capacity of 3,260 million cubic meters (MCM) able to serve 415,000 hectares. In addition RID has installed pump irrigation to serve 45,000 hectares in the wet season and 8,200 hectares in the dry season. However it is estimated that only 320,000 hectares are actually irrigated. Included in the surface storage data are 544 small reservoirs (tanks) having a combined storage capacity of approximately 895 MCM. Besides providing water for animals and domestic use, they are estimated to irrigate 137,000 hectares. Prior to 1975 many tanks contracted were relatively large (often greater than 5.0 MCM) but since 1976 small tanks (less than 1.0 MCM) have been emphasized.

It is estimated that if all existing and planned irrigation systems were completed, they would serve no more than 15 percent of the total cultivated area of the Northeast. This would still leave 85 percent of the cultivated land and over 82 percent of the total farm families dependent upon rainfed agriculture.

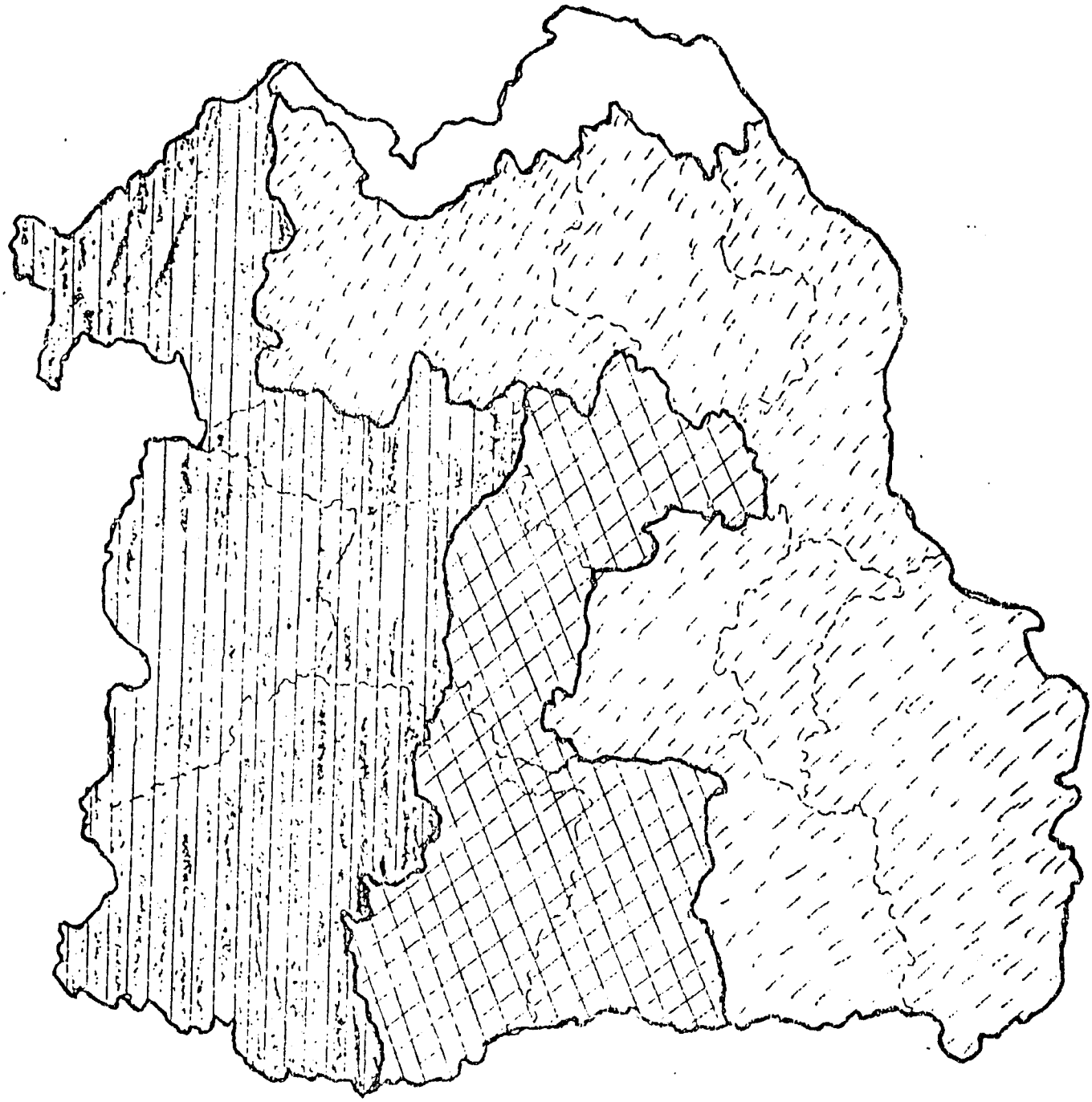


FIGURE 1-7. NUMBER OF TOTAL DROUGHT DAYS* FOR THE PERIOD OF MAY TO OCTOBER.

60 DAYS

60-80 DAYS

80-100 DAYS

100 DAYS

* Drought Day = Calculated for paddy

Land Use

Of the 170,000 km^2 (17 million hectares) in the Northeast, 5.4 million hectares are in rice lands and 1.4 million hectares are under upland field crops. Vegetables cover 64,000 hectares and fruit trees are planted on 32,000 hectares. The remainder of agricultural land is in pasture grassland or is left idle.

Rice Land. The highest proportion of cultivated land under paddy occurs in the eastern provinces, on the flood plains beside the Mekong River, and in the central, southeastern provinces of Roi Et, Yasothon, Surin and Si Sa Ket (i.e. on the plains along the lower reaches of the Chi and Mun Rivers). In these latter provinces over 90% of the cultivated land is under paddy, even in a drought year such as 1976 or 1977.

Variations in quantities of rice plantings, yields and total production are important factors in determining year-to-year income levels. The most stable areas occur in the North and eastern provinces where the annual mean rainfall is greater than 1400 mm. The least stable areas occur in the western hilly provinces where rainfall is less than 1,200 mm. per year and there are more than 100 drought days in the May to October period. In the center, Kalasin and Maha Sarakham are moderately stable in all respects, while in the south Buri Ram is very stable. The most complex patterns are found in Roi Et, Surin, and Si Sa Ket. They have high constant paddy acreage from year to year but very unstable yields and total production. Zones of rice stability are presented in Figure 1-8.

The proportion of paddy land actually planted depends on the occurence of drought early in the season while yields per land unit are primarily a function of the rainfall pattern later on. The effects of these drought periods on paddy production can be analyzed using time series data. Figure 1-9 plots reduction rate against paddy yields for a twenty year period. The trend is clear but there is a considerable scatter of points.

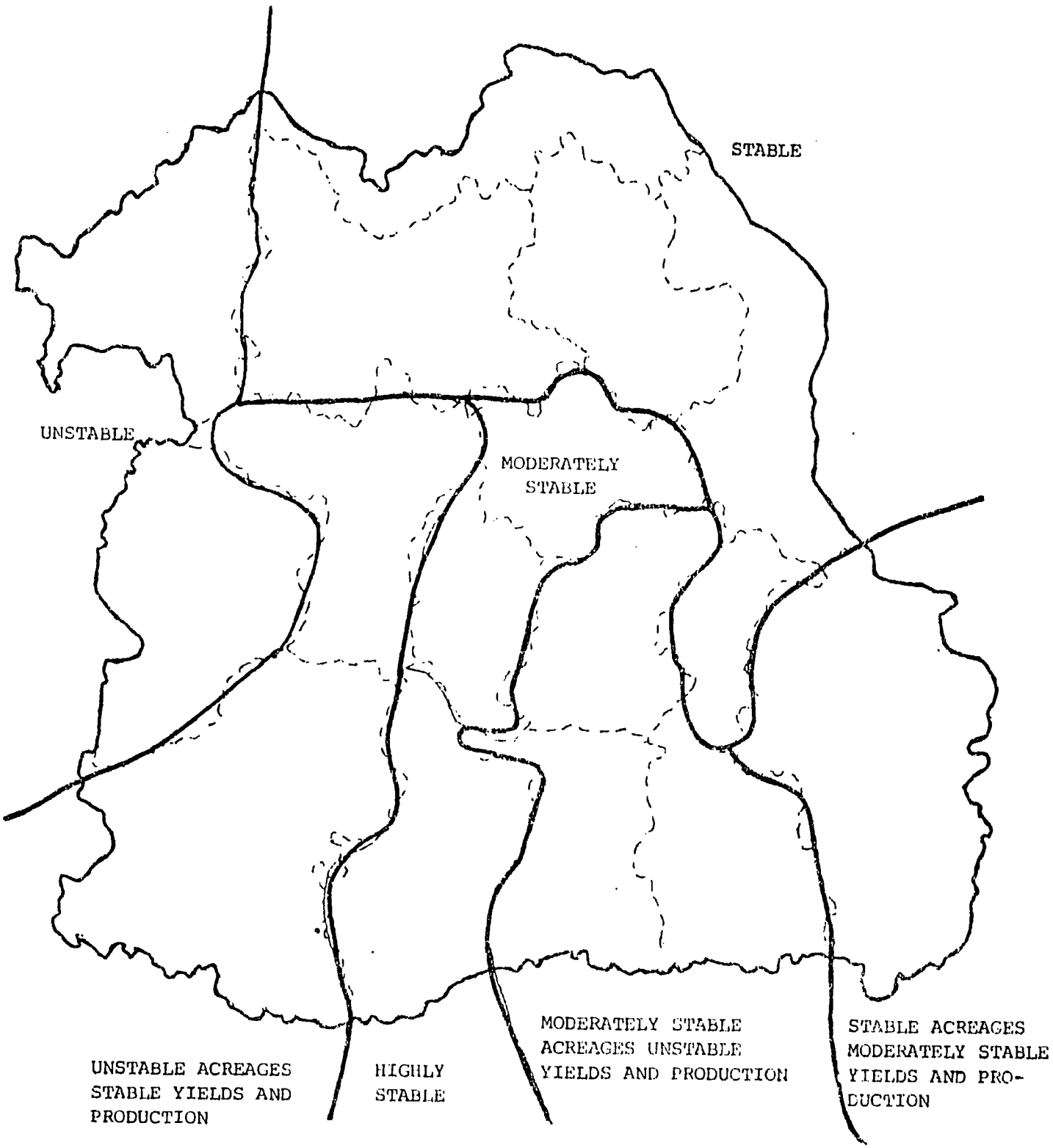


FIGURE 1-8. ZONE OF RICE PRODUCTION STABILITY

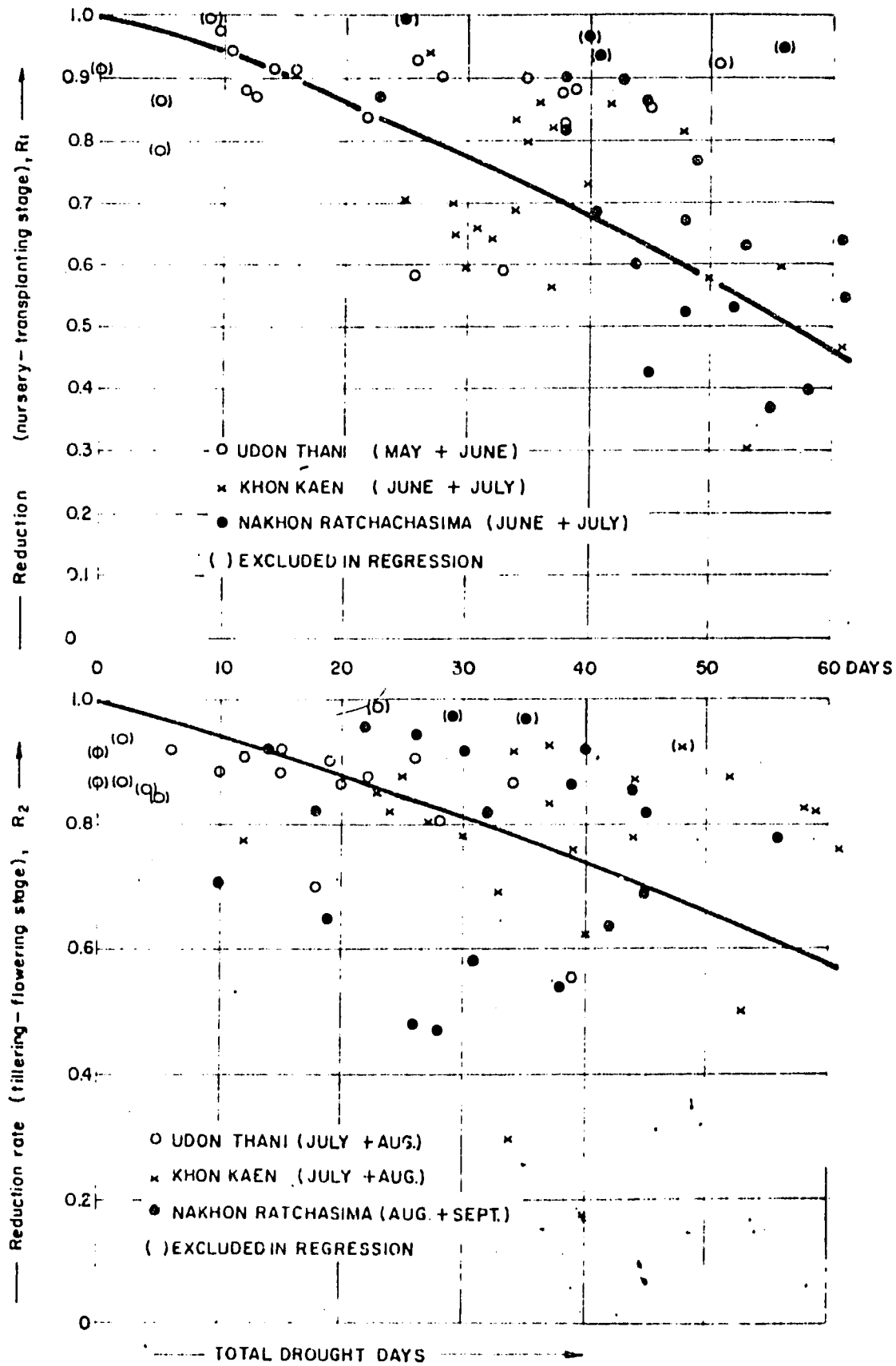


FIGURE 1-9. EFFECT OF DROUGHT DAYS ON PADDY YIELD (1974)

$$Y = Y_{max} \times R_1 \times R_2$$

Perhaps much of this can be explained by flooding which may significantly reduce yields even during years of good rainfall.

The most important measure of stability for the individual farmer and his family is the annual fluctuation in rice production per capita. If 300 kgs. of paddy per head is considered, the normal requirement (NESDB cites a figure of 285 kg. of paddy per head) it appears that in a drought year only 5 provinces (Nong Khai, Sakon Nakhon, Udon Thani, Chaiyaphum and Buri Ram) meet their subsistence requirement. In a good year however, all of the provinces, except Loei, are in surplus.

Rice production is split between glutinous and non-glutinous rice. Over most of the region the various ethnic groups prefer glutinous or sticky rice but in the southern and southwestern provinces non-glutinous rice is preferred. The relative production of glutinous and non-glutinous rice is mapped in Figure 1-10.

Field Crops. Most of the land suitable for field crops is in the western provinces. In these provinces, the land is deeply undulating or mountainous and more appropriate for field and upland crops than for paddy. In the central area of the Northeast, 10 to 25 percent of the cultivated land is also suitable for field crops. This land lies mostly in the shallow undulating land where paddy is grown in the depressions and field crops on the higher land in between. To the east there are only small acreages of field crops.

Cassava, kenaf, and corn are the most important field crops, comprising 95% of the upland crop acreage. In 1977 cassava was the most favored, occupying 49 percent of the upland crop acreage with kenaf and corn planted to 21 percent and 25 percent, respectively. Cassava and kenaf are planted throughout the West and center while corn is highly concentrated with more than 90% located in the three provinces of Nakhon Ratchasima, Loei and Si Sa Ket. Corn requires more fertile land and is less tolerant to drought.

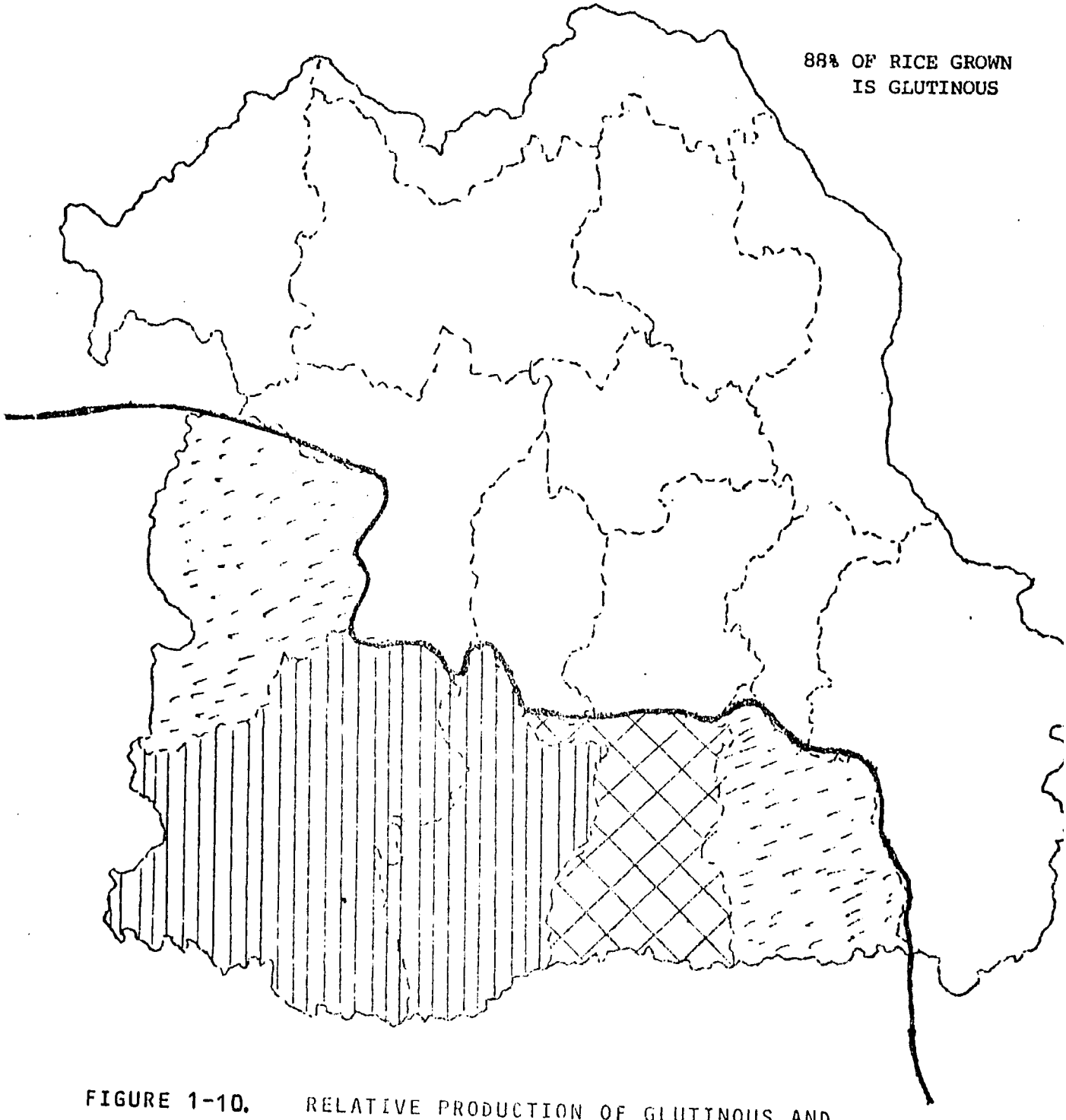


FIGURE 1-10. RELATIVE PRODUCTION OF GLUTINOUS AND NON-GLUTINOUS RICE GROWN

- > 90% OF RICE GROWN IS NON-GLUTINOUS
- > 50% OF RICE GROWN IS NON-GLUTINOUS
- > 30% OF RICE GROWN IS NON-GLUTINOUS
- > 88% OF RICE GROWN IS GLUTINOUS

Cassava and kenaf, however, are better adapted to the infertile, sandy soils of the undulating topography of the region.

In 1980 the planted area of cassava in the Northeast exceeded 720,000 hectares with a production of more than 10 million metric tons. Corn planted area was more than 300,000 hectares which produced over 730,000 metric tons of grain. Kenaf was planted on approximately 300,000 hectares.

Non-Cropped Areas: Accurate information on the exact status of non-cropped lands is difficult to obtain. Since the early 1960's, land in rice cultivation has almost doubled and there has also been a significant increase in the amount of land devoted to upland crops. The bulk of new land development has been carried out by individual farmers converting forested uplands in the watersheds and reclaiming swamp and flooded land. This process can be illustrated from a recent study of Khon Kaen and Maha Sarakham provinces. Using LANDSAT data for these two provinces, a comparison of land use between 1973 and 1979 was made. In Khon Kaen, a total of 377,307 hectares, or 35.5 percent of the total forested area disappeared during the past 6 years. This forested land was transformed into agricultural land of 371,503 hectares, with 600 hectares of forest land transformed into urban land and 5,204 hectares into water resources. The depletion rate is 16.3 percent per annum.

The gross change of forest land use of Maha Sarakham province between 1973 and 1979 was 111,404 hectares or 19.3 percent of total forested area. The forest land was transformed into urban land (300 hectares), agricultural land (110,524 hectares) and water resources (580 hectares). The depletion rate is 11.2 percent per annum.

Total agricultural lands in Khon Kaen province are 773,333 hectares, or 72.8 percent of the total area. This has almost doubled since 1973 as a result of the opening of new lands. In Maha Sarakham, total agricultural land covers 449,928 hectares, or 77.8 percent of the total area. This has

increased by approximately 25 percent since 1973 at a result of the opening of new lands. In all of the Northeast planted rice land, alone, has increased by more than 1.9 million hectares since 1962/63. According to the recent TURA study, 43 percent of the forest reserves in the Northeast have been destroyed (approximately 1.5 million hectares).

Livestock

Farming in the Northeast of Thailand, as in other parts of the country, has been traditionally an integrated farming system, consisting mainly of paddy rice, upland crops and livestock, including poultry. Farmers, who are generally small holders, have integrated their livestock and crop production. Due to the vast area for agriculture in the Northeast, its share in agriculture, especially livestock, has been quite significant. Almost 64 percent of the water buffalo in Thailand are found in this region, while more than 40 percent of cattle and at least 2.2 percent of swine are produced in the Northeast annually.

Buffalo and cattle provide the main source of draft power to crop farming under prevailing rainfed conditions, and also represent long-term savings as well as security of farmers in case of crop failure. Most rice production in the Northeast depends on the use of buffalo and cattle for land preparation, transportation, etc. The use of animals for draft is quite suitable economically and socially since most farmers live in remote areas, own only small areas of land, while family labor is available whenever needed. Buffalo and cattle production is not regarded as a distinct enterprise, rather as an integral part of a crop production system and many characteristics of crop production systems are reflected in the patterns of bovine use and production. Farm households maintain 1-5 head of buffalo and/or cattle with about 60 percent of the total herd inventory being working animals. In general, most farm households own buffalo while about 40 percent own cattle. These animals are fed mainly on crop residues and native grasses and weeds available in villages and surrounding areas

such as fallow paddy fields, upland scrub forests, highway shoulders, communal grazing lands, etc. Buffalo and cattle depend mainly on rice straw and stubble as well as other crop residues such as corn stalks, cassava and kenaf leaves, etc. during the dry season. During the crop season those bovines not being used for work are kept away from the cropping areas and are therefore restricted to roadside, communal grazing lands, and upland scrub forests. Buffalo and cattle at work have to depend on grasses grown on rice bunds or marginal land. Bovines are kept under or around houses at night and manure collected there is the principal source and, in many cases, the only source of fertilizer used for crop production. Buffalo and cattle production is thus very closely integrated with village cropping patterns, and increases in crop yields are likely to improve bovine feed supply through increased amount of crop residues and by-products. On the other hand, an increase in buffalo and cattle production could also improve crop yields through providing more manure for fertilization and more animals for work in crop fields.

Dairy production in the Northeast has not developed to any degree up to present time. The Sum Jan dairy colony (about 16 kms away from KKU) has been promoted by the RTG for more than 3 years but its success or failure remains to be evaluated. However, production of dairy crossbred heifers from Brahman crossbred cows artificially bred with Holstein-Friesian semen has become well accepted by many farmers. If better price guarantee measures for dairy heifers could be provided by the RTG, this enterprise is expected to further expand in the immediate future since the demand for dairy cows in Thailand has been very high and will remain very high in the foreseeable future.

Pig production is traditionally associated with rice production, where rice bran and broken rice are sometimes used by small farmers as feed supplement for pigs. Village pigs are generally fed with locally available weeds and crop wastes such as water hyacinth, morning glory, banana stems, grasses, sweet potato vines and tubers, papaya leaves or fruits, etc. The farmers feed only minimum amounts of rice bran or broken rice to pigs and

these are usually boiled or mixed with garbage. In some areas pigs are allowed to scavenge around houses and cropping areas near the villages with minimal supplement of rice bran and garbage available. It is estimated that more than 90-95 percent of the total pig production in the Northeast, as well as in Thailand, is produced under these small-scale integrated systems. Only a very small portion of pig production comes from a semi-commercial system where more than 15-20 pigs are raised at one time.

Poultry production in the Northeast is mainly backyard poultry raising, which is also an integral part of small farms and rural households. About 80-95 percent of households in the villages raise some number of the indigenous chickens, ranging from 5 up to 50 birds per household. Chickens are generally raised for cash income and home meat consumption. Village chickens generally scavenge around houses and feed on insects or other feedstuffs. Occasionally, a minimal amount of paddy rice is given to the flocks. It is estimated that not less than 80-100 million birds are produced among rural households in the country, and the majority of these are in the Northeast. The number of these chickens, however, are not available in the national statistics due to certain difficulties in the sampling technique.

Chickens, ducks and geese also play a role in livestock-crop integration. Ducks are usually raised around the water ponds scavenging weeds, snails, and small fishes, while geese are raised around the households where they feed on grasses and household garbage.

It is clear that the number of livestock in the Northeast has not increased during the last 10 years. The 1975-79 livestock statistics indicated a slight fluctuation in the number of buffalo, cattle, and swine. (Table 1-1). With the average rate of human population growth of 2.3 - 2.5 percent it is evident that the gap between demand and supply for livestock will continually widen. There is a serious shortage of buffalo and cattle in the country judging from drastic increases in the price of work animals and beef.

THAI GROUPS: CAPITAL LETTERS

OTHER GROUPS: Small Letters

FIGURE 1-11. DISTRIBUTION OF ETHNIC GROUPS IN NORTHEAST

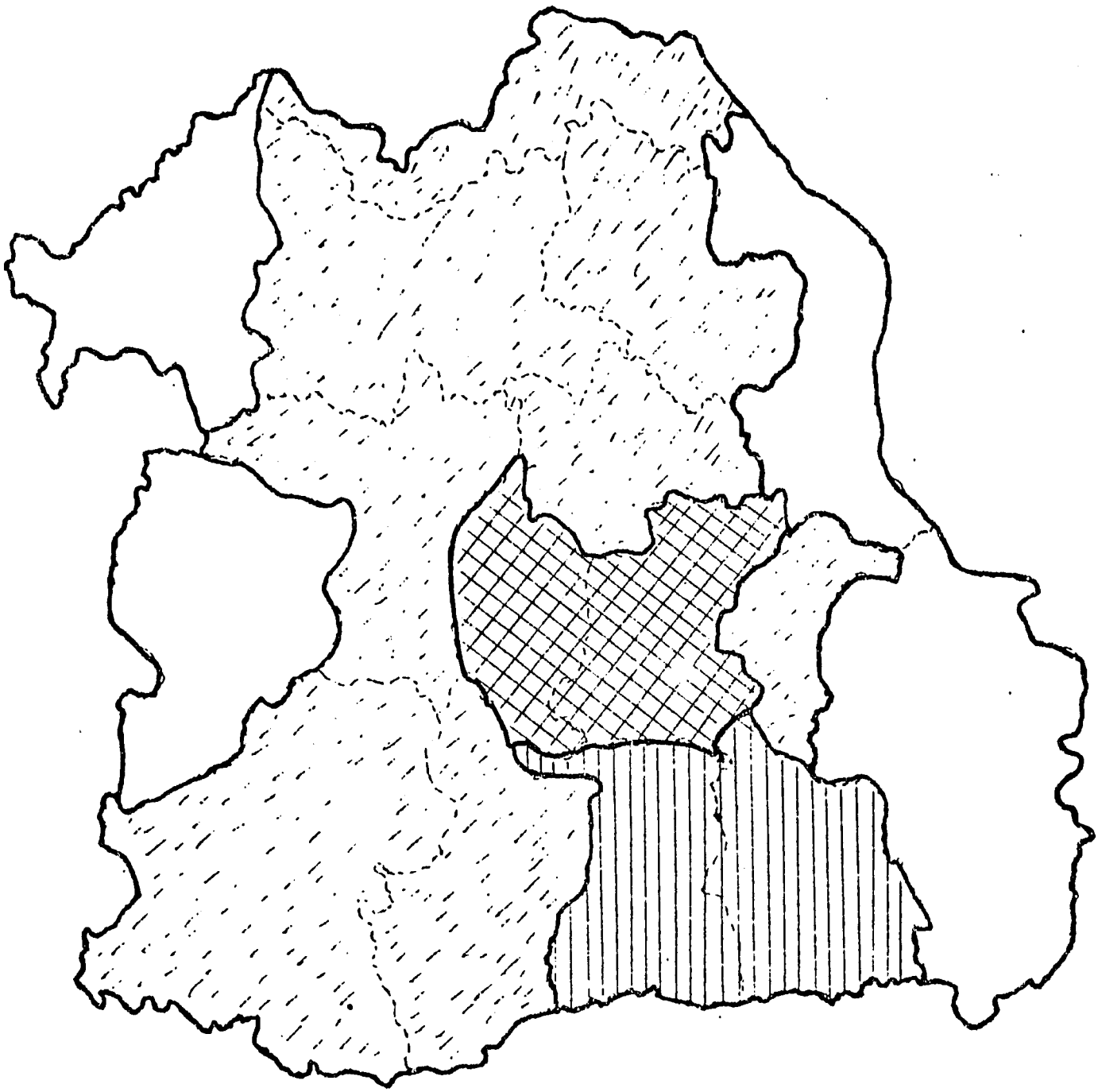


FIGURE 1-12. POPULATION DENSITIES BY PROVINCE

> 120/km^2

100-120/km^2

80-100/km^2

<80/km^2

Table 1-1. Production of Livestock in the Northeast 1975-79.

Year	(million heads) Buffalo	Cattle	Swine
1975	3.459	1.636	0.832
1976	3.674	1.729	0.799
1977	3.665	1.752	0.806
1978	3.830	1.769	1.222
1979	3.838	1.733	0.749

Source: MOAC, Office of Agricultural Economics.

Human Population

The population of the Northeast is estimated at 17 million people, or about one third of the total population of the Kingdom. The majority of the population belong to Phaw-Thai (Thai Isan) who migrated into the Northeast from Laos and the left bank the Mekong River over the past few hundred years. There are seven distinctive sub-groups, the largest being the Laos-Wieng who are located in the center and northeast of the region. The second largest group is the Thai-Korat, numbering 3 million, located in the southwest. The region also contains nearly 0.5 million Khmer in the three Southern provinces (Figure 1-11). Average population density is 88 per km^2 (86 per km^2 for the whole Kingdom), but the provinces of Maha Sarakham, Roi Et, Surin and Si Sa Ket, which contain the plains along the lower reaches of the Mun and Chi Rivers, also have districts greater than 100 per km^2. (see Figure 1-12). Average family size is 6.5 persons per family with a population growth rate of approximately 2.5 percent per year. The average size of farm holding varies by province but in general is around 4 hectares.

About 80% of the population have completed only primary school (Prathom 4) but educational facilities have increased rapidly in the last ten years. There are 1,100 secondary schools; mostly in district or provincial centers. Institutes of higher education, including 2 universities, 6 teacher training colleges and 8 agricultural colleges, are located in all but two provinces.

Villge Structure

The average village in the region comprises 710 people in 105 families. Tambons contain from 5 to 18 villages.

Typically, the Northeast village is clustered, with homesite and agricultural fields separated, and the homesites are not very large. Some villages are fragmented or linear, with their houses scattered along the road. Houses are built of modified Thai design, 1.5-2.5 meters above ground, and have one room or more, a kitchen and a large open area. The size of the house and home site depend on the economic status of the owners. Some have well-defined homesites enclosed with a fence and planted with fruit trees. Poorer households share homesites with their neighbors or relatives. Livestock are quartered under the house alongside a pile of farm implements. A section is set apart for the household's women folk for weaving. During the summer season, this area under the house serves the same function as the veranda because the latter is too hot for relaxation. Most homes will have a bed under the house for added comfort.

Since the homesite is relatively small vegetable gardens are seen only in some households. Generally, vegetables are grown near canals or ponds where water supply is available. In addition to serving as a playground for the children the homesite is also where granaries are built.

Traditionally, there is no public market in the village, except a small shop where household necessities and food are sold. Most of the people go to the town or district center for their supplies. Social centers in the village include the local temple, village hall, school, and the public wells which serve as the meeting places for people, either formal or informal. Some small villages have no local temple or school, and have to share with other larger villages. The local temple is where religious and festive activities take place and it is where people come for community activities in addition to their personal desire for peace and quiet at other times.

The village school is the central place where children attend elementary classes. It is also where meetings between villagers and administrators are held, where sports events between the village schools in the same tambon are organized and recreational activities, such as occasional movies, take place. Furthermore, there is also a village hall (Sala Klang Ban) which may be used to hold meetings and any social gatherings. The public well is also an informal meeting place where the people go to take their domestic water in the morning or evening.

In Thai-Isan culture, girls inherit the land unless there are no daughters, so that young men principally acquire land through marriage. The man usually goes to live with the bride's family for a while and the parents often give the young couple a plot to farm separately during their lifetime. But young men will also acquire land by opening up forest areas, sometimes at a distance from the village. The youngest daughter and her husband are expected to stay in the parental home and look after the parents until they die. They then inherit the house and homesite together with their share of the paddy land. The overall consequence is a fairly rapidly shifting pattern of movement of individuals between villages and of fragmentation and extension of agricultural holdings. Virtually all land in the Northeast is owner occupied and farmed. There are very few tenant farmers; in contrast with the Chiang Mai Valley.

Because of the pattern of female inheritance young men have traditionally left home to seek a wife and land, or a well paid job in another province. Internal and external pattern of migration in the region thus has ancient origins. Today young girls are also going away or are sent away to work.

An important traditional custom in the Northeast Village has been that of labor exchange (long khack). This has been used principally for transplanting and harvesting rice. Farmers are helped by relatives and

neighbors in these tasks. They provide a meal during the work day and later on supply their own labor in return. Usually a village has several such exchange groups.

Labor exchange is now much less common, partly because of the growth of upland cropping which involves much tighter labor scheduling. Hired labor is now widespread and a common practice is to hire a young man for the rice season, who lives with the family and is then paid 100 thang (10 kg.) of rice at harvest. Labor exchange, however, is still important in the construction of rice granaries or houses.

Household Structure: The rural household in the Northeast consist of a nuclear family of 6 to 7 people (Table 1-2). This typically consists of parents plus 2 to 3 school age children, the remaining adults being the grandparents or a married daughter and her husband.

Table 1-2. Characteristics of farm households in Khon Kaen Province.

Item	Number
Number of households surveyed	129
People per household	7
Average number working fulltime	3
Average age of head of household	50
Education of household head:	
No formal education	9.2%
Prathom 1-4	84.1%
Above Prathom 4	6.9
Experience of formal farm training	34.6%
Average land holding/household	31.8 rai

Virtually all the households farm their own land,with over 16 rai being paddy land (Table 1-3). Farmers usually own both upland and paddy land but little is known of the relative distribution of upland, upper paddy and lower paddy. Similarly in Roi Et and neighboring provinces, in addition to paleaquult and palustult soils, farms may also be partially or wholly on dystropept and tropaquept soils, but again the typical distribution of soil types on farms in the non-flood and flood plains is not known.

Table 1-3. Average Land Holding and Land Use for Four Villages in Khon Kaen Province

Land Holding	Rai
Owned land	25.06
Rented land	0.47
Paddy	16.75
Upland crops	6.00
Horticulture	0.09
Residential	0.51
"Idle"	2.17

In addition to major crop land, the farm usually contains clumps of trees or individual trees. According to Fleckenstein (1980) these are mostly kapok, coconut, banana, papaya, and mango, all grown for subsistance and sale, together with leucaena grown principally for subsistance; the pods and tender shoots being eaten with almost every meal.

Most farms also have a vegetable garden for subsistance, located near a good water supply (The average size in Ban On, Roi Et Province, was 48 sq. m.). Vegetables commonly include yardlong bean, chillis, garlic, onions and chinese cabbage.

Livestock are also important. In the villages of Khon Kaen province each household has an average of 3 buffaloes, 1 cow, a pig and several chickens. The buffaloes are used for farm work but the oxen are now no longer used for transportation. Cattle are stabled under the house at night and the manure used on the land.

Silk worm rearing is also important in much of the Northeast. Mulberry bushes are grown either close to the village or close to field huts placed in the paddy land.

The final agricultural enterprise is fishing and most farms, particularly those located in the flood plains, have access to fish ponds, swamps, streams or rivers.

Income from non-crop agricultural activities is a significant percentage of gross income and, given its low input requirements, often forms the bulk of farmers' net income. This fact is illustrated in Tables 1-4 and 1-5.

Table 1-4. Gross Income per Household from Agriculture for Four Villages in Khon Kaen Province in 1979

Source	Baht
Rice	8,976
Cassava	4,207
Kenaf	578
Mungbean	22
Peanut	56
Others	440
Crops - Total	14,270
Livestock & poultry	1,064
TOTAL	15,334

Table 1-5. Net Income Per Household for 6 Households in Baon-On Village, Roi Et (Fleckenstein 1980)

Source	Baht
Rice	9,265
Cassava & kenaf	688
Other cash crops	-38
Vegetables	115
Tree crops	620
Livestock and fishing	5,262
TOTAL	15,912

Farm households in the Northeast are not, however, confined to agriculture production. Non-agricultural enterprises and off-farm employment are a rapidly growing component of farm income.

The range of household enterprises is illustrated by a recent survey (Table 1-6). Members of the household also increasingly work in nearby towns in agricultural processing, construction, textiles, wood, bamboo and cane manufacture and services, as well as on government sponsored rural work programs.

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Table 1-6. Households Engaged in Non-agricultural Household Enterprises (Mead and Charsombaat 1980)

Enterprises	Khon Kaen	Roi Et
Households surveyed	418	278
Silk	132	21
Cotton	30	-
Mats	93	-
Baskets	44	21
Poultry	18	-
Salt	-	10
Knives	-	22
Rice containers	-	13
Oxcarts	-	22

For 4 villages in Khon Kaen province off farm income per household in 1979 amounted to 10,105 Baht (compared with 15,334 Baht from agriculture). The growth rates since 1975 are as follows (in real terms):

	Farm Income Per Capita	Off-Farm Income Per Capita
1975	1,411	160
1979	1,736	1,144
Growth rate	5.32%	63.53%

2. RESEARCH CAPABILITIES IN RAINFED AGRICULTURE

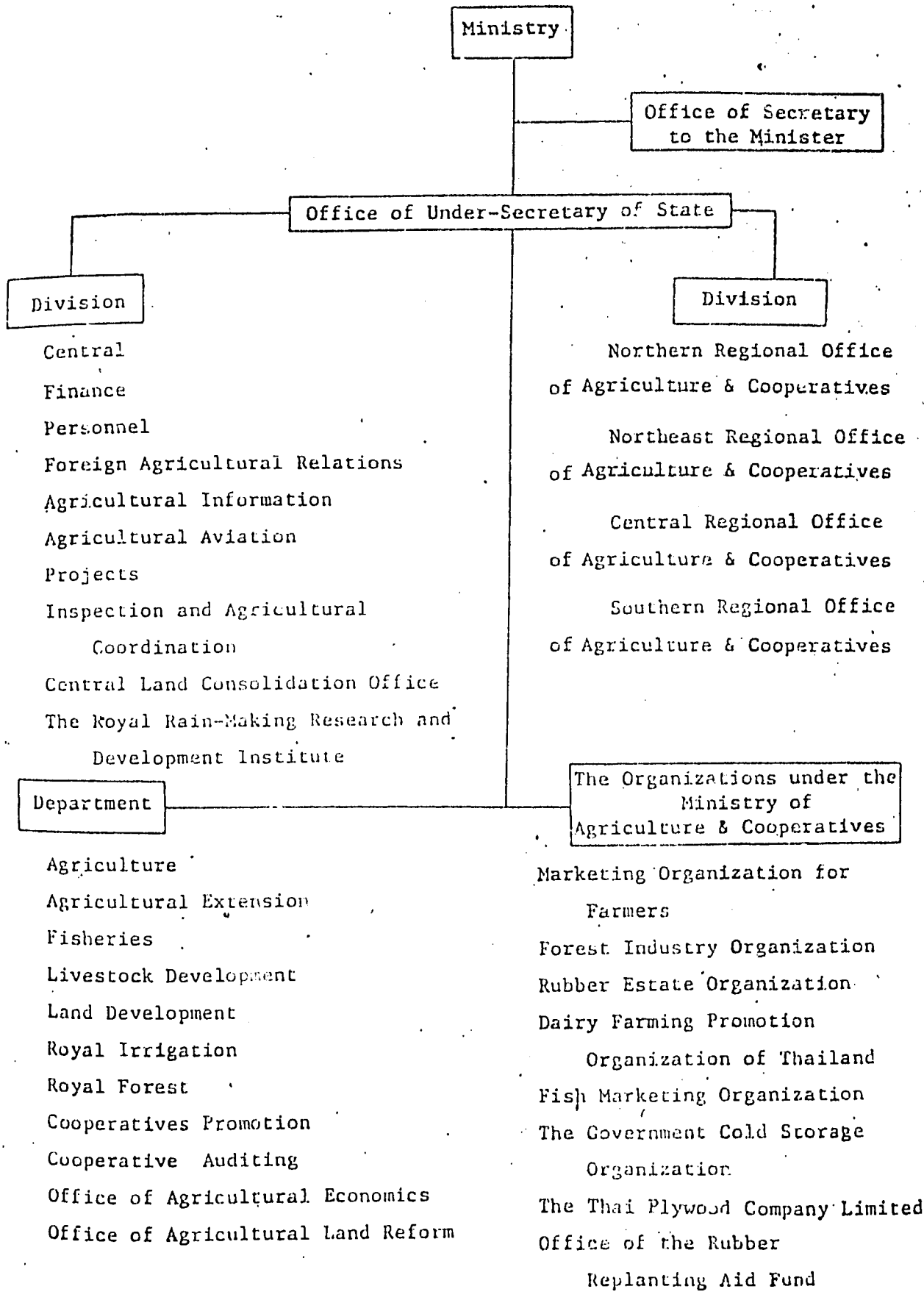
Background

The Ministry of Agriculture and Cooperatives (MOAC) is the principal public agency responsible for agricultural research and technology diffusion. The Department of Agriculture (DOA) undertakes research work in crop production while the Department of Agricultural Extension (DOAE) is responsible for diffusion of crop production technology. Other departments in this Ministry perform their duties both in research and extension in their respective fields. i.e. livestock production research and extension are under the Department of Livestock Development (DOLD) while the Department of Fisheries (DOF) is responsible for marine, fresh, and brackish water fishery production research and extension. The Royal Forest Department (RFD) and the Department Land Development (DLD) are likewise responsible for both research and extension in their respective fields. The Cooperative Promotion Department is not only responsible for promoting the cooperative system but also for technology diffusion to cooperative members. An organization chart of the MOAC is presented in Figure 2-1.

The MOAC delegates to the Agricultural Land Reform Office the authority to transfer research technology to people in certain geographical areas under the Agricultural Land Reform Plan.

Besides the MOAC, the Ministry of Interior is also responsible for technology transfer within specific geographical areas. For example, the Self-Help Land Settlement and the Hilltribe Welfare Divisions under the Public Welfare Department are responsible for agricultural development and technology diffusion in their respective areas. The Office of Accelerated Rural Development is responsible for employment and income development, infrastructure development, and agricultural productivity improvement. Technology transfer is a means to achieve these objectives.

Figure 2-1. Organization Chart of the Ministry of Agriculture and Cooperatives (MOAC).



Besides the Ministry of Agriculture and Cooperatives, the Ministry of Defense supports extension activities through the National Security Command Headquarters. Responsibilities of this organization involve technology diffusion for infrastructure development--roads, reservoirs, small dams; introduction of new breeds of livestock, feed stuffs and plant varieties appropriate for particular areas; encouraging community members to set up cooperatives and/or solving their marketing problems. These activities are conducted only in selected politically sensitive areas with the specific aim of countering communist efforts in recruiting members from those villages.

Two universities, namely Kasetsart and Khon Kaen, perform both research and limited extension activities in the Northeast. Agricultural research findings from these institutions are either transferred to concerned ministry departments or directly to the communities in the vicinity of research locations

To sum up, technology diffusion activities of the public sector are undertaken mainly by departments of the MOAC. Other government units are charged with such responsibilities only within specific areas. All agricultural research and technology extension activities of the public sector are intended to improve agricultural production efficiency of the country.

Research Constraints (DOA)

Research activities, while primarily concentrated under the Department of Agriculture (DOA), are not organized in such a manner as to be directly applicable to the wide range of needs of Northeast villagers. This is particularly true if farming is viewed as a total system with crops, livestock, fisheries, tree crops and off-farm opportunities, seen as components of the system. DOA research is straight commodity oriented with separate divisions for rice, upland crops (field crops), horticulture, sericulture, and rubber. Each of these divisions has its own experiment

stations and, in effect, run independent research programs that originate and are controlled out of Bangkok. To further complicate the issue, livestock and fisheries are different departments under the MOAC and therefore have their own research agendas. Extension and agricultural economics are also separate offices with independent budgets, leadership and work plans.

This dispersion of research activities, as well as the lack of regional control, makes it very difficult to examine agricultural activities as a total system.

Initially it was thought that the Northeast Regional Agricultural Research Center at Tha Phra would be able to bring focus to the independent research programs of the various departments and divisions. Unfortunately, the power of the divisions and departments was such that they have been able to effectively reduce the research role of the Northeast Regional Center (now a coordinating office) to insignificance.

Even though the research program of DOA is very fragmented, if there was enough technical competence they could at least produce some valuable component technology. However, as there are very few highly qualified scientists permanently assigned to the Northeast, present DOA research results are not very pertinent to actual farmer needs nor is most of the research very well supervised. It is not unusual, for example, to find rain-fed rice trials have been irrigated by staff at that specific rice research station. While this action guarantees that the rice will survive to maturity and thus provide data it does not tell researchers how well those varieties perform under actual farmer field conditions.

The distribution of personnel by degree for some of the major MOAC departments is presented in Table 2-1.

Table 2-1. Partial Distribution of MOAC Regional Personnel - 1981

Department	Degree Level				
	Unclassified	Vocational	B.S.	M.S.	Ph.D.
DOA	24	543	254	35	6
DOAE	78	7,405	1,360	40	-
DOLD	184	816	400	-	-
DLD	593		81	4	-
RID	800	429	126	6	-

From Table 2-1, which represents all the regions of the country rather than just the Northeast, it is apparent that very few post graduate MOAC research scientists are assigned to field offices in the region. In addition there are a few post graduate level research scientists assigned to the regional offices such as the one at Tha Phra.*

DOLD Livestock Research Activities in the Northeast

Besides Khon Kaen University and the Northeast Regional Office of Agriculture and Cooperatives, the Department of Livestock Development (DOLD) carries out most livestock research in the Northeast. There are 7 livestock breeding stations in the Northeast out of the country total of 12 stations; they are located at Tha Phra, Lamphyaklang, Maha Sarakham, Sakon Nakhon,

*A complete survey of rainfed agricultural research by the DOA is presented in the excellent report, A Survey Report on Rainfed Agricultural Projects in Northeast Thailand. Because of the availability of this report through the Office of the Under Secretary of State, MOAC, this information is not repeated in this document.

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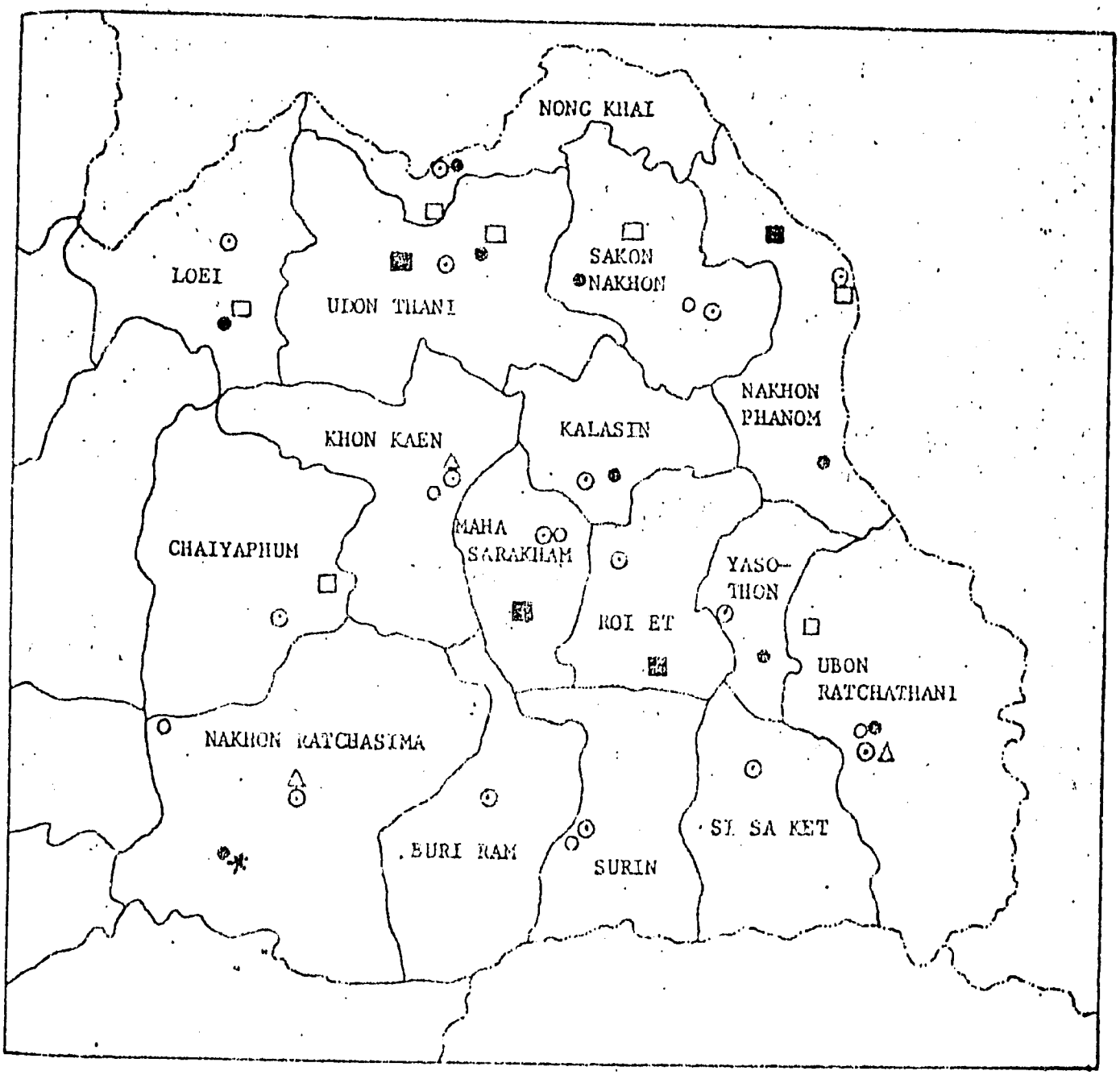
Ubon Ratchathani, Surin, and Pak Chong (see Figures 2-2 and 2-3 and Table 2-2). In addition, the Tab Kwang Livestock Breeding Station, Saraburi Province, is at the periphery of the Northeastern region. The Chaiyaphum Cattle Distribution Center has also been in the process of upgrading to become a livestock breeding center. These livestock breeding stations have buildings, animals, and facilities available for the researchers from the outside of the stations such as those from the research divisions in the DOLD as well as from colleges and universities. Besides these livestock breeding stations, there are other stations and units in which research can be conducted. They are the Artificial Insemination Stations (3), the Forage Crop Stations (9), the Public Pasture Development Units (14), and the Vaccine Production Center at Pakchong. And most of all, the DOLD has established the Office of Livestock Development Project in the Northeast (NELDP) at Tha Phra where excellent research facilities are available. In addition, the NELDP operate 16 Livestock Development Units (LDU) and these LDU's in turn supervise 80 Livestock Development Centers (LDC). These LDU and LDC's are located throughout the Northeast. Although these units and centers are mainly engaged in livestock development at the village level, certain research activities could be enhanced by these units.

The DOLD also seconds certain research officers to work at the Northeast Regional Office of Agriculture and Cooperatives (NEROAD) at Tha Phra. In addition, the DOLD operates the Disease Diagnostic Laboratory in the compound of the NEROAC with the assistance from the West Germany Assistance Agency (GTZ). The project is now in the final year of its first phase (4 years), and the second phase of 4 years has already been approved.

Research and Development Programs and Activities: DOLD research activities are mainly concerned with the improvement of cattle and buffalo production. Only some research work has been conducted with swine and, to the lesser degree, with poultry. Research work in cattle and buffalo has been aimed at finding better feeds and forage crops and feeding methods, better health care and disease prevention techniques, better breeds and breeding



○ Livestock Breeding Station

□ Livestock Distribution Centre

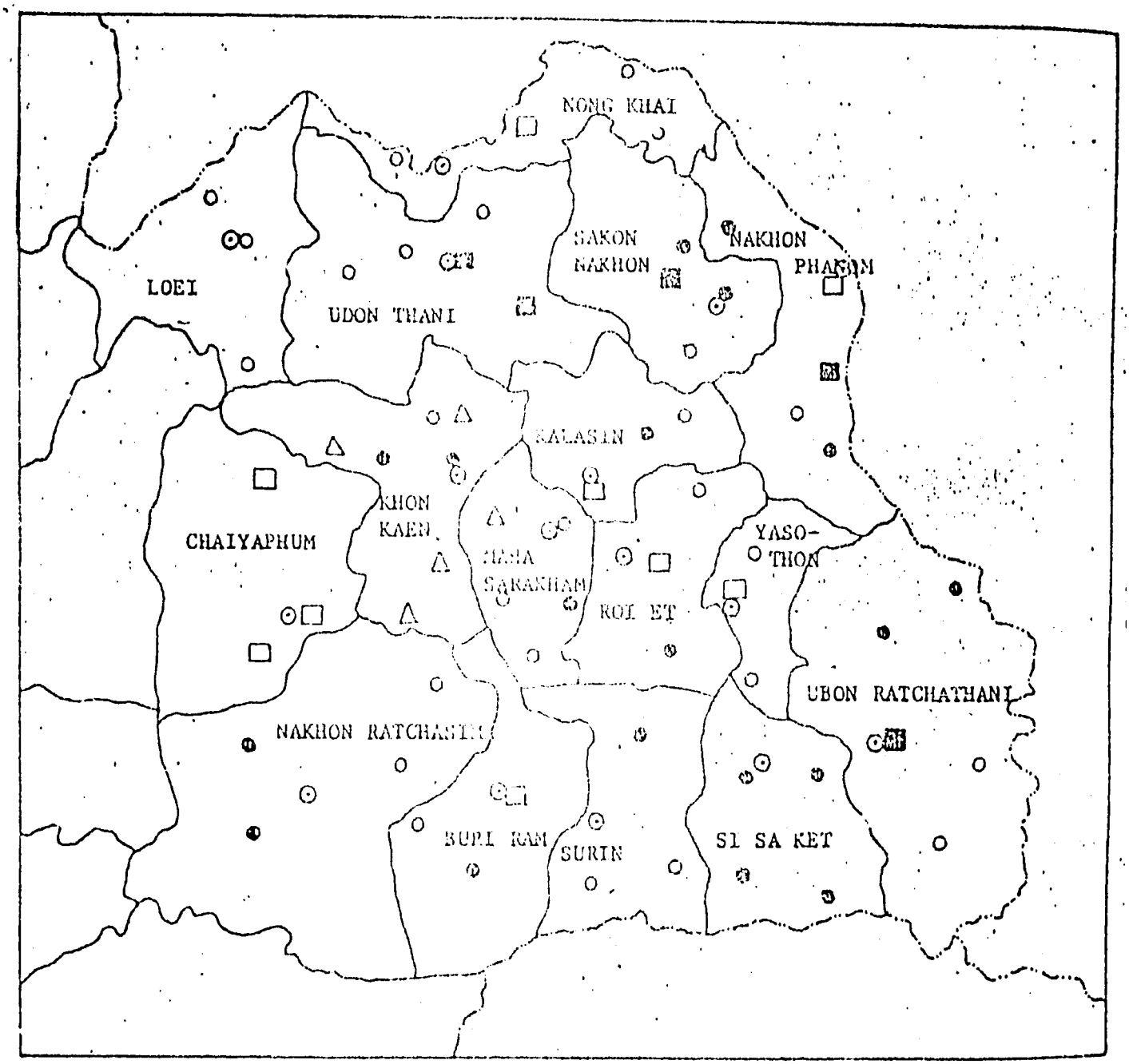
△ A.I. Station

● Forage Crop Station

■ Public Pasture Development Unit

* Vaccine Production Center

Figure 2-2. Locations of livestock station, livestock distribution centre, A.I. station, forage crop station, and public pasture development unit in the Northeast



△ Livestock Development Centre, established in 1976

■ Livestock Development Centre, established in 1977

□ Livestock Development Centre, established in 1978

● Livestock Development Centre, established in 1979

○ Livestock Development Centre, established in 1980

Figure 2-3. Livestock development centre in the Northeast during the years 1976-1980

Table 2-2. Distribution of beef cattly in different livestock breeding stations and centers, 1979

unit: head

livestock breeding station	beef cattle			livestock centers	beef cattle		
	bull	cow	combined		bull	cow	combined
Northeastern Region:				Northeastern Region:			
Tha Phra	132	307	439	Udon Thani	9	7	16
Lamphyaklang	68	483	551	Nong Khai	8	-	8
Maha Sarakham	125	354	479	Ubon Ratcha-thani	11	-	11
Sakon Nakhon	45	180	225	Sakon Nakhon	2	-	2
Ubon Ratcha-thani	53	149	202	Nakhon Phanom	4	5	9
Surin	9	-	9	Loei	14	26	40
Pakchong	84	158	242	Chaiyphum	-	-	-
Other regions:							
Tab Kwang	210	522	732				
Chiangmai	59	158	217				
Yala	19	1	20				
Tak	86	229	315				
Nong Kwang	103	273	376				
total	993	2,814	3,803	total	49	38	87

Note:

American Brahman	1,540
Santa Gertrudis	220
Charolais	52
American Brahman crossbrd	1,477
Santa Gertrudis crossbrd	72
Charolais crossbrd	1

Source: Thirty-six Years of Department of Livestock Development, Ministry of Agriculture and Cooperatives

efficiency, as well as improved management and animal care techniques. Similar types of research and development activities have been conducted with swine. The most apparent impact in livestock improvement achieved by the DOLD has been successful crossbreeding and upgrading of the indigenous cattle and pigs with introduced breeds, using both natural breeding as well as A.I. techniques.

The Northeast Livestock Development Project: This is a 5 year project utilizing a World Bank loan and the RTG budget totalling 292 million baht which is scheduled to end in June 1982. The results of this project have made a wide impact on livestock production in the Northeast. It is learned that some funding agencies have shown serious interest in continuing the project. The NELDP has a main Office of Livestock Development Project (OLDP) at Khon Kaen from where the main policy decisions are relayed to project staff at all levels. Staff located at Khon Kaen include the Project Director, the heads of research and demonstration, extension services and administrative sections. The subsections at OLDP responsible to the section heads include seed production and collection, pasture development and seed distribution, semen collection and distribution, and animal health (in collaboration with the diagnostic laboratory).

The NELDP research program emphasizes finding appropriate technology for increased livestock production in existing crop-livestock integration systems. The research aims to find a technological package suitable to different agro-climatic and socio-economic situations. Findings from research and observations include genetic improvement and introduction of new species of livestock and poultry into the systems, introduction of low-cost pasture and fodder production, improved utilization of crop by-products, improvement of health program, needs for organized markets and credit accessibility, etc.

Bovine nutrition is being improved through (1) the oversowing of village communal grazing lands, including roadsides and second growth forest areas, with introduced tropical legumes, particularly Verano (Stylosanthes hamata) and Siratro (Macroptilium atropurpureum); (2) the development of backyard and private pasture on small areas of land or rice paddy bunds belonging to individual farmers, (3) the acceleration of pasture development and fodder production through initiation of a program to contract farmers to produce pasture seed, (4) the improved preservation and utilization of crop residues and farm by-products.

Besides promoting the development and improvement of pasture by the small farmers themselves, there is a task for government to improve waste land or non-cropping areas and natural grazing lands, to make them available as efficient communal grazing areas. Oversowing of Verano and Siratro has proven successful and provides protein-rich feed and increased total dry matter for grazing animals, as well as improving soil fertility through nitrogen fixation. The Northeast Livestock Development Project has been successful in the production of Verano seed on a small farm contractual basis and a total yield of about 69 tons was bought in 1980. Helicopters have been used broadcasting Verano and Siratro mixed seeds over communal land and regrowth forest areas to accelerate the pasture development program. About 10,000 rai (1600 ha) of the areas in the Northeast had been oversown by the end of July, 1980.

Native cattle are being upgraded by American Brahman cattle, either through artificial insemination or by mating with bulls provided to farmer groups under a loan bull program. In some project villages, the contracted dairy calves production program has been introduced where crossbred Brahman females are artificially inseminated with Holstein Friesian frozen semen. At present, the Department of Livestock Development, through the Northeast Livestock Development Project, guarantees to purchase the calves at 6-8 months of age, females for a price of 30 Baht and males for 12 Baht per kilogram liveweight.

Livestock disease is to be better controlled through the introduction of co-ordinated and regular vaccination service and veterinary advice. Local central livestock markets to serve several farmer groups are being promoted but have not yet been established. Provision of credit to farmers is not included in the project, but the assistance in drawing up the program and seeking a source of the loan is provided. It is anticipated that about 4,800 villages will benefit from the development.

Introduction of geese and Muscovy ducks into villages to help utilize weeds and crop wastes is on demonstrational scale.

Since most farmers are small holders and are practicing livestock-crop integration, animal health programs of the department benefit this majority group and play an important role in the success of crop-livestock integration. Most of the major infectious diseases, including Haemorrhagic Septicemia, Anthrax, Foot-and-Mouth Disease, Infectious Bronchitis, New Castle Disease and Duck Plague are now coming under control in selected villages through vaccination programs. The vaccination service is provided free to small farmers.

Some Results from the NELDP: (1) Roadside and communal grazing areas: Roadsides in Northeast Thailand are grazed by livestock when access is denied animals to paddy areas. The Project has undertaken a program of sowing legume seed (*Stylosanthes & Hamata* cv. Verano, *Macroptilium atropurpureum* cv. Siratro) from the back of utility vehicles before the rainy season with the intention of boosting quality, quantity and persistence of available grazing and having some weed control as well.

Communal grazing areas exist near some Northeast villages and the above species together with additional legume species S. guyanensis, and grass species Urochloa mosambicensis (Sabi) have been sown. Some areas have had weeds slashed by rotary cutter and tractor but that has had limited value because of temporary relief it gives from weeds. From the start of the Project to the end of the 1979 wet season (September) 13,555 ha. had been oversown with improved pasture species by field staff. This includes roadside areas as well as communal grazing areas. Besides public land there is a large area of privately owned land which is suitable for oversowing. This may include some paddy bunds but mostly is upland area. From the beginning of the Project in 1976 to September 1979, 5,804 ha. of private land had been oversown by field staff.

The third aspect of seed dispersion is the establishment of backyard forage areas in villages. From 1976 to September 1979, 64,205 farmers have had forage areas established in their villages.

(2) Seed Production: Prior to 1978-79 season, the only legume seed produced by the project was on livestock and forage crop stations. This was found to be unsatisfactory with yields of less than 100 kg per ha. Village farmers were then contracted in the 1978-79 season to produce S. hamata cv. Verano seed and in the second such year (1979-80) 68,650 kg. of seed was purchased by the project. All other grass and legume seed is harvested from stations, in the 1979-80 season a total of about 17,980 kg. of legume seed and 5,347 kg. of grass seed was harvested. The OLDP has a seed cleaning and storage unit with a capacity to machine clean all seed produced.

The village seed contract scheme will be expanded to include M. atropurpureum cv. Siratro, and S. scabra cv. Seca. Farmers have shown aptitude in seed harvest with yields of clean Verano seed as high as 600 kg. per ha. They are enthusiastic because it is profitable when compared with other upland crops such as kenaf and cassava.

The seed production section has become a major asset of the project providing most of the seed required by Livestock Stations and farmers as well as communal areas.

(3) Breed improvement. The loan bull program was instigated to cover village cows where A I services could not be regular or where it was considered necessary to have some overlap. The concept was good but there have been some problems with its operation. Some imported Brahman bulls did not have resistance to local diseases, especially tick fever (Anaplasmosis), and apart from losses, fertility was greatly impaired. There has been a tendency to take bulls to the villages at too young an age. Brahman bulls have been found to work best at 3 years and older. (The number of loan bulls in service at February 1980 was 304 of which only 53 were aged 3 years or more.) When loan bulls are delivered to villages one person is appointed to be responsible for the good care and nutrition of the bull, but this has not always been well done and, because body condition is closely related to fertility, there has been low fertility or temporary sterility in some cases. Brahman bulls are shy breeders yet frequently matings are attended by noisy crowds. Some of the loan bulls have suffered physical damage that has rendered them incapable for varying lengths of time. Resting of bulls has been attended to, but not always under satisfactory conditions of balanced diet.

The A I program has been operating from Khon Kaen since before the NELDP was begun. It has become a regular service to 54 districts in the Northeast with both fresh (8 districts) and frozen semen now being used. Conception rates have been reported to be acceptable where animals can be inseminated within 12 hours of standing heat. Frequently figures of conception to A I have been based on a non-return of the cow, whereas it may have been possible for such females to be pregnant by village bulls. The inception of the dairy crossbred heifer scheme will provide a reliable check on the success of the A I program.

The main problem with A.I. is the short time available for the technician to be notified by farmers, to travel to the village and then inseminate, with all the associated limitations normally associated with the technique. In the early years of the project, fresh semen lost viability from prolonged transport time, usually by public transport system. Now, frozen semen can be sent either by vehicles travelling for other purposes to units or if the livestock development officers are travelling to OLDP for monthly meetings or other purposes. There is less reliance on the public transport system.

Despite this new development (1 1/2 years) and considering the above limitations, plus the added one of FDOs having extra responsibilities in their extension package, the A.I. program has made progress in the objective of upgrading native cattle in remote villages.

(4) Health Program. Due to a lack of personnel at the HDO (provincial) level, the animal health improvement part of the project was severely hampered. In the year since two field-operative veterinarians and accompanying diagnostic facilities have been going, progress has been made but as yet the impact has been small. Most of the work so far has been in investigation, especially concerning the incidence of Brucellosis. Now vaccinations are being used against Brucellosis, Haemorrhagic Septicaenia, and Foot-and-Mouth disease in both cattle and buffalo. Pilot village studies are underway to investigate low reproductive rate among cattle. Farmers are being trained in the use of poultry vaccinations and will have Newcastle Disease, fowl pox, fowl cholera and duck plague vaccines available for their own use. The health program has also been of small impact because the field development officers have not received proper training in a field not well understood by them. This problem is likely to continue as long as there is a chronic shortage of health officers.

On a small scale, but likely to expand greatly because of strong demand, is an extension service provided by the Project for establishing poultry (geese, Muscovy ducks, improved-breed chicken) in Northeast villages. Preliminary research has been conducted and shown geese to be acceptable and viable in villages.

The National Buffalo Research and Development Center Project: The DOLD has been the key agency to promote buffalo research and development activities since 1971 when it decided to make the Surin Livestock Station a National Buffalo Breeding and Research Center. In 1975, the Memorandum of Agreement on the Cooperative Project on Buffalo Production was signed by the collaborative agencies; they are the DOLD, Kasetsart University, Khon Kaen University, the Office of the Northeast Agriculture, and the Rockefeller Foundation. Chulalongkorn University, as well as some other colleges and universities interested in buffalo research, joined the project later on. In 1979, a project proposal to establish the National Buffalo Research and Development Center (NBRDC) was submitted, and this project was approved by the DOLD in 1980. However, foreign sources for project support have been sought by the DOLD. To date, the research costs have been supported by each cooperating agency, utilizing buildings, field equipment and facilities, research animals, and field personnel of the DOLD. More than 65 research staff from various agencies are identified to participate in the project. Many research projects in various disciplines have been conducted such as those in reproductive physiology and A.I., nutrition and feeding, disease and parasite prevention and control, village production practices, as well as the breeding selection program going on at the Surin Buffalo Breeding Center. Every year several million baht for buffalo research spending is channeled to the project both indirectly and directly. Some outside donors, both foreign and domestic, contribute to the project each year. Some foreign research support such as that from the Rockefeller Foundation, the Netherlands Government, the FAO/IAEA, the IFS, etc. has been obtained by certain cooperating institutions in the project. The NRC also supports certain buffalo research projects submitted annually. The NBRDC project

combines all research and development activities all over the country but most of its activities have been concentrated in the Northeastern region where more than 60 percent of the buffaloes are produced.

Other Research Activities: (1) The Northeast Disease Diagnostic Laboratory. There are about 25 technical staff with at least the D.V.M. degree working at the laboratory at Tha Phra. The laboratory has as its function disease diagnosis upon receiving case samples from the field. The case samples could be sent in by the provincial or district livestock officers, farmers, or its field visiting officers. The laboratory has received technical assistance from the West German Government during the last 4 years and this assistance will continue for another 4-year period. This laboratory works very closely with the NELDP and takes active participation in the NBRDC project.

(2) The Nong Sarai Vaccine Production Center at Pak Chong. This center specializes in the research and production of vaccine, especially Foot-and-Mouth Disease vaccine. This center carries a large number of technical staff with higher qualifications since it is the first and the largest vaccine production center in Thailand. The Japanese Government has given sizable technical assistance to this center.

(3) Research Projects in Swine and Poultry. Most research done by the DOLD concerning swine and poultry is in the fields of feeding and health. The National Swine Research and Training Center (NSRTC) was established jointly by the DOLD and Kasetsart University about 15 years ago. The NSRTC carries out most of its research activities at the KU second campus at Nakon Phathom Province, however, considerable research activity has also been conducted in the Northeast. In certain projects such as that on cassava nutrition, joint research activities are also done in cooperation with the Department of Animal Science, KKU. One swine breeding station of the NSRTC is located at Tab Kwang, Saraburi Province, where research in different disciplines has been conducted.

(4) Research in Dairy Production. Previously DOLD was directly involved in dairy research through the Thai-Danish Dairy Project at Muak Lek, Saraburi/Nakhon Ratchasima. The project later on was promoted to become an autonomous agency in the Office of Under-Secretary, MOAC, called the Dairy Promotion Organization of Thailand (DPOT). The DPOT, since its beginning as the Thai-Danish Dairy Project, is now in its twentieth year. There are a relatively large number of extension and development officers in the DPOT. Most of them are mainly engaged in dairy development and training work at present. DPOT potential for research is great judging from its available equipment, animals, etc.

Role of the University

Historically, Thai universities were viewed as teaching institutions with no research responsibilities. It was not until recently that research was officially made one of the university's functions although the bulk of university research funds are provided by outside funding sources. While agricultural universities in Thailand produce annually more than 1,000 graduates in agriculture, their present role in agricultural research and extension is severely constrained both due to lack of Government research budget and refusal by the MOAC to recognize the legitimacy of the research role of the University. Agricultural universities in Thailand receive less than 5 percent of the national agricultural research budget.

However, in spite of their institutional constraints, agricultural universities are increasingly developing a significant number of well qualified staff with advanced degrees from abroad. There are more Ph.D. and M.S. level qualified staff at Khon Kaen University, alone, than are stationed outside of Bangkok for the DOA throughout the country. Even after the completion of the National Agricultural Research Project, there will be more than twice as many Ph.D. agriculturalists at the regional universities than at DOA research stations (if Kamphaengsaen Campus of Kasetsart University is considered a regional university then there are more than four times as many).

In spite of a historical philosophical reluctance within the MOAC in Bangkok to recognize the competence of the university staff, DOA, DLD, DOLD and DOAE staff are increasingly drawing on the skills found at the agricultural universities. This is particularly true in the Northeast where MOAC has a very limited number of post graduate staff. Both on a personal and formal basis agricultural staff from Khon Kaen and Kasetsart University are playing a major role in regional training, research and extension projects. Specific research activities include Kasetsart and Khon Kaen University cooperative assistance with the Department of Livestock Development (DOLD), Tha Pra Center, and the Surin Livestock Center. Their research work is designed to promote water buffalo research and development activities. Out of this collaborative research has grown the National Buffalo Research and Development Center (NBRDC). The majority of the buffaloes are produced in the Northeast and therefore most of the NBRDC work is located in the Northeast. Khon Kaen and Kasetsart Universities are also working closely with the DOA Technical Division in joint research on cropping systems. This research has been underway since 1976 and involves research at sites in Ubon, Khon Kaen and Pimai plus organization and attendance at local and regional cropping system seminars. Khon Kaen and Kasetsart University staff, along with staff from the Field Crops Division of DOA, are in process of finalizing a cooperative research project on groundnuts. The project, with support from IDRC, will link directly with Peanuts CRSP activities funded under the Title XII program. There has now been established an informal working group which is to serve as the coordinating body for a Coordinated Groundnut Program. Eventually it is planned to formalize this committee. Assistance from Khon Kaen University in the Northeast will allow the DOA to divert more of its resources to the North where there is not as strong on-going research program. Each year, Khon Kaen University provides assistance for training programs organized by the DOAE, Department of Community Development, Department of Public Welfare, Department of Local Administration and other national, regional and local organizations.

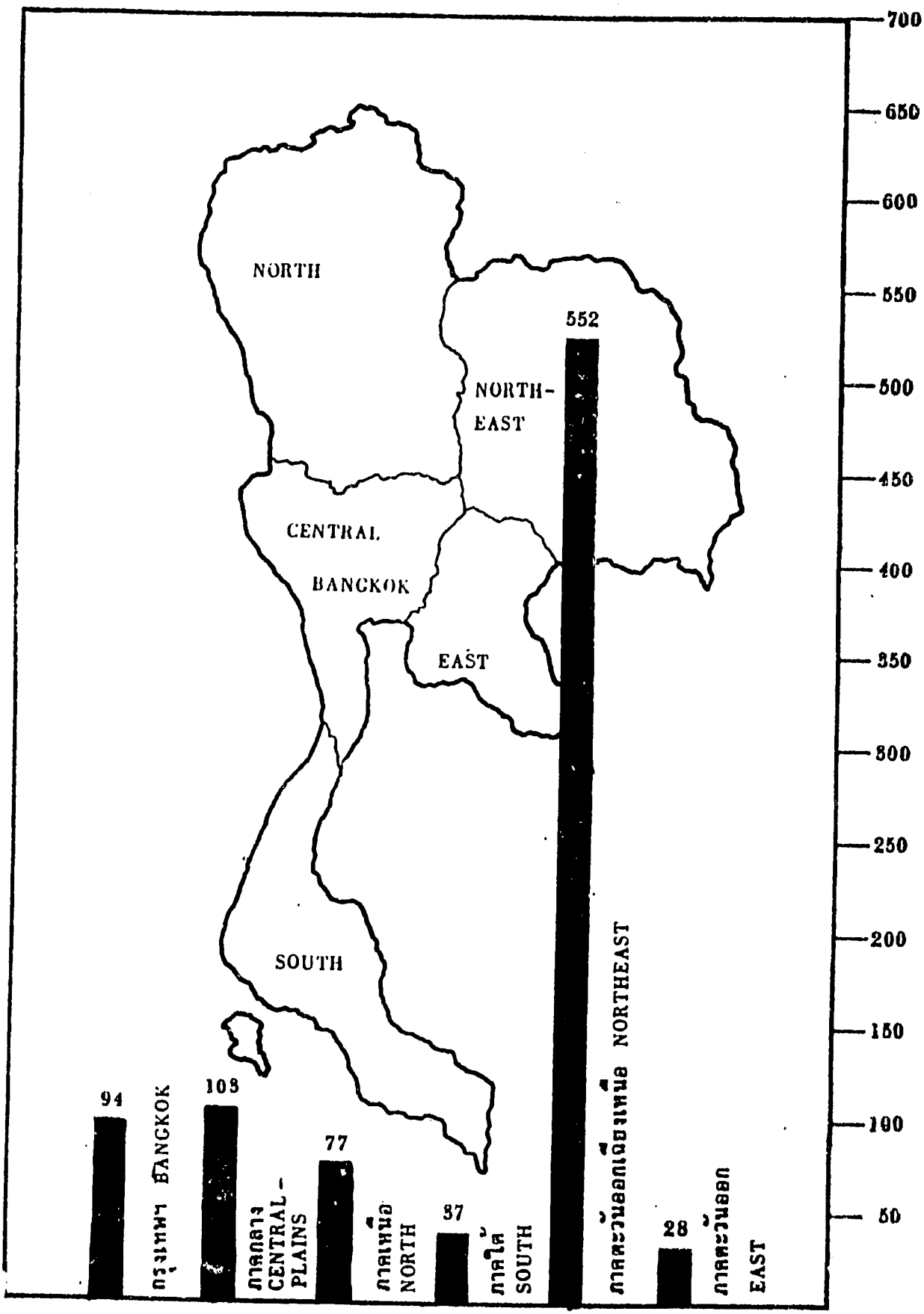
3. KHON KAEN UNIVERSITY INSTITUTIONAL ANALYSIS

Background

Though officially established in 1966, Khon Kaen University (KKU) actually came into existence under the name "University of the Northeast" in the 1964-65 academic year during which time instruction was given at the Faculty of Medical Sciences of Mahidol University. It was not until January 25, 1966 that KKU was granted its Royal Charter and its name changed to Khon Kaen University in harmony with the name of the provincial town within which it is now located. KKU was established to serve the needs of the sixteen provinces of Northeastern Thailand. Evidence of academic expansion can be readily assessed in terms of academic programs and other academic activities available, while physical expansion is evident in terms of budgets, academic and residential buildings, as well as other supporting facilities. Beginning with two degree granting faculties--Agriculture and Engineering--the following faculties were subsequently added: (1) Education (1969); (2) Nursing (1971); (3) Science-Arts (1973); (4) Medicine (1974); (5) Medical Technology (1978); (6) Humanities and Social Sciences (1978); (7) Public Health (1978); (8) Dentistry (1978) and Graduate School (1978). A Faculty of Pharmacy is also in the advanced planning stage.

Enrollment has grown steadily from 107 in 1964-65 to 4,294 in 1980-81. Approximately 50% of the annual total enrollment is from the Northeast itself and this proportion is expected to increase in the years to come. To help achieve this end, KKU has, since 1970, also set aside special quotas and offered special admission privileges to students who have completed their high school studies in schools within the sixteen Northeastern provinces. From Figure 3-1 it is obvious that the University is serving the Northeast as over 62 percent of the entering students during 1979 are from within this region.

FIGURE 3-1. ORIGIN OF ENTERING STUDENTS



Staff

Including the Graduate Faculty, the University now includes 11 faculties with 836 professional staff members. Currently there are 135 Ph.D.s., 466 M.S.s., and 235 B.S.s. Distribution of staff members by faculty is shown in Table 3-1.

Table 3-1. Staff Members by Academic Qualifications (1981)

Faculty	Education in Thailand			Education Abroad			Total Regular Staff
	B.S.	M.S.	Ph.D.	B.S.	M.S.	Ph.D.	
Agriculture	18	20	-	7	38	29	112
Engineering	37	17	3	1	30	13	101
Education	49	44	-	-	17	17	127
Nursing	57	25	-	-	12	1	95
Science	27	65	-	2	20	13	127
Medical	3	96	21	-	12	35	167
Medical Tech.	14	9	-	-	-	-	23
Humanities and Social Sciences	16	23	-	1	19	3	62
Public Health	3	4	-	-	5	-	12
Dentistry	-	10	-	-	-	-	10
Total	224	313	24	11	153	111	836

Out of the 836 presently employed staff members, 144 are studying for higher degrees in Thailand and abroad. Distribution of these staff members by faculty are detailed in Table 3-2.

Table 3-2. Staff Presently Studying in Thailand and Abroad

Office/Faculty	Overseas			Thailand			Total Staff
	B.S.	M.S.	Ph.D.	B.S.	M.S.	Ph.D.	
Rectors Office	-	-	-	3	3	-	6
Agriculture	-	6	14	5	-	-	25
Science	-	-6	6	2	5	-	19
Engineering	-	4	15	1	4	-	24
Education	-	-	-	2	10	1	13
Medical	-	6	10	-	3	-	19
Nursing	-	7		-	21	-	28
Humanities and Social Sciences	-	3	4	-	3	-	10
Medical Tech.	-	-	-	-	-	-	-
Public Health	-	-	-	-	-	-	-
Dentistry	-	-	-	-	-	-	-
Total	-	32	49	13	19	1	144

In addition to the Thai permanent professional staff, there were 16 overseas staff at KKU in 1981. These included two experts from New Zealand working on small-scale water resource development in the Faculty of Engineering, three British doctors in the Medical Faculty, five Japanese experts in the Faculty of Agriculture involved in the JSPS funded Shifting Cultivation Project, two VSOs (one in the Faculty of Humanities and Social Sciences and one in the Faculty of Science), three PCVs (two in the Faculty of Humanities and Social Sciences and one in the Faculty of Science) and one German volunteer in the Faculty of Agriculture.

Students

Undergraduate enrollment in the University presently is around 4,300 students. The greatest numbers of students are enrolled in the faculties of Engineering, Agriculture, Education, and Nursing (see Table 3-4). In 1981 there were 2515 male and 1776 female undergraduate students with females outnumbering males in the faculties of Education, Nursing, Dentistry, Humanities and Social Sciences and having essentially equal percentages in the Faculty of Science. In 1981, the entering class was 55 percent male and 45 percent female.

The majority of the graduates from KKU remain in the Northeast (Table 3-5). Employment opportunities in the Northeast, particularly in the private sector, have increased over time. Students from the Faculty of Agriculture are now starting to hold many key positions in agro-business in the Northeast.

Table 3-4. Undergraduate Student Enrollment by Faculties (1980-81)

Faculty	Year 1	2	3	4	5	6	Total
Agriculture	180	176	150	189	-	-	695
Engineering	200	203	177	293	-	-	873
Education	164	191	211	274	-	-	840
Nursing	197	158	93	107	-	-	555
Science	140	106	92	136	-	-	474
Medicine	74	75	71	58	54	68	400
Humanities and Social Sciences	59	57	26	32	-	-	174
Public Health	27	29	-	-	-	-	56
Medical Tech.	32	27	15	-	-	-	74
Dentistry	29	29	-	-	-	-	58
Total	1,163	1,085	835	1,089	54	68	4,294

Table 3-5. Type and Location of Employment of Graduates

Faculty	Year	Civil Service N	Civil Service %	Private Business N	Private Business %	Government Enterprise N	Government Enterprise %	Graduate Students N	Graduate Students %	% Working in N.E.
Agriculture	1976	64	49	42	32	*	*	3	2	29
	1977	36	30	45	38	*	*	3	2	35
	1978	61	42	45	31	5	3	1	1	39
	1979	37	26	53	37	7	5	2	1	39
Engineering	1976	50	40	56	45	*	*	1	1	24
	1977	48	38	45	36	*	*	6	5	17
	1978	20	18	69	61	9	8	3	3	38
	1979	14	12	58	48	21	17	3	2	10
Science	1976	11	50	4	18	*	*	4	18	45
	1977	48	38	45	36	*	*	6	5	17
	1978	20	18	69	61	9	8	3	3	38
	1979	26	35	13	18	3	4	15	20	27
Humanities and Social Science	1978	16	67	5	21	-	-	-	-	50
	1979	22	88	2	8	-	-	-	-	32
Medicine	1978	13	100**	-	-	-	-	-	-	53
	1979	30	100**	-	-	-	-	-	-	40

* No data
**Required 2 years government service

University Budget

The budget for Khon Kaen University provided by the Royal Thai Government (RTG) has increased dramatically since establishment of the University. The government budget was Baht 15 million in 1964-65. This increased to Baht 43.5 million in 1972 and to Baht 252 million in 1978. Actual budgetary expenditures in 1980 exceeded Baht 290 million. Breakdown of this budget by office/faculty is presented in Table 3-6.

For 1980, the operating budget was approximately Baht 115 million while the budget for capital development exceeded Baht 176 million primarily due to construction of the new Health Sciences Complex.

Table 3-6 1980 Budget Allocation by Office/Faculty

Office/Faculty	Actual Expenditure (Million Baht)
A. General Administration	42.247
B. Teaching and Research	
1. Science	14.235
2. Agriculture	26.980
3. Engineering	11.900
4. Education	11.324
5. Nursing	6.984
6. Medicine	171.117
7. Humanities and Social Sciences	3.858
8. Medical Tech	1.111
9. Public Health	0.577
10. Dentistry	0.443
Total	290.777
- Operating	114.492
- Capital Investment	176.285
Revolving Funds	
Total	29.673
- Operating	29.119
- Capital Investment	0.554

The New Zealand Government has provided capital assistance to the Faculty of Medicine as well as to the Faculties of Engineering and Agriculture. In total more than U.S. $1 million worth of buildings were provided to the Faculties of Agriculture and Engineering by the New Zealand Government during the period 1966-1973. Between 1974-1978, the New Zealand Government provided over U.S. $16.5 million for capital development, mainly for the Health Science Complex but also for a capital development in the Department of Food Technology. As of 1982, total capital development funds provided by the RTG equal about U.S. $70 million (Table 3-7).

Table 3-7 RTG Capital Development Budget By Office/Faculty 1964-1982 (Million Baht)

Faculty/Office	Capital Development and Equipment (Million Baht)
Agriculture	40.528
Engineering	58.069
Science	64.659
Education	43.934
Medicine	1,057.986
Nursing	20.067
Dentistry	10.719
Medical Tech	20.779
Humanities and Social Sciences	9.976
Public Health	2.531
Pharmacology	.535
General Administration	21.433
Educational Services	9.713
Graduate School	.457
Total	1,461.383

Research Budget

In addition to RTG budget for operating expenses and capital development the RTG also provides a small direct budgetary allocation for research. For 1977, this budget was Baht 550,000 which increased to Baht 800,000 for 1978 and 1979 and is presently Baht 1,000,000. Distribution of these funds by faculty is provided in Table 3-8.

Table 3-8. University RTG Research Budget (Thai Baht)

Faculty	YEAR 1977	1978	1979
Agriculture	100,000 (12)	236,150 (13)	331,010
Engineering	100,000 (7)	138,240 (6)	47,000
Science	100,000 (7)	229,500 (13)	88,800
Education	100,000 (11)	36,400 (3)	142,240
Medicine	100,000 (3)	106,000 (6)	185,950
Nursing	50,000 (4)	20,500 (3)	5,000
Others	-	33,210 (2)	-
Total	550,000 (44)	800,000 (46)	800,000

( ) Number of projects.

The National Research Council (NRC) also allocates Baht 40,000 per year to the University to be used for research. Significant amounts of research funds have also been provided by various foreign governments and donor organizations, notably Australia, Canada (IDRC and CIDA), the Netherlands, New Zealand, the United Kingdom, Israel, West Germany, and the Ford Foundation. Generally, this funding has been for specific projects and often these projects have direct RTG funding above the regular RTG research budget. Budgetary information concerning some of these research projects is presented in Table 3-9.

Tabler 3-9. Partial List of Specific Project Research Budget Amounts and Source--1977-1979 (Thai Baht)

Project and Source	YEAR 1977	1978	1979
Semi-Arid Crops			
IDRC	1,130,000	1,480,000	960,000
RTG	302,000	336,850	297,740
Cropping Systems			
Ford Foundation	625,200	1,206,000	1,314,000
RTG	254,800	290,750	290,740
Pasture Improvement			
Australia	3,388,000	1,936,000	1,826,000
RTG	480,500	480,500	480,500
Cassava Nutrition			
IDRC	769,400	916,600	-
RTG	224,530	310,365	348,230
Processing Legumes			
IDRC	-	707,000	393,000
RTG	119,570	100,280	115,000
Economic Evaluation of Small Reservoirs			
Ford Foundation	-	1,220,000	1,000,000
RTG	-	-	-
Environmental Study Nam Pong			
Ford Foundation	-	1,000,000	2,631,000
RTG	-	To Mekong Comm.	To Mekong Comm.
Total - RTG	2,041,600	2,458,745	2,492,210
Total - Foreign Donors	5,912,600	8,485,600	8,124,000

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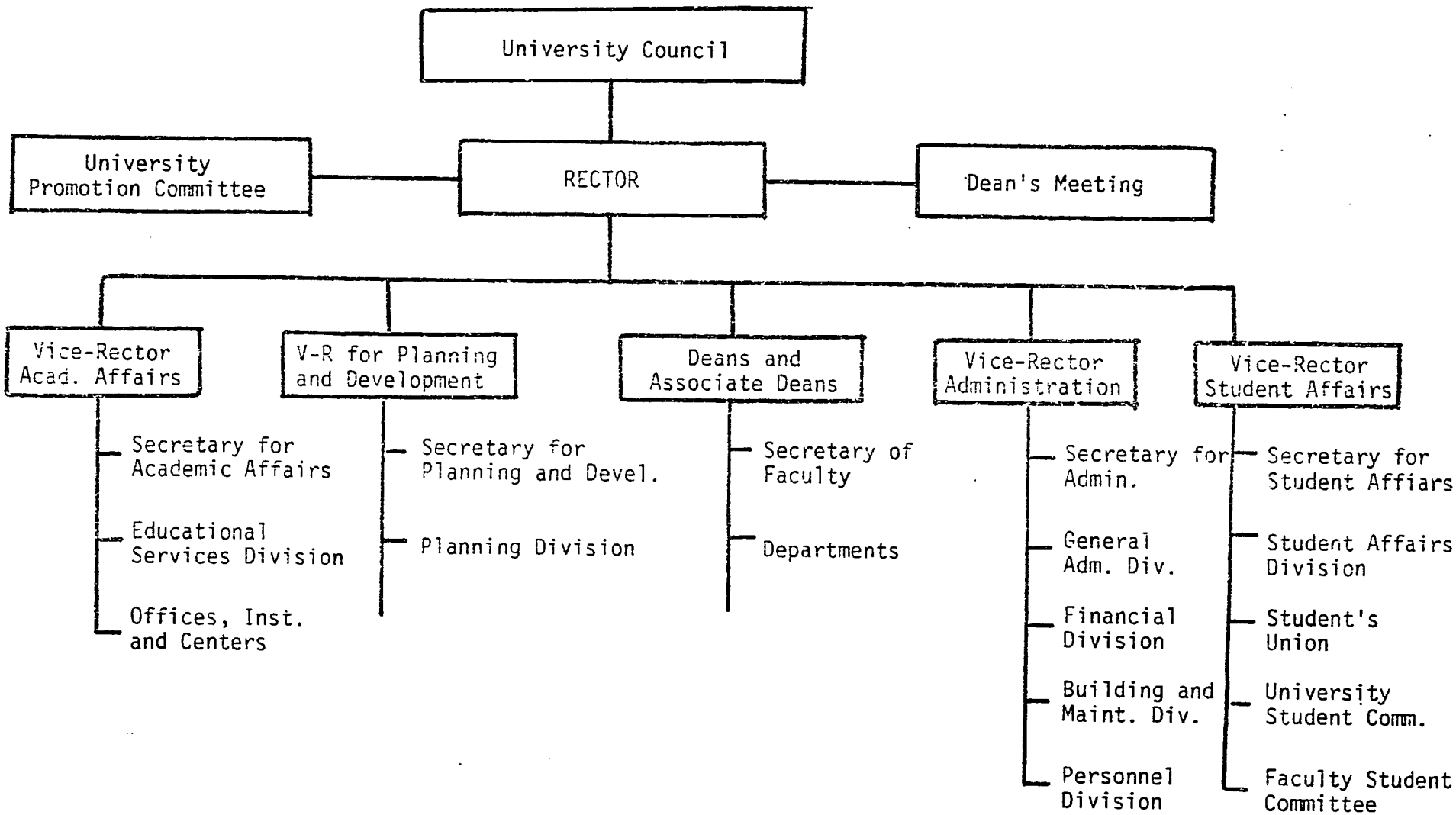
It is interesting to note that counterpart research funds provided by the RTG are approximately 2.5 million Baht during 1978 and 1979. When contrasted to official RTG research budget funds of 800,000 Baht annually, these extraordinary budgetary allocations are more than 3 times normal RTG research funds. When funds from other sources, including individually contracted projects, are also included it seems likely that actual research expenditures at KKU may exceed 15 million Baht annually.

Organization

KKU is a Thai Government University operating under the supervision of the Office of University Affairs (OUA). There is a University Council consisting of the Rector, Vice-Rector, and Deans as ex-officio members. The President of the Council and an additional 9-15 members are appointed by His Majesty the King from recommendations submitted by OUA via the Cabinet. (The present council is listed in Appendix I). The Council's main roles are supervision and policy control. Presently, in addition to the rector, there are vice rectors for planning and development, academic affairs, student affairs and administration. Figure 3-2 illustrates the organizational arrangement of KKU and also details some of the units under each Vice Rector. With respect to research the Vice Rector for Academic Affairs is the most important position as offices, institutes and centers fall under his office. This means that the computer center, the Research and Development Institute and special offices such as the Office of the Central Library are administered through the Vice Rector for Academic Affairs.

Computer Center: The Computer Center at Khon Kaen University is a computer center in name only. The RTG has not been willing to purchase a computer for KKU so the only machine in the center is a castoff N.E.C. Computer from Chulalongkorn University. This machine has 32K bytes of CPU which is extremely small for any type of major data analysis. Without the necessary software support, complicated by the fact that it is difficult to

FIGURE 3-2. ORGANIZATION CHART OF KHON KAEN UNIVERSITY

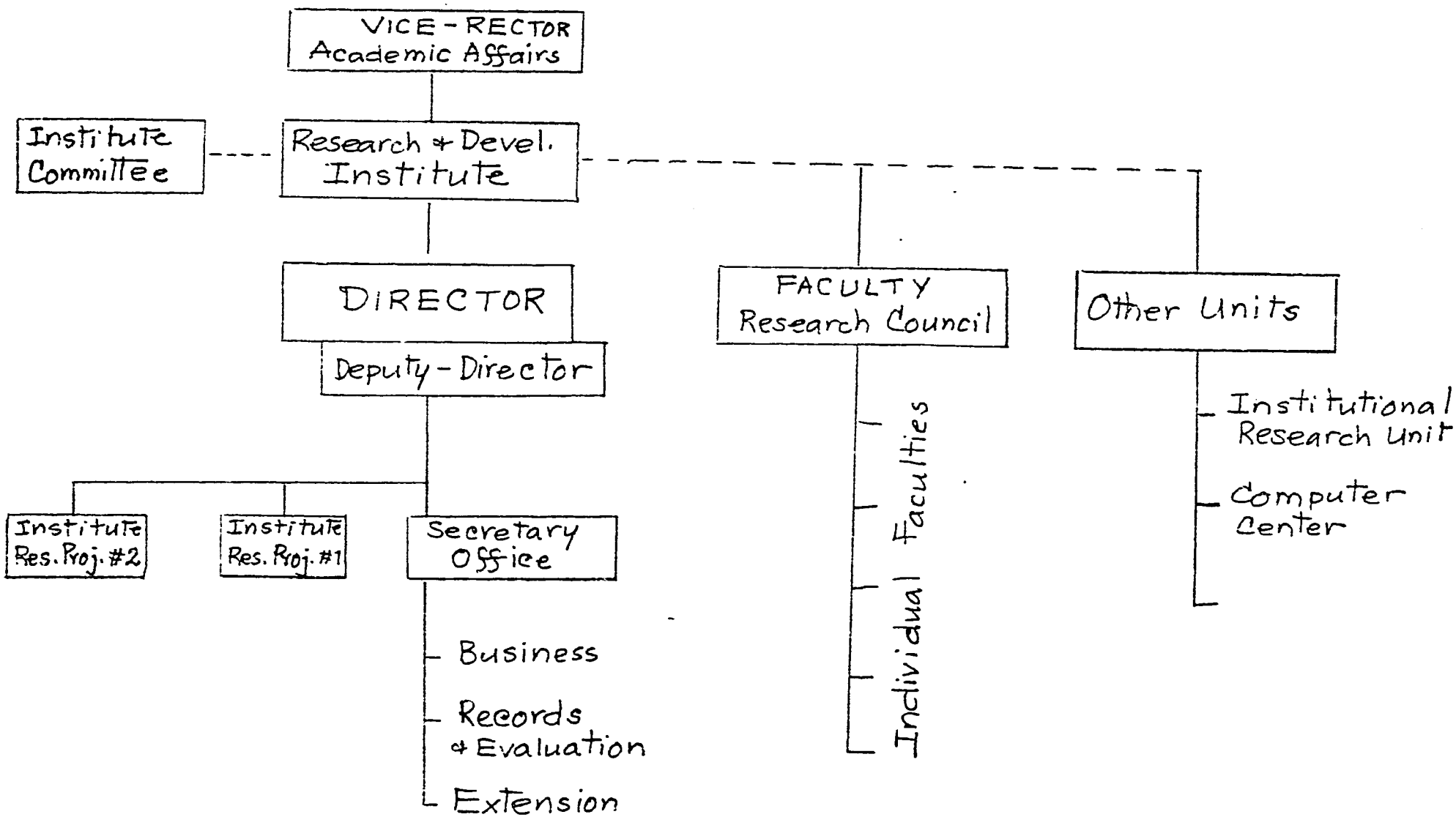


keep the computer operating (No N.E.C. service facilities are available in the Northeast), the staff have real problems in using this computer.

Central and Satellite Libraries: The University maintains a Central Library plus separate libraries in each faculty. Most of the faculty libraries have their own librarians with the librarian's salary and the bulk of the operating budget provided by the faculty. Presently there are approximately 100,000 volumes and 300 Thai language journals and 557 English language journals in the new Central Library. The total annual budget allocation for the Central Library is more than 4 million Baht including 1.2 million Baht for purchase of books and journals. In contrast, the library in the Faculty of Agriculture has about 6,000 volumes (4,100 in English), 89 English language journals and 65 Thai language journals. This library receives 200,000 Baht from the faculty and 30,000 Baht through the Central Library budget. Total expenditure for books and journals in all the libraries on campus is about 2.4 million Baht annually.

Institute of Research and Development. In 1980 KKU received authorization to establish an Institute for Research and Development. The primary purpose of the institute is to coordinate and extend research activities. In particular, the institute is intended to play a coordinating role when projects cut across a number of faculties. Research projects that are within a single department or involve two or more departments within a single faculty will continue to be the responsibility of the concerned department or faculty, respectively. Organizational flow of responsibility of the institute is detailed in Figure 3-3. To date, a director of the institute has not been appointed nor has the institute started to function although funding has been allocated to pay the director and for general administrative expenses. No government funds for actual research have been made available which means, in effect, the office will of necessity have to seek outside funding for research projects. An active search is now underway to recruit a well known researcher to lead this institute.

Figure 3-3. Organizational Arrangement of the Research and Development Institute



Faculty of Agriculture

The Faculty of Agriculture, established as one of the first three faculties, aims to produce practical and responsible agriculturalists by emphasising practical and relatively broad training in agriculture. The faculty consists of seven departments: Agricultural Economics, Agricultural Extension, Agriculture Products, Animal Science, Entomology and Plant Pathology, Plant Science, and Soil Science.

The Faculty of Agriculture main complex consists of a central administration and classroom building, a laboratory building, a 1,500 seat auditorium, a service building for experimental food processing, and a new Plant and Soil Science Building. All of the buildings in the main complex, with the exception of the new Plant and Soil Science Building, were built with grants from the New Zealand Government under Colombo Plan assistance. A 320 hectare farm on the western part of campus is used for research and training. The University Farm consists of the following sections: Feed Mill, Poultry, Swine, Beef Cattle, Dairy Cattle, Fisheries, Veternary Clinic, Forage Crops, Fruit Crops, Vegetable Crops, Field Crops, Ornamental Plant Survey, Soil and Fertilizer, and Agriculture. The faculty also operates a small experiment station at Chulabhorn Dam (800 meters above sea-level) located approximately 140 kilometers from the main campus.

Most staff are very young with slightly less than one-half female. Fourteen percent have Ph.D.s and 53 percent M.S. degrees. In the Faculty of Agriculture the qualifications of staff of each department are as follows:

Department	B.S.	M.S.	Ph.D	Total
Agricultural Economics	-	7	1	8
Agricultural Extension	1	5	1	7
Agricultural Products	4	3	-	7
Animal Science	5	7	13	25
Entomology & Plant Path.	2	11	4	17
Plant Science	10	15	7	32
Soil Science	1	8	7	16
Total	23	56	33	112

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In 1981, approximately 30 staff members were on study leave locally and abroad. Faculty budget from the RTG in 1981-82 fiscal year is Baht 24.87 million. The total allocated budget for KKU is Baht 410.00 million, but this is not usually completely utilized. The Departments of Plant Science and Animal Science started graduate programs in 1981 to be followed by the Department of Soil Science during 1982.

The Faculty of Agriculture at KKU is the most active faculty in terms of research. In 1980-81 fiscal year there were 35 major research projects with a total budget of approximately U.S. $500,000, roughly one third of the Faculty Budget. Major research projects are listed in Table 3-10.

Table 3-10. Major Research Projects - Faculty of Agriculture 1980-81 (Thai Baht)

Project Subject	Funding Source	Budget (Thai Baht)*	Responsible Department
Pasture Improvement	ADAB	2,306,500	Plant Science
Cropping Systems	Ford Foundation	1,604,740	Plant Science
Semi-Acid Crops	IDRC	1,257,740	Plant Science
Cassava Nutrition	IDRC	1,226,965**	Animal Science
Home Processed Legumes	IDRC	508,000	Agri. Products
Shifting Cultivation	JSPS		Soil Science
Nitrogen Economy-Soils	JSPS		Soil Science

*1979 Budget
**1978 Budget

Having strong interest in agricultural and rural development, the faculty has participated in the SEARCA Social Laboratory program since 1978. Ten villages are visited by faculty members to develop their human resources and to monitor change. With assistance from the Asia Foundation, an Intensive Farm Training Program has been set up on the University Farm. In this program, 10 young farm families are moved to KKU Campus and given one year's training in intensive farming on a 0.3 ha. plot of land allocated

to each family. The Faculty of Agriculture has played a leading role in planning, training, and supervising 15 farm families involved in an experimental small dairy farming project. The Animal Science Department is also involved in improving backyard poultry in villages in several Northeast provinces. The Faculty publishes a bi-monthly journal, called "Kan Kaset" which is a semi-technical journal. This is now the tenth year of publication.

Department of Plant Science: As the leading department in cropping systems research this department's organization and activities deserve further elaboration. The Department is divided into three divisions; Field Crops, Horticultural Crops, and Farm Mechanics with a number of branches under each division. In addition, this department is responsible for operation of the University Farm and the Research and Training Station at Chulaporn Organization of the department is detailed in Figure 3-4 with staff qualifications presented in Table 3-11. There are 100 undergraduate students majoring in Plant Science (50 per class starting in the third year). There are now 8 graduate students in Crop Production and Plant Breeding. Another 10 will start in 1982.

Within the department, research is separated into five majors areas.

(1) Improvement of Field Crop for the Northeast

- Commodity oriented - Breeding, Agronomy, Pathology, Entomology, etc.

- Will have breeding work only for a few selected crops, the rest will be only limited varietal testing.

- Previously have had breeding programs for sorghum, soy bean and groundnut (in the KKU-IDRC Semi-Arid Crops Project); now will reduce to only groundnut (Groundnut Improvement Project proposed to IDRC)

- Began joint project (informal arrangement) with the DOA in 1981 on sugar cane.

- Other crops which have research on limited scale: mung bean, cow pea, pigeon pea, pearl millet, sesame, castor bean, chick pea, upland rice.

(2) Cropping System Project - Ford Foundation

(3) Pasture Improvement Project - Australia

(4) Vegetable Crops Project - No outside support. Emphasis on vegetable for processing with special emphasis on tomato and seed production.

(5) Fruit Crops Project - No outside support

- Collection of various kind of fruit crops to test their suitability in the N.E.

- Limited work on temperate fruit at Chulaporn Research and Training Station

For those projects without foreign support, funds were obtained by requesting research funds from the university, or the National Research Council on an annual basis. The rest of requirements are met from the regular budget for farm operation - e.g. each farm unit will have permanent laborers, and limited funds for fertilizers and supplies.

Figure 3-4. Organizational Chart of Plant Science Department

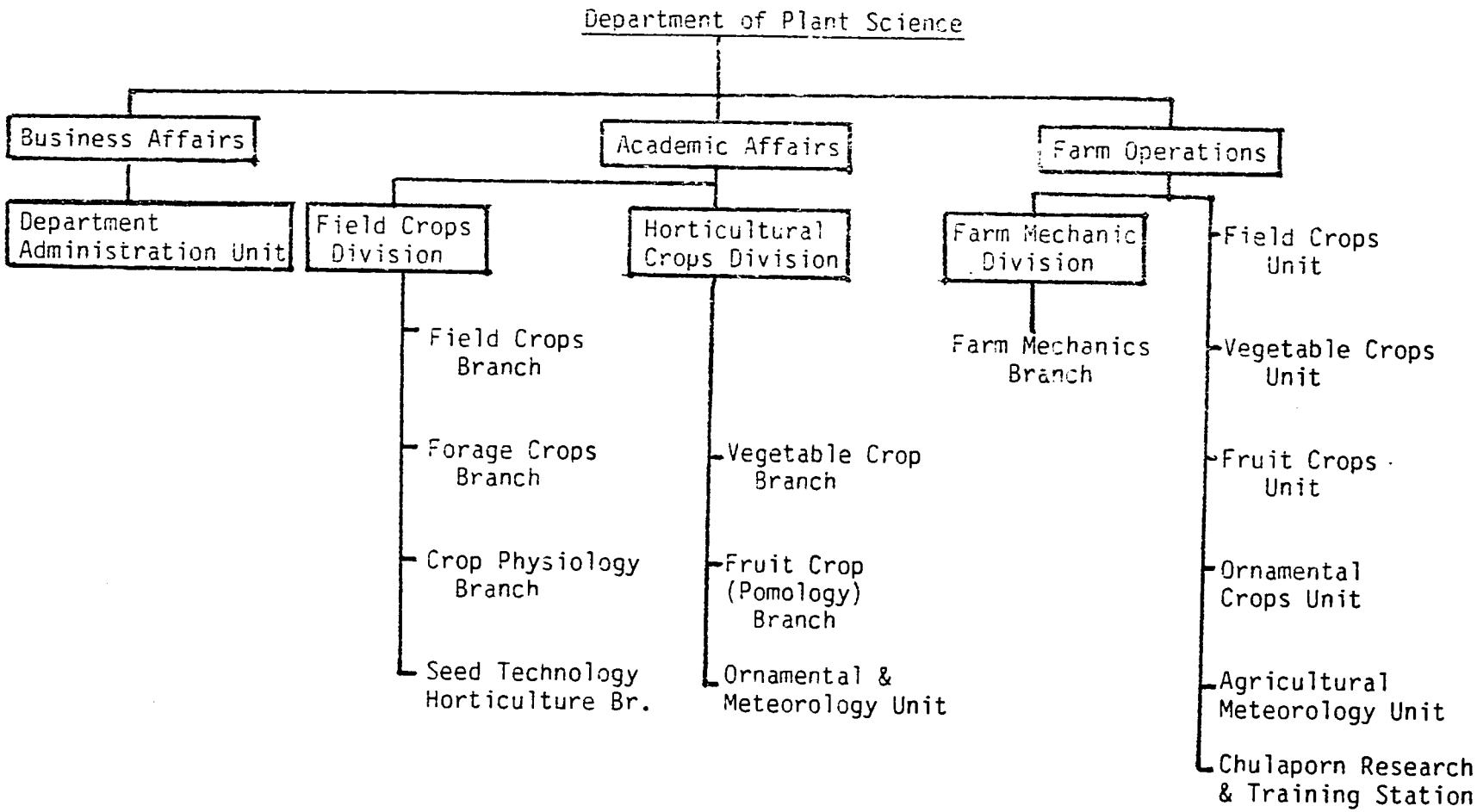

Table 3-11. List of Academic Staff of the Department of Plant Science

Name	Highest Degree	Specialty
Field Crops		
1. Dr. Terd Charoenwatana[1/]	Ph.D.	Plant Breeding
2. Dr. Aran Pacanothai[2/]	Ph.D.	Plant Breeding
3. Mr. Sanid Landthong	M.S.	Agronomy
4. Mr. Nimitr Voorasoot*	M.S.	Agronomy/Agro-climatology
5. Mr. Kanha Boonphromma	M.S.	Agronomy
6. Ms. Wasana Phlalak	M.S.	Agronomy
7. Mr. Anan Polthanee	M.S.	Agronomy
8. Mr. Prasit Jaisil	M.S.	Plant Breeding
9. Mr. Preedha Neera	B.S.	Agronomy
10. Mr. Suwit Laohasiriwong*	M.S.	Plant Breeding
11. Mr. Sanan Jokloy	B.S.	Plant Breeding
Forage Crops		
1. Mr. Virote Pongsakuls[3/]	M.S.	Agronomy
2. Dr. Anake Topark-ngarm	Ph.D.	Plant Breeding
3. Ms. Sadudee Wanapat	M.S.	Range Ecology
Crop Physiology		
1. Mr. Teera Suwanarat	M.S.	Physiology-Weed Sciences
2. Dr. Viriya Limpinan	Ph.D.	Crop Physiology
3. Dr. Amnonysilp Suksree	Ph.D.	Crop Physiology
4. Mrs. Panna Vaikakul*	M.S.	Seed Physiology
5. Dr. Banyong Turnsan	Ph.D.	Crop Physiology/ Microbiology

1/ Vice Rector
2/ Department Head
3/ Associate Dean

Seed Technology

1.	Mrs. Lamyai Kowitayakorn*	M.S.	Seed Technology
2.	Miss Paungtong Jarasransichol	M.S.	Seed Technology
3.	Vacant Position	M.S.	Seed Technology

Vegetable Crops

1	Mr Thavorn Kowitayakorn	B.S.	Breeding
2.	Mr. Soros Jindaprasert	B.S.	Production
3.	Mr. Tomya Tonglerng	B.S.	Production
4.	Mr. Kamol Lertlat	M.S.	Breeding
5.	Vacant Position	M.S.	Production

Pomology

1.	Dr. Samrit Fuengjan	Ph.D.	Pomology
2.	Mr. Tawekiert Yiemsawat	M.S.	Pomology
3.	Mr. Jaroon Promchun*	M.S.	Pomology
4.	Mr. Amnouy Kamtue	M.S.	Pomology
5.	Mr Sirichai Kalyanarat	M.S.	Pomology

Ornamental Crops and Floriculture

1.	Mr. Warin Tongcharoen	B.S.	Horticulture
2.	Mr. Paitoon Kitpausong	M.S.	Horticulture

Farm Mechanics

1.	Mr. Khemchart Rangsimanop	B.S.	Ag. Mechanics
2.	Mr. Sereephap Srinukul	B.S.	Ag. Mechanics

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* On leave for Ph.D. training
**To be filled shortly

Department of Animal Science. This department has a total academic and technical staff of 29, consisting of 13 Ph.D.s, 6 M.S.s, 1 D.V.M., and 9 B.S.s (Table 3-12). Research in animal nutrition, breeding, production, physiology, and forage crops has been carried out by the academic staff with the assistance of technical staff and technicians. The Department maintains several experimental farms for research and training in poultry, swine, beef (and buffalo), dairy, forage crops, veterinary clinic, and fisheries (Figure 3-5). Research activities and projects in the Department of Animal Science are as follows.

(1) Cassava Nutrition Project supported by the IDRC and the RTG (1976-82).

(2) KKU Department of Livestock Development Joint Project on Livestock and Poultry Development (since 1977).

(3) The Sum Jan Dairy Development Project jointly organized by the Office of Land Reform, Department of Livestock Development, The Dairy Promotion Organization of Thailand, and KKU in early 1979.

(4) The Research Program on the Utilization of Fibrous Agricultural Residues supported by various research funds from the National Research Council (NRC), the International Foundation for Science (IFS), the Australian-Asian Fibrous Agricultural Residues Research Network, as well as from the regular budget.

(5) The Geese Production Project jointly conducted with the DOLD Livestock Development Project (The Office of Northeast Agriculture, Tha Phra) with additional research support from the NRC and the annual budget.

(6) The Rabbit Production Project jointly conducted with the Livestock Development Project (Tha Phra) and the Office of Northeast Agriculture (Tha Phra), with additional research support from the NRC annual allocation.

(7) Other individual research projects such as that on forage crops, fisheries, etc. These projects obtain support from various sources from year to year

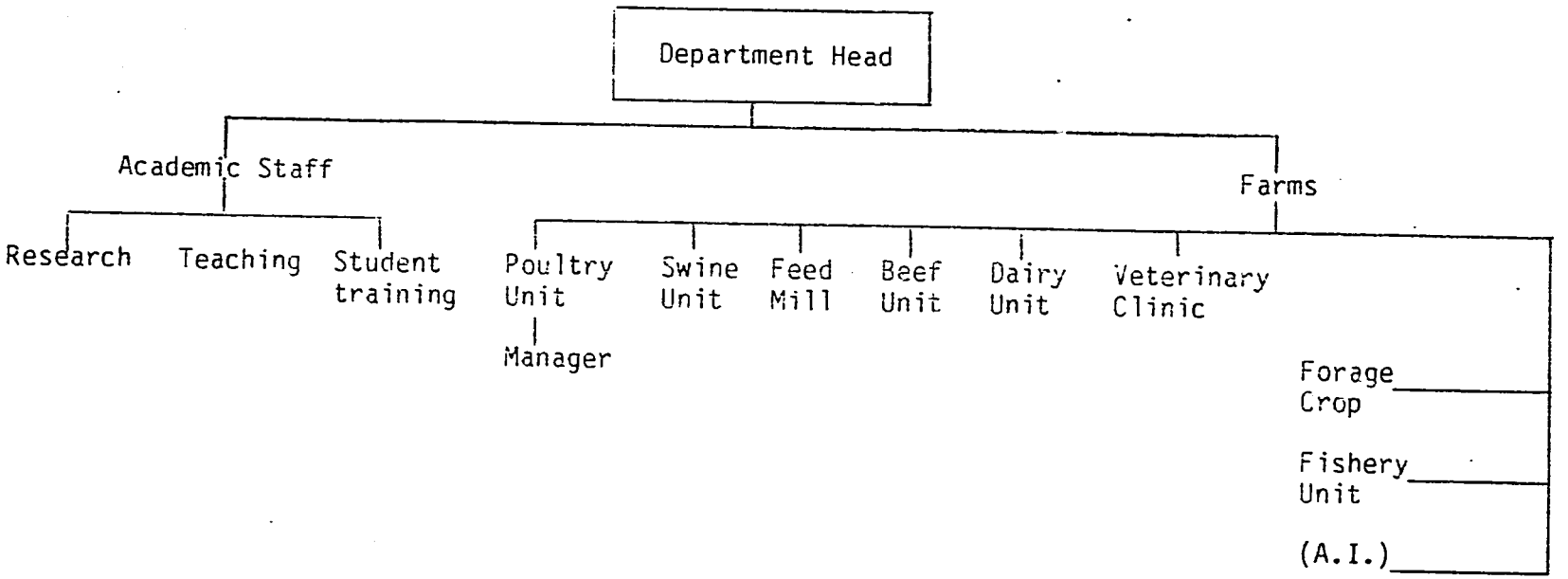
(8) Some staff members also take active part in various research projects run by other departments or other agencies such as the Pasture Improvement Project in the Department of Plant Science, a survey on village development in the Northeast by the National Economic and Social Development Board (NESDB), as well as other agricultural development projects.

Table 3-12 Staff Qualification in Animal Science

	Specialty	B.S.	DVM	M.S.	Ph.D	Total
1.	Nutrition, Simple St. & R.	1			4	5
2.	Breeding & Gen.			2	2	4
3.	Forage			1	1	2
4.	Production	3		1	1	5
5.	Pathology (Avian)				2	2
6.	Physiology			2		2
7.	Fishery			2		2
8.	Anatomy		1			1
	Tech. Personnel	5				5
	Total	9(5+4)	1	8	10	28

Study abroad = 3 (Dairy, Anatomy, Animal Science)

Figure 3-5. Organization Chart of the Department of Animal Science



Major projects are described below.

(1) Cassava/Nutrition Project: The project was started in 1976 and is to be terminated in 1982 with a total research budget of 9,278 million Baht (7,178 million Baht from the IDRC and 2,100 million Baht from the RTG. This is the only project in the Department of Animal Science which receives substantial support from a foreign donor, with well-planned, long-range objectives. The project is aimed at (a) improving the nutritional quality and reducing adulteration in cassava products and (b) expanding consumption of cassava products by the domestic livestock industry.

The first phase of this project was directed to a survey of the nutritional quality of cassava chips and pellets produced from different parts of the country by taking samples of the cassava products for chemical and nutritional analysis periodically throughout the year. Data thus obtained were used to develop a grading system for cassava products. The four-grade system has been developed along with a price index for cassava products. A monitoring system to detect adulteration such as sand addition in cassava pellets was developed during the first phase of the project.

The second phase of the project, to end in 1982, emphasizes monitoring of cassava product quality, and evaluation of adoption of the grading system by cassava traders, and reasons why the grading system is used or not used in cassava trading.

During both phases of the project, various nutritional and feeding studies have been conducted with poultry, swine, dairy, and beef cattle, in order to find ways and means to expand the use of cassava products in animal feeds. Results from these studies indicate that cassava products can be used in animal feeds at various levels, depending on species and stages of production. It is possible to replace high price feed ingredients such as soybean-oil-meal, fish meal, or rice bran with cassava chips or pellets in various animal rations. In economic terms, it is profitable to use cassava products as animal feeds, except for beef cattle. However, the use of

cassava products in animal industry in Thailand has been limited so far due to the availability and competitive prices of other feed ingredients such as corn, rice bran and broken rice, etc.

Toward the later period of the project's second phase, attention was given to the development of cassava-based rations for small farm pig producers who can grow their own cassava crops for animal feeding. Practical and economical methods for reducing hydrocyanic acid content in cassava and cheap supplementation in cassava feeding to pigs and dairy cattle have been developed.

One of the further research areas concerning cassava nutrition relates to the field of cassava feeding for beef production. The increasing demand for beef for domestic consumption along with the reduction of the export of cassava products to the EEC markets creates a sound economic possibility of feeding cassava to beef cattle and buffalo at the village level.

(2) Village Poultry Project: Designed to increase cash income and household protein supply at the village level through the improvement of chicken quality and the prevention of loss due to diseases and parasites. A survey of village chicken production covering 222 households in 10 provinces all over the Northeast was conducted in order to obtain useful information for the planning of effective research studies to promote village chicken production. Various research projects were conducted in relation to village level prevention and control of some infectious chicken diseases and parasites. Useful technical and socio-economic data concerning small farmers acceptance of introduced technologies, as well as the weaknesses of some technologies when applied by village households, have been reported. Attempts to introduce improved breeds of chicken to cross with the indigenous chicken in the villages were made. Preliminary results indicate satisfactory performance of crossbred stock but further and wider investigation is yet to be carried out. It can be said that, in spite of its

limited budget and personnel, this project has produced some useful preliminary results concerning the identification of chicken disease problems, seasonal pattern of outbreaks of chicken diseases in the villages, practical measures for the introduction of effective chicken vaccination programs to the village level, the possibility of increasing village chicken production through crossbreeding with improved chicken breeds, as well as other extension information related to backyard chicken production.

Besides this village chicken research, the Village Poultry Project, under the same leadership, also includes a Geese Production Project. Like the chicken production project, the Geese Production Project seeks to promote geese raising in village households in order to increase villagers' cash income and household protein supply. Research problems are mainly concerned with low fertility and hatchability in locally-available stocks of Chinese geese. The project so far has concentrated on genetic selection of superior breeding stocks with respect to egg production as well as growth performance under low nutritional regimes. Problems concerning the management of breeding flocks as well as the reproductive physiological aspects have been studied. This project, as mentioned earlier, has been faced with budget and personnel limitations, therefore only a limited number of research studies were conducted during the past and much remains to be investigated. It is hoped that selected breeding stock resulting from the project will soon be made available to the villagers. The development of backyard geese raising at the village level is facilitated by the DOLD/Livestock Development Project which has provided significant support to the Geese Project, not only in terms of research budget, but also buildings, equipment, etc.

(3) Research Program on the Utilization of Fibrous Residues: This is a relatively new research program in the Department of Animal Science at KKU, as well as in Thailand. It has been commonly recognized that crop residues produced at the farm level serve as a significant feed supply to ruminant animals, especially buffalo and cattle. So far as Thailand is concerned,

only very few research investigations were conducted in the past in relation to the improved utilization of crop residues such as rice straw and stubble, kenaf leaves, cassava leaves, etc. This research program is organized in order to develop various methods for better utilization of crop residues especially rice straw which is the main feed supply for farmers' buffalo and cattle during the dry season. Although the feeding of rice straw to buffalo and cattle is a general practice at the village level it is well known that the nutritional quality of rice straw and stubble is not sufficient to sustain animal growth, or even to maintain animal weight during the dry period of the year. Hence, this project is putting emphasis on how to improve the feeding quality of such crop residues in order to improve buffalo and cattle production on small farms, this will provide direct benefits to farmers, especially in the rainfed areas.

This project is also a part of the National Buffalo Research and Development Center Project (NBRDC) organized jointly by the DOLD, Kasetsart University, Khon Kaen University, the Office of the Northeast Agriculture, Chulalongkorn University, plus other regional institutions such as Prince of Songkhla University, Institute of Agricultural Technology (Mae Jo), and Surin Agricultural Campus (Institute of Agriculture and Vocational Education). The NBRDC is organized by the joint efforts of various agencies and disciplines in order to increase buffalo production in Thailand to cope with the ever increasing demand for beef and for draft animals. One problem that has been clearly defined in the research programs of the NBRDC is the problem of low calving rates of village buffalo herds. The factor that significantly contributes to this is the feeding problem.

As mentioned earlier, so far a very limited number of research projects of this kind have been conducted in Thailand. The KKU research program is only 2-3 years old, therefore, much remains to be investigated in the future. Research that has been done in this program so far relates to the improvement of rice straw utilization for cattle by ensiling with urea.

On-going research emphasizes further improvement in the utilization of the ensiled rice straw with cheap or locally available supplements such as cassava leaves.

(4) Other Research.

(a) Pasture Research. The Department of Animal Science takes active part in the pasture research program which is directed by the Department of Plant Science. Main research activities involve the evaluation of the newly tested varieties of forage crops including legumes and grasses, comparison of pasture productivity under beef and dairy production, and appraisal of chemical and nutritional qualities of forage crops. Results from the project have so far been very useful to the Livestock Development Project. Certain forage species has been recommended and adopted by the Livestock Development Project, such as Verano stylo (Stylosanthes hamata cv. Verano) and Siratro (Macroptilium atropurpureus cv. Siratro). Results at the village level have proven to be quite successful, judging from the favorable response by farmers to the forage development program.

(b) Rabbit Production Research. The project is mainly engaged with the examination of how to produce rabbit meat at least cost by using small amounts of concentrate supplements throughout all stages of production. Due to limited budget and personnel, only a few research projects have been completed. Research findings reported are on least-cost combinations of concentrates and roughages for gestating and lactating does, as well as for growing rabbit for the fresh meat market.

(c) The Sum Jan Dairy Project: KKU mainly takes part in providing technical support, dairy training, and buying milk produced by the project for pasteurization and distribution. No significant research activities are underway at present.

The budget for research in the principle projects of the Department of Animal Science is shown in Table 3-13.

Table 3-13. KKU Research Budget in Animal Science

	Project	Baht	
1.	Cassava/Nutrition Project (terminated in 1982)		
	First Phase (- 4 yrs)		
	- IDRC	3,066,000	3,8
	- RGT	800,000	5,4
	Second Phase (- 4 yrs)		1.
			3
	- IDRC	4,112,000	1
	- RGT	1,300,000	10.6
2.	Joint KKU/DLD Livestock Research		
	- Budget (5x120,000)	600,000	
3.	Geese Project		
	- KKU Budget (per yr)	400,000	
	- NELDP, much larger but unknown	*	
4.	Crop residue utilization		
	- IFS (1981-2)	230,000	
	- NRC, varies per year	30,000-40,000	
5.	NRC supports to other projects per year, up to	120,000	
	TOTAL	10,668,000	

Other Faculties

Engineering: The Faculty of Engineering was established in 1964 with assistance from Canada and New Zealand. Striving to provide engineering talent to help with development of the region, the faculty aims: (1) to produce well trained engineers at the undergraduate and graduate level, (2) to initiate and carry out problem-oriented research relevant to regional development and (3) to serve as a regional center for engineering consultation and service. The Faculty consists of five departments: Agricultural Engineering, Civil Engineering, Electrical Engineering, Industrial Engineering, and Mechanical Engineering. All of these departments offer majors. Present staff number 101 individuals including 16 Ph.D.s and 47 M.S.s with 15 members studying abroad for the Ph.D. The Department of Civil Engineering is one of the best staffed departments in the country with 10 Ph.D.'s and 16 M.S.'s. The Faculty also maintains well equipped laboratories and a mini-computer laboratory. In 1980, a Water Resources Center was established. Presently a M.S. program in structural engineering is available with other graduate degree programs to start soon. Research activities of the staff have focused on specific technical needs of the Northeast particularly water resource development. Under the auspices of the Ford Foundation, staff have actively engaged in programs involving the design, construction and evaluation of small reservoirs and village weirs. In collaboration with New Zealand staff the faculty has established a water resources extension program. Research in agricultural engineering has concentrated on developing farm equipment appropriate for Northeast conditions.

Education: The Faculty of Education, established in 1969, was the first institution in the Northeast to offer a degree in education. Its main objective is to produce university trained teachers both at the degree and diploma levels. Other objectives include giving in-service training programs and other extension services involving primary and secondary education to local teachers and schools, as well as conducting research in the areas

of education and psychology in rural areas. The faculty is composed of six departments: Basic Education, Secondary Education, Primary Education, Educational Psychology, Educational Technology and Physical Education. In addition, the faculty also maintains a Demonstration School from kindergarten up to the secondary level. Total faculty student enrollment is now 683, with 63% being female. Faculty members now number 124 with 18 holding doctorates, 44 holding Masters and 38 holding Bachelors degrees. An additional 22 are currently taking advanced degrees.

All research and community service programs are geared toward improving teaching and evaluation techniques and are directed toward rural school teachers. Some of these projects include the Village Development Pilot Project (in cooperation with Khon Kaen provincial authorities), research on Organization and Administrative System in Municipal Schools, research on Classroom Arrangement for Students in Two-Age Groups in Municipal Schools, Training Programe for Headmasters Who Are Group Leaders, Educational Guidance and Counselling Service Programs, and Volunteers for Educational Development in Rural Area Program.

Nursing: The Faculty of Nursing was established in 1971 in collaboration with the Ministry of Public Health and Mahidol University. The aim was to provide at least a partial, if not full, solution to the problem of an acute shortage of nursing personnel for the whole Northeastern region. The faculty prides itself on being the first Faculty of Nursing in the nation. Consisting of seven departments: Medical-Surgical, Public Health, Phychiatry, Midwifery, Maternal and Child, Research and Nursing Administration, and Foundation of Nursing, the faculty offers a four year program leading to a baccalaureate degree in Nursing and a two year supplemental programme leading to a Bachelor of Arts in Nursing degree. The supplemental program was designed in compliance with the request of the Ministry of Public Health to upgrade diploma nurses all over the country. Today the faculty has a total enrollment of 428 nursing students most of whom are female.

Various research and student training programs have placed both faculty members and students in constant contact with villagers.

Science: The Faculty of Science was established in 1964 as a service faculty by providing basic courses in the fields of natural sciences, mathematics and statistics. Realizing the need for well trained scientists and specialists to fill up places in higher education institutes as well as in government and private agencies, the faculty has, since 1973, been offering degree granting programs leading to the Bachelor of Science degree in Biology, Chemistry, Physics, Mathematics and Statistics. Also a degree program in Geology was first offered in 1977.

The faculty is also actively involved in applied research and in-service training programs. The latter in particular sees the faculty regularly giving intensive summer training courses in several fields of basic sciences to secondary school teachers from Northeastern provinces.

Medicine: The Faculty of Medicine was established in 1974 as a major component of the Health Science Center. Development of this center rests on the premise that production of doctors and health related personnel which is normally at great expense can be made much more efficient and at a much lower per-head expenditure if unnecessary repetition of various departments, equipments and facilities is eliminated and if cooperation among these departments is better integrated. Development of health related faculties under a cohesive framework underlying this Health Sciences Center Scheme is thus deemed to be an appropriate approach.

The Faculty of Medicine in particular aims at producing general practitioners; well-trained in community medicine and knowledgable about local diseases. The faculty offers a four-year program leading to the Bachelor degree in Medical Sciences and a six-year programe leading to the M.D. degree. Total enrollment is now 274, of which twelve students are expected to be the first graduates from KKU in 1979-80.

Apart from its 19 constituent academic departments, the faculty also operates a hospital and a blood bank as part of its community service programs. Under the auspices of the IDRC, the faculty also runs a number of health training programs for selected local villagers. The aim is to train them in basic treatment procedures suitable for minor illness and health problems commonly found in local areas so that they will return to give voluntary service in their own villages. This is not to replace the need for well-qualified physicians but rather to provide supplementary care, particularly in remote areas. Medical Technology is a newcomer to KKU. The objective in establishing this faculty is to increase manpower for laboratory medicine especially for health centers at all levels in the Northeastern region. The first class of about 20 students is expected to commence in the 1979-80 academic year. In addition, one-year course for a certificate in medical technology will be offered each year beginning also in 1979-80. Courses in Physical therapy are planned for the future.

Social science related programs of the Faculty of Medicine's Department of Community Medicine are described in detail in the following section.

Social Science Teaching and Research at Khon Kaen University

Research that can be broadly labelled social science is carried out across a wide range of faculties and departments at Khon Kaen University. The Department of Social Sciences in the Faculty of Humanities and Social Sciences has primary responsibility for the field but there is also a significant concentration of social scientists located in the Faculty of Agriculture's Departments of Agricultural Economics and Agricultural Extension. Staff of the Department of Community Medicine in the Faculty of Medicine, and the Department of Community Nursing in the Nursing Faculty, also carry-out village surveys of a social science character. Several lecturers in the Faculty of Education also engage in social science research activities. It is therefore necessary to take these units into account in assessing social science research capabilities of Khon Kaen University.

Faculty of Humanities and Social Sciences: The Faculty of Humanities and Social Sciences is one of the youngest faculties in Khon Kaen University, having only been established in July 1980. Certain departments (foreign languages, library science) had previously been part of the Faculty of Science, while the Department of Humanities and the Department of Social Sciences were newly created.

The Faculty is composed of 4 Departments: Foreign Languages, Library Science, Humanities, and Social Sciences. At present, degrees are offered only in English and Library Science. A major in Community Development will be offered commencing in 1983, with Administration and Management and Thai Language and Literature to be added in 1984, and a major in Population Studies planned for 1985. According to the Faculty's 15 year plan, 10 B.A. degree programs will be offered by 1995, including sociology and anthropology, local government, social work, economics, geography and the environment, etc.

In 1982 there were 172 students majoring in English and Library Science. The intend student intake in 1983 to the Community Development Program will be 25, increasing to a total enrollment of 100 when the program is fully developed. Administration and Management will accept 40 students beginning in 1983 with enrollment projected to rise to 500 by the end of the 15 year plan. Population Studies will commence with 25 students in 1985 and reach an enrollment of 100 by 1988. For the Faculty as a whole, an enrollment of 1,500 majors is projected for 1995.

In addition to its own majors, the Faculty offers compulsory courses and elective service courses to all of the other faculties in Khon Kaen University. In fact, the major share of the teaching load is related to these distribution courses, with more the 5,000 students enrolled in i1982. This represents a full-time equivalent enrollment of 600 students. Since there is a total teaching staff in residence of 44 (with an additional 18 members away on study leave), the staff student ratio of 1 to 14 is considerably less favorable than it is in other longer established facilties

such as agriculture (1:6). This problem is accentuated by the proliferation of courses being offered. According to the 1982 catalog, the Faculty offers 100 courses in the Department of Foreign languages (19 teaching staff currently in residence) 28 courses in Library Science (5 staff) 102 courses in the Department of Humanities (9 staff) and 42 courses in the Department Social Sciences (11 staff). Not surprisingly, the average staff work load of 29 hours per week is the highest reported for any faculty.

At present the Faculty is housed in a single building. A second structure containing offices, classrooms, and a library, is under construction with completion scheduled for December 1982. Construction on a third building devoted to classrooms will begin in 1984. No space is presently allocated for research purposes. The faculty library currently contains about 8,000 volumes with additional holdings scattered in individual department libraries. When the new building is completed, all these collections will be consolidated, with a librarian provided by the university's Central Library administrating the Faculty collection. Periodicals are ordered through the Central Library but there is no union catalog for all of the holdings of the various faculty libraries. Journal subscriptions are quite limited (no international journals in rural sociology or Asian studies are received, for example) and staff report that it is very difficult to order new subscriptions.

No comprehensive collection of social science research reports and publications relating to the Northeast is available at Khon Kaen University although the Institute of Research and Development has begun to assemble such a collection, with the current Fulbright Professor, Dr. Leedom Lefferts, having requested researchers who have been worked in the Northeast to contribute copies of their publications to the institute's collections. The response has been generous but these materials are not yet cataloged and available for staff use.

The Faculty has no computer facilities of its own, having to rely on the University Computer Center for any required services.

Social Science Staff: The Department of Social Science currently has 13 staff members, of whom 2 are away on study-leave. Three additional members are under recruitment in 1982-83. Two of the currently employed staff hold Ph.D.'s, while all of the remainder have master's degrees. One additional Ph.D. is being recruited with the other 2 new positions are advertised for entry level master's degree holders.

Disciplinary qualifications (based upon discipline for which highest degree awarded) of the staff are shown in Table 3-14.

Table 3-14. Discipline and Degree Status of Staff of the Department of Social Sciences

Discipline	Currently Employed	Under Recruitment
Administration/Business Management	3 (M.A.)	1 (M.A.)
Anthropology	--	1 (Ph.D.)
Community Development	--	1 (M.A.)
Economics	3 (M.A.)	--
Geography	1 (M.A.)	--
Sociology	3 (2 Ph.D., 1 M.A.)	--
Social Work	3 (M.A.)	--

In addition to staff of the Department of Social Sciences, there are also members of the Department of Humanities whose interests relate to social science, particularly with regard to the study of Isan culture.

Staff opportunities for advanced graduate training appear relatively good, especially since the establishment of the Fulbright Program last year. Along with providing a resident American social scientist to serve as consultant to the Department of Social Sciences and the Institute for Research and Development, the program has provision for two Ph.D. fellowships at American universities to be granted each year for three years. Unfortunately, cutbacks in Fulbright funds have forced a reduction to giving only one fellowship each year but it is hoped the program will be prolonged to six years in compensation.

Research and Research Capability. Research has only become a serious concern of the Faculty in the last 18 months and is still carried out on a much lower scale than in the longer established and better staffed faculties. At present there are six projects relating to agriculture underway or about to commence.

- Attitudes of farmers in Khon Kaen Province towards agricultural development projects of the government agencies. This project is funded by a 90,000 Baht grant from the Frederick Ebert Stiftung.

- The impact of returning migrants on their place of origin. This is a joint project with NIDA with Baht 47,635 provided from KKU's research fund.

- The components of life of people at Ban Ped. Funded by a grant of Baht 25,000 from KKU.

- Management of household resources and the role of women. This research is funded through a direct contract between the investigators and AID/Population Council.

- Rural development emphasising the forest reservation at Paktong Chai District, Nakhon Ratchasima. Funded by a US$3,000 contract between the investigator and UNDP/FAO.

- Farmer reaction to use of new chicken vaccines, funded by a Baht 19,000 grant from KKU.

There is no central planning of research within the Faculty. Proposals are initiated by individual staff based upon personal interests and knowledge of potential funding sources. No formal process of reviewing proposals prior to submission is followed although an information copy is supposed to be given to the Dean.

It is difficult to evaluate research capability within the faculty at this stage since no project has yet been completed and no final reports have been written. It appears, however, that there is an almost exclusive reliance on survey research using standardized questionnaires. Interview are mostly done by paid assistants and the social scientists have relatively little direct contact with the rural population they are supposed to be studying.

There appear to be a number of major constraints on carrying out high quality research:

- Lack of experience in designing and implementing field research projects.

- Individual staff members prefer to pursue separate small projects rather than combining their efforts in larger scale joint activities.

- There is no clear relationship between teaching and research responsibilities. Staff who spend time doing research report receiving criticism from those who only teach.

- Many of the staff who have been employed for the longest are professionally underqualified and feel threatened by recruitment of new research-oriented staff with more advanced degrees.

- Social scientists lack close personal contacts with staff in the Faculty of Agriculture. This is a major obstacle to organization of collaborative projects.

Despite these evident constraints on research, remarkable progress has been made by the Faculty in the past three years. More qualified staff have been recruited and several rural development oriented research projects have been launched. A basis now exists for further development of research capability, a basis that was conspicuously absent before.

Social Science in the Faculty of Agriculture

Two departments in the Faculty of Agriculture--Agricultural Economics and Agricultural Extension--have significant social science teaching and research capability and experience.

Department of Agricultural Economics: This department has 9 staff members. Only one has a Ph.D. with the others holding master's degrees. No staff are currently away on study leave although it is hoped, with the initiation of the doctoral program in agricultural economics at Kasetsart University, to send staff there for Ph.D. training.

The department has 45 majoring students in addition to teaching service courses to the Faculty as a whole. No graduate students are currently enrolled.

Departmental staff are active in a wide variety of research efforts. There has been long-term relationship with the Cropping System Project with 2 staff members assigned to work together with CSP on a continuing basis. Other projects, usually done on the basis of direct personnel contracts between staff and outside agencies include

- Cooperatives and Small Farmer Development funded by the Netherlands Government and the Royal Tropical Institute through a grant to the International Cooperative Alliance and the Cooperative League of Thailand. The first phase of this project, which involved socio-economic surveying of farmers in two villages and introduction of micro-development projects, is completed and an analytic report has been published. Funds are being sought from the Dutch Government for a second stage.

- Rural Job Creation Project Evaluation. Research carried out under a direct contract from the Prime Minister's Office.

- Off-farm income survey in resettlement villages

- Non-farm employment study. Completed in 1981 under NESDB/World Bank sponsorship.

- NERAD data analysis for USAID.

Research competence within the department appears quite high. According to the Department chairman, one major constraints on research is the dispersion of effort across too many small projects. There is also difficulty in focusing on a single project for a protracted period. There is also a need for intermediate level administrative and technical staff to do routine research tasks currently done by the acadamic staff.

Department of Agricultural Extension: Formerly known as the Department of Rural Development, the Department of Agricultural Extension currently has 7 staff members. One holds a Ph.D. in Community Development, 5 have Masters' degrees (3 in extension, 1 in social development, 1 in education administration) and 1 a bachelor's degree in cooperatives. One additional Ph.D. in agricultural education will join the department next year and one of the Master's degree holders will go to UPLB to do a doctoral work related to extension.

The department offers five courses per semester. Lecturers have a teaching load of 3 to 5 hours per week. They also carry out regular on-campus in-service short training courses for MOAC amphoe and tambon extension agents, as well as serving as lecturers in special courses at the Northeast Regional Office of Agriculture and Cooperatives.

The department has a major applied rural development research commitment exemplified by its "social laboratory" project which was established in 1976 with SEARCA sponsorship. The objective is to organize the farmers in 10 villages to take advantage of new technology developed by researchers at Khon Kaen University. The project began with a base-line survey of farmer's needs. SEARCA has ended its sponsorship but Khon Kaen University now funds the social laboratory at a level of 80,000 Baht per year. All departmental staff spend about 4 hours per week on Social Laboratory related work. One member is also involved in the Cropping Systems Project, carrying out research on farm labor resources. There is also a small project funded by Khon Kaen University on the use of radio for extension.

A major departmental responsibility is editing and publishing Kan Kaset, a bimonthly Thai language technical journal which publishes papers by agricultural researchers from throughout Thailand. With a circulation of 700, it is perhaps the leading publication in its field. Publication costs of 50,000 Baht per year are supported by Khon Kaen University.

Department of Community Medicine, Faculty of Medicine

The Department of Community Medicine is responsible for teaching methods of assessing rural health and nutritional status, demography, epidemiology, and medical sociology to all students in the Faculty of Medicine. Students are required to take at least one course in community medicine in each of their first five years. A noteworthy feature is the requirement that all students take part in village field work. Students in the first year course spend 1 day in a village practising demographic data collection, in the

second year they live in a village for one week, and in the third year must spend two weeks in a village doing a comprehensive health and nutritional status assessment. This village work is carried out during the hot season vacation so as not to conflict with their normal course requirements in other departments.

The present first year enrollment is 60 with 80 students accepted for next year. It is expected that as many as 100 students will be enrolled in future years. The medical degree is a six year program involving 5 years of instruction and a final year of internship.

No graduate courses are offered but the department is involved in a cooperative MPH training program with the University of Queensland initiated two years ago. Each year, a group of Queensland MPH students, mainly from Southeast Asian countries, spend 3 months in Khon Kaen working on a community health assessment of a rural village. A heavy emphasis is placed on nutritional assessment using 24 hour recall interviewing supplemented by observation and weighing of food intake. Students are required to write final reports on their findings, copies of which are kept on file in the department.

The department has 6 staff members. Five hold Master's of Public Health Degrees, all granted by Thai institutions. One has a M.S. in human nutrition from the London School of Hygiene and Tropical Medicine. The teaching load is relatively light with the norm 3 to 4 hours per week. Demands on staff time during the hot season vacation are much higher because of the need to supervise student field work.

The department has an active research program and staff involvement in research projects appears to be strongly encouraged. Studies currently in progress include:

- Comparison of the nutritional status of rural children from well-educated and less-well educated households. This Thai government-funded study is being carried out in 2 villages in Khon Kaen Province.

- Analysis of the effects on rural child nutrition of supplementary feeding of enriched snack foods. This is a longitudinal survey sponsored by the Dutch Government.

- Epidemiology of goitre in Northeast Thailand. A joint study with the University of Nottingham.

Also identified as important research questions relevant to agricultural development are the resurgence of malaria particularly among illegal squatters clearing farms in forest areas, the impact of village water storage programs on *Aedes* mosquito populations (The vector for dengue fever), and the relation of the rural diet to occurence of bladder stones.

Major constraints on research are shortage of staff, lack of adequate funds, and unavailability of scientific literature. All staff have basic knowledge of research design but they would like to have the opportunity for advanced graduate training. The shortage of funds forces a concentration on discrete, small-scale research projects. Especially needed is money to hire temporary technical assistants to help collect, process and analyse data. Library facilities are very limited with only a few journals available. Staff planning a new project are thus forced to go to Bangkok to do background literature reviews in the much better libraries in the capital.

Despite these limitations, the atmosphere in the Department of Community Medicine appears to be a favorable one for research. Staff displayed evident interest in the RAI project and repeatedly inquired how they might best become involved in the development.

Faculty of Nursing: The Faculty of Nursing is one of the oldest faculties at KKU, having been established in 1971. It is divided into 7 Departments. Nursing; Nursing Education, Research and Nursing Administration; Midwifery Nursing; Maternal-Child Nursing; Psychiatric Nursing; Public Health Nursing; and Medical-Surgical Nursing.

The Faculty offers 2 programs of study: a 4 year Batchelor's of Science in Nursing and a 2 year Batchelor of Arts in Nursing. 140 students are admitted each year in the B.S. Program.

All students are required to do independent study projects, most of which are related to social science. Third year students must spend seven weeks during the hot season vacation at a District Hospital. They use the hospital as a base from which to carry out research on health conditions in surrounding villages. Fourth year students must spend 2 months doing the same sort of village studies. The village field program is jointly supervised by staff from the Departments of Public Health Nursing, Maternal and Child Nursing, and Psychiatric Nursing. This year students are working in 7 villages in 7 districts. Students must write reports on their fundings with copies kept on file in the Faculty Office.

In addition to supervising student research, staff are engaged in several social science related projects of their own.

- A study of diet patterns of patients in the Northeast. This one year project, which has not yet commenced, will survey food consumption patterns in 15 villages throughout the Northeast. Funded from KKU research funds.

- Study of factors influencing health services of Khon Kaen people. (in progress).

- Study of factors relating to birth weight of babies in Khon Kaen. (in progress)

Major limitations on staff research appear to be:

(1) Time. Staff are heavily involved in teaching and supervision of students. During the hot-season vacation, staff must spend most of their time supervising student village field work.

(2) Lack of expertise in research design. Some staff have attended research methods workshops run by the NRC/SSRC but still feel underqualified to design field research projects.

Overall, the Faculty of Nursing does not seem likely to provide leadership in social science research at Khon Kaen University. On the other hand, staff displayed considerabled interest in the possibility of becoming involved in the RAI project and could represent a considerable resource for conducting village level base-line studies.

4. FARMING SYSTEMS: RESEARCH AND METHODOLOGY

Cropping Systems Program/IRRI Network

Other than the Cropping Systems Project at KKU all cropping system research in the Northeast is directly connected into the IRRI Cropping Systems Network. Research methodology is modified somewhat to meet local conditions but in general the research groups follow a similar format throughout the region. Methodological concerns have varied as the groups have matured; where initial concerns focused more on questions related to site selection, identification of relevant economic conditions and on-farm testing and evaluation, present concerns are now directed at crop scheduling under erratic rainfall, identification of short duration pre-monsoon upland crops and weed control and fertilization methods. The following section presents a brief outline of the activities of this research program in the Northeast.

The cropping systems program of the DOA, Kasetsart University, and Khon Kaen University carried out cropping pattern testing in farmers' fields in different locations. Khon Kaen University is in charge of testing of cropping patterns in areas around Khon Kaen Province located in the Northern part of the Northeastern region (Figure 4-1). The Rice Division of the Department of Agriculture tests cropping patterns in the paddy areas of Ubon and Pimai which are located in the eastern and central parts. The three cropping patterns test sites located in Northeastern Thailand represent different agroclimatic zones.

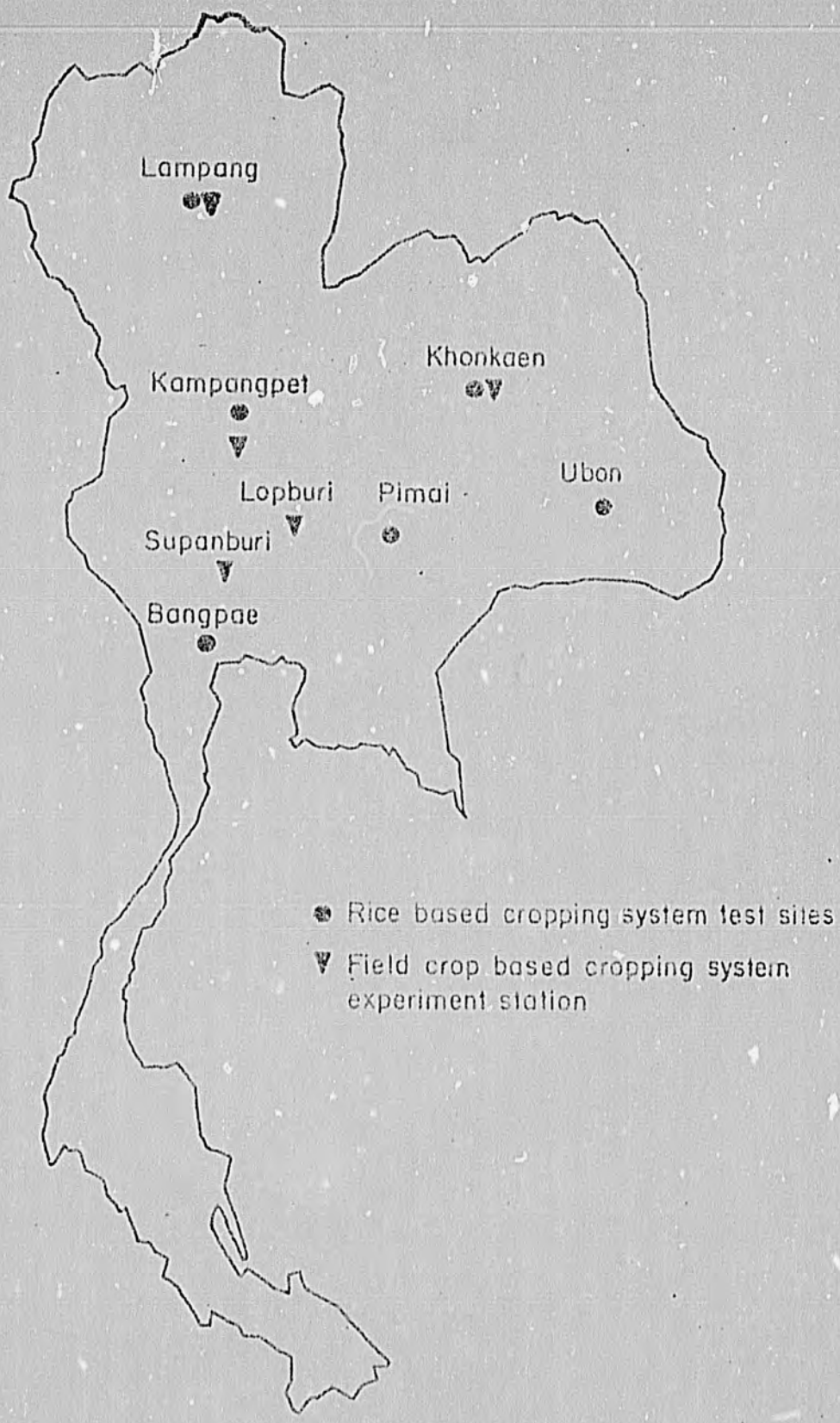


Fig.4-1. The rice based cropping systems test sites and experiment stations having field crop based cropping systems trials under rainfed condition in Thailand.

Cropping Pattern Testing at Khon Kaen

Field Crop Before Rice: The cropping systems program of Khon Kaen University emphasizes the need for establishing field crops before rice in the proposed pattern given in Figure 4-2. The success of these cropping patterns will partly depend upon the maturity of field crops. Short rotational crops give time advantage to farmers, enabling them to plant rice earlier than the patterns using field crops having longer maturity.

Field crops grown before rice include peanut, mungbean, cowpea; soybean, sorghum and corn harvested for green cob as vegetable (baby corn). The results of these cropping patterns including the yield of field crops and rice are given in Table 4-1.

In the upland paddy located in the middle or high terrace area, cropping patterns depends mostly upon the rainfall distribution. If rainfall distribution is slanted towards the first half of the season but ceases in September, the yield of field crops is high but the rice crop tends to produce low yields. If rainfall distribution is well towards the end of the rainy season and erratic distribution occurs earlier, field crops such as corn, soybean and mungbean suffer from drought and yields are generally low. In the results obtained, suitable crops grown before rice were peanut, mungbean and cowpea.

In the lowland paddy, results obtained were quite satisfactory due to ample amount of moisture in soils. However, lowland paddy fields were flooded and complete loss of field crops and rice occurred in 1978 and 1980. Promising patterns found in 1977 and 1979 were those having field crops which were short in maturity, such as mungbean and cowpea before rice.

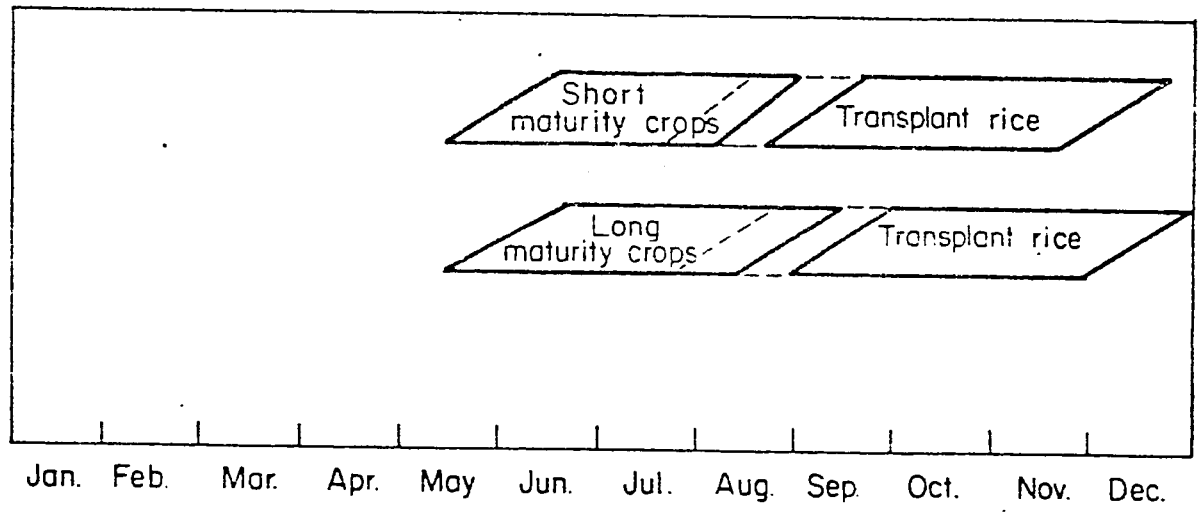


Figure 4-2. Cropping patterns which has been tested at Khon Kaen by Khon Kaen Cropping Systems Program.

Table 4-1. Yield and Incomes Received by Farmers from Planting Crops in the Tested Patterns Involved with Field Crop-Rice at Khon Kaen (Data Summarized from Terd Charoenwatana 1980)

Cropping Patterns	First Crop		Second Crop		Total Net Income (Baht/ha)
	Yield (Kg/ha)	Net Income (Baht/ha)	Yield (Kg/ha)	Net Income (Baht/ha)	
Mung-Rice	546.88*	660.00	1,351.25	2,323.75	2,796.25
	337.50**	-381.25	1,225.00	2,375.00	1,993.75
Cowpea-Rice	612.50	390.00	1,403.75	2,433.75	2,822.50
	395.31	-457.81	1,115.63	2,165.25	1,595.31
Baby Corn-Rice	363.75	1,322.50	1,167.50	1,962.50	3,283.75
	332.81	1,031.25	1,335.94	2,596.88	3,628.13
Peanut-Rice	965.00	2,508.75	1,197.50	1,961.25	4,372.50
	1,243.75	3,603.13	1,064.06	2,053.13	5,256.25
Soybean-Rice	225.00	693.75	456.25	728.75	243.75
	165.63	701.56	650.00	1,225.00	520.31
Sorghum-Rice	427.50	-1,263.75	331.25	535.00	-110.00
	355.63	-1,295.31	447.25	1,028.13	-242.19

* Upper paddy field
**Low paddy field

Field Crop After Rice: Trials of growing field crop after rice were conducted both in the upland and lowland paddy fields with a wide range of management practices. Method of crop establishment included broadcasting of seeds in the paddy prior to rice harvesting and planting field crops with and without land preparation.

None of the crops tested produced any measurable yield regardless of management practices employed. Legumes generally germinated and grew better than the non-leguminous crops. However, all crops died before flowering due to extremely low amount of soil moisture. The Khon Kaen University program is now seeking the possibility of testing early maturing rice variety which can be harvested earlier. The soil moisture status after the rice crop is harvested would then be higher and provide enough moisture for field crops after rice.

Cropping Pattern Testing in Ubon

Among cropping systems research sites belonging to the Department of Agriculture, the cropping pattern testing at Ubon received the most success in terms of crop performance and adoption by farmers. Ubon area is located in the upper eastern part of Northeastern areas which experiences late drought periods at the end of the monsoonal season. The possibility of having late seasonal drought at panicle formation, heading and flowering of rice crop is high. Quite often, early monsoon rains occur followed by an insufficient amount of water during the grain filling period. However, early season rains are more dependable in amount and regularity.

Five cropping patterns consisting of two crops were tested in Ubon in 1977. Rice crops in the patterns consisted of glutinous rice (NSPT), improved non-photosensitive varieties (R.D. 6, 7, and 9) and local photosensitive varieties (PMI 6646-3-4-15 and HYV 71) (7). The patterns tested and the corresponding yield of each crops are shown in Table 4-2.

Among five cropping patterns tested, yard long bean-rice and rice-peanut gave the best yield results. The former pattern represents field crop before rice and the latter field crop after rice. The results obtained in 1977 indicate the possibility of growing field crop before and after rice if the particular crops were planted immediately after the onset of rain in May. Consequently, success in establishing field crops after rice depends on immediate planting to make the full use of soil moisture. However, the risk of crop failure when grown after rice exists, if rainfall ceases early in September

In 1978, six cropping patterns were tested in Ubon area with an attempt to establish one more crop before the traditional rice season. The crops grown before rice were promising, particularly when yard long bean, peanut, corn and mungbean were used before well distributed rainfall in the rainy season of 1978 (Table 4-3). Rice fields that were found suitable for establishment of field crops are those classified as upper paddy since excess water could be easily drained after heavy rain and the field crop could escape waterlogging conditions.

Patterns consisting of rice crops were promising when direct seeding of non-photosensitive variety as first crop was used, followed by a transplanted photosensitive variety for the second rice crop. Although the yield of rice and ratoon rice were low (Table 4-4), there is a possibility of improving this pattern so that two rice crops can be successfully grown with minimum labor requirement. R D 5 improved non photosensitive variety was sown at the start of the wet season. Harvesting was done in August during the period in which water was available for regrowth. Yield of main crop and ratoon were 763 and 575 kg/ha respectively in 1978. All experiments tested at Ubon during 1977-78 were reconducted again in 1979 to assure stable results.

Table 4-2. Yields of the First and Second Crops of Rice Based Cropping Systems at Ubon in 1977

Cropping Pattern		Yield (Kg/ha)	
First Crop	Second Crop	1st Crop	2nd Crop
Yard long bean	Rice (NSPT)	5,975	1,431
Rice (RD 6)	Cowpea	2,181	881
Rice (RD 9)	Sweet corn	2,500	23,438*
Rice (RD 7)	Peanut	2,719	1,106
Rice (PMI 6646-3-4-15)	Rice (HY 71)	2,206	550

*Marketable ears

Table 4-3. Cropping Pattern Tested at Pimai (1977-1980)

Field Crop	Rice
Sesame var. black grain	var. Kow-dog-malee 105
Mungbean var Uthong 1	var. Kow-dog-malee 105
Peanut var. Lampang	var. Kow-dog-malee 105
Sweet corn/Peanut Sweet corn var. super DMR Peanut var. Lampang Rice var. Kow-dog-malee 105	

Table 4-4 Yields of the First and Second Crops of Rice Based Cropping Systems at Ubon in 1978

Cropping Pattern		Yield (Kg/ha)	
First Crop	Second Crop	1st Crop	2nd Crop
Yard long bean	Rice (RD 6)	2,088	2,100
Peanut	Rice (RD 6)	1,406*	2,281
Glutinous corn	Rice (RD 7)	28,438**	3,138
Mungbean	Rice (RD 7)	244	1,806
Rice (RD 7)	Rice (RD 6)	1,519	2,406
Rice (RD 5)	Ratoon	763	575

* Dried pod weight
**Marketable ears

Crop Testing Pattern at Pimai

The Pimai area, located in the lower-central part of the Northeastern region, represents another type of lowland. Although rainfall occurs from May through November, drought may occur for 2-3 weeks at any period in the rainy season due to poor and irregular distribution. The probability of early season drought can be as high as 30 percent.

There were four cropping patterns tested in Pimai farmer fields. Crops before rice, such as sesame and peanuts, were completely destroyed by floods in both 1978 and 1979. Mungbeans were harvested in 74 days but the crops suffered severe root problems due to waterlogged conditions and produced yields of only 600 kg/ha. Sweet corn was harvested before flooding occurred and produced marketable ears of 25,000 cobs/ha.

Yields for rice were generally low due to flooding which caused increased water depth especially at the transplanting stage. The difference between fertilizer treatments given to the field crops before rice did not cause any increase in rice yield. Yields of rice in every pattern were between 1,500 - 1,800 kg/ha. Results of cropping pattern testing in Pimai in 1978-79 did not indicate any suitable cropping pattern which may be adopted in that particular area and further testing is being conducted.

Cropping System Project- KKU

To develop improved cropping systems for rainfed areas of Northeast Thailand, the Faculty of Agriculture of Khon Kaen University, with financial assistance from the Ford Foundation, initiated a cropping systems project in 1975. Over the past five years, a number of cropping patterns were tested in the university farm and in farmers' fields. Work has also been complemented by investigations on component technology and a limited number of socio-economic studies. In this paper, results of the cropping patterns tested during 1975-1980 are summarized, and framework of the 1981 program is outlined.

Current and Proposed Cropping Systems: The major constraints to crop production in Northeast Thailand are low soil fertility combined with low water holding capacity and erratic rainfall. Current cropping systems are mainly monocropping of rice, kenaf, and cassava. Rice is the primary subsistence crop and occupies more than two-thirds of cropped land. Rice fields not only occupy lowland areas but also spread up to the middle terrace. These middle terraces are often left idle due to insufficient moisture for rice planting. Kenaf and cassava are the dominant crops in the upland areas, and although they are grown as cash crops, they are rarely fertilized, resulting in progressive depletion of soil fertility and declining crop yields.

Due to the undulating terrain of the Northeast, it is necessary to look at the agricultural land in three different categories. These three types are upland, upper (middle-terrace) paddy, and lowland (low-terrace) paddy. Cropping systems proposed for these three types of land are as follows:

Upland area

(a) Cassava-field crop intercropping
(b) Kenaf-field crop double cropping
(c) Double cropping of field crops

Upper paddy area

(a) Double cropping of field crops
(b) A field crop before and/or after rice
(c) Late monocropping of field crops

Lowland paddy area

During the early phase of the project, emphasis was placed on screening of cropping systems for the different types of land previously described, initially in the university farm and/or rented farmers' fields and later by farmer cooperators on their own land. Five villages in Khon Kaen province, varying in land use from mainly upland to mainly paddy area, were selected as village test sites. Component technology research was kept at a minimum during the initial phase but increased over time. Economic evaluation of the cropping systems was done as an integral part of the system evaluation. Other socio-economic studies included a base line survey of the project villages and a study on marketing systems of major crops of Northeast Thailand. Only results of the pattern trials are summarized in this report.

Cassava-Field Crop Intercropping. Several field crops were tested in intercropping with cassava. Crop tested included peanut, mungbean, soybean, cowpea, corn, sorghum, and upland rice. Some studies also were done on spatial arrangements of cassava legume intercropping, planting dates, and response to fertilizers. Results, although varied, showed that the legumes generally caused little or no reduction in cassava yield, and best results were obtained from cassava-peanut, cassava-mungbean, and cassava-cowpea intercropping. Early planting generally gave poor performances of the interplanted crops, while later planting around May or June in the period of more assured rainfall resulted in better yields.

Problems confronted in this cropping system included crop establishment of cassava and subsidiary field crops, with the exception of peanut, when planted right into the monsoon season. Strict insect pest control was also required for all legumes. Shortage of farm labor appears to be another main obstacle for adoption of the system since its weeding period often coincided with rice transplanting activities.

Kenaf-Field Crop Double Cropping: Trials were conducted to examine the possibility of growing field crops after kenaf. Crops tested included peanut, mungbean, soybean, cowpea, corn, sorghum, pearl millet, yam bean, and water melon. Several dates of kenaf cutting from mid-August to October were also compared. In most cases, none of the field crops grown after kenaf produced yields high enough to be of practical value. Early cutting of kenaf resulted in a significant reduction in fiber yield, and yield of the second crop could not compensate for the loss in kenaf yield in terms of net return. However, in one village (Ban Haad) where soil moisture appeared to remain longer after the end of rainfall period, satisfactory yields were obtained for some second crops, suggesting the possibility of using the system on certain types of soils.

Double Cropping of Field Crops in Upland Area: Several combinations of crops were tested in the double cropping systems. Crops tested as the first crop were peanut, soybean, mungbean, cowpea, corn, and sorghum. The second crops evaluated were peanut, soybean, mungbean, cowpea, sorghum, pearl millet, yam bean, water melon, and sesame. Better success was obtained from peanut-mungbean, peanut-cowpea, mungbean-peanut, mungbean-cowpea, cowpea-peanut, and cowpea-mungbean combinations. Considering the limited market for cowpea, peanut-mungbean and mungbean-peanut appeared to be the most promising combinations. The results, however, varied from field to field and from year to year, indicating that the system is unstable. More stable results were obtained from the village where moisture in the soil appears to last longer. In any case, with the existing cassava price (฿25/ton or more), the system requires higher cash inputs and produces lower net income than monocropping of cassava.

Problems with this cropping pattern were crop establishment for the first and second crops, delayed land preparation for the second crop resulting from water logging during the rainy season, low yields of the second crop, and disease and insect management. More work on soil and crop management are required to improve the stability of the system.

Double Cropping of Field Crops in Upper Paddy Fields: Evaluation of various double cropping combinations was done in a similar manner as in the upland area, and similar results were obtained. The results, however, were generally better than in the upland area because of better soil moisture at the end of the growing season. Major problems included poor drainage, long turn over period, poor performance of the second crop in the year when the rain ended early, and insect damage.

Growing Field Crop Before Rice in the Upper Paddy Field: The patterns tested were mungbean-rice, peanut-rice, soybean-rice, cowpea-rice, sorghum-rice, and baby corn-rice. Promising combinations were mungbean-rice and cowpea-rice. Peanut-rice was also successful if the peanut could be planted very early and harvested as "boiled peanut". The system worked nicely in years with a dry early season, but gave poor yields for the legumes in years with heavy rainfall during the early rainy season. Major problems were water logging for field crops if drainage management was not done properly, and limited time for water collection for rice growing.

As double cropping per se, the system appeared to be unstable. However, considering that upper paddy fields are generally left idle in most of the years due to insufficient rainfall for rice growing, the system has a great advantage over the present system in that the farmer is at least able to harvest a single crop every year, i.e. legume in the dry year and rice in the wet year, and in some years both the legume and rice can be harvested. Thus, as a flexible system of cropping, the system is stable and would increase the long-run average return for this type of land.

Late Monocropping of Field Crops in Upper Paddy Field: Several field crops were tested in this system. However, the results were generally unsatisfactory. The intended planting time in late September was generally too wet for good land preparation for field crops, and planting was possible only in October which appeared to be a bit too late.

Growing Field Crops After Rice in Upper and Lowland Paddy Fields: Several field crops were grown after rice in both upper and lowland paddy fields, and several methods of crop establishment were attempted. Seeding methods included sowing with and without land preparation, direct seeding in rice stubble, and broadcasting before rice harvesting. None of the crops or seeding methods produced satisfactory seed yield. The crops germinated well and grew to a certain size, but later died or produced insignificant seed yield.

Evaluation: Though some promising systems have been identified, many of the tested systems still showed a high degree of instability of production. However, we noted that in a certain village results of several cropping systems were better and more stable than other villages. We also noted that some of the tested cropping systems are already practiced by farmers in certain areas, e.g., peanut is grown after rice or kenaf in Surin province, sesame is grown before rice in Buriram province, and water melon and yam bean are grown at the end of the rainy season in several locations.

Trips were made in early 1981 to places where these rainfed double cropping systems are normal practices to learn more about farmers' management techniques and environmental conditions. We found that farmers' techniques differ from the ones used by KKU. In growing peanut after rice or kenaf, farmers plant peanut very late after the rain ended, make very good land preparation, and plant the peanut much deeper. We have attempted to plant the second crops as early as possible to get the crops in before the rain ended, thus, land preparation is carried out while the soil is wet and could not be done as well as it is by the farmers. Rainfall also compacted the soil resulting in more rapid loss of soil moisture. In growing sesame before rice, farmers plant the crop early in March at the onset of the first rain, while we were able to plant the crops only in late April or early May. Examination of soils in those locations did not reveal any distinct characteristics, in terms of texture or water table.

With these findings, field research in 1981 was concentrated on testing whether the success of the proposed cropping systems depend on soil type or management techniques. Three villages varying in soil types, particularly the level of soil moisture in the dry season, were chosen as the test sites (two are old sites and one is new). Comparisons are being made between the farmers' management techniques and the techniques previously used.

Agroecosystem Analysis of Northeast Thailand

In December 1980, an interdisciplinary workshop on "Agroecosystem Analysis of Northeast Thailand" was held by the Cropping Systems Project (CSP) staff at KKU to gain a better understanding of the problems of agricultural development in the Northeast. A major activity at the seven-day workshop was an attempt to identify the primary agroecological zones of the Northeast. It was felt this was necessary in order to bring some focus to the CSP, which hitherto had been concerned with rainfed agriculture in general, and to target a special area for research. As a result of this workshop four zones--the Korat Triangle, the Mekong Provinces, the Western Hills, and the Northern Hills were identified (Figure 4-3). Since the CSP wanted to focus on areas having the most critical problems, of rainfed cultivation with the lowest productivities and stability of production, the decision was made to exclude higher rainfall areas along the Mekong and the lands with heavier soils of the hilly and mountainous land of the west and south. Therefore, CSP decided to concentrate their research activities in the zone designated the Korat Triangle.

The Korat Triangle is best visualized on the basis of the land capability map (Figure 4-4) as comprising the bulk of the land designated flat or shallow undulating rainfed land. It consists of a fine or course mosaic of paleaquult and paleustult soils, with a block of dystropepts in Roi Et.

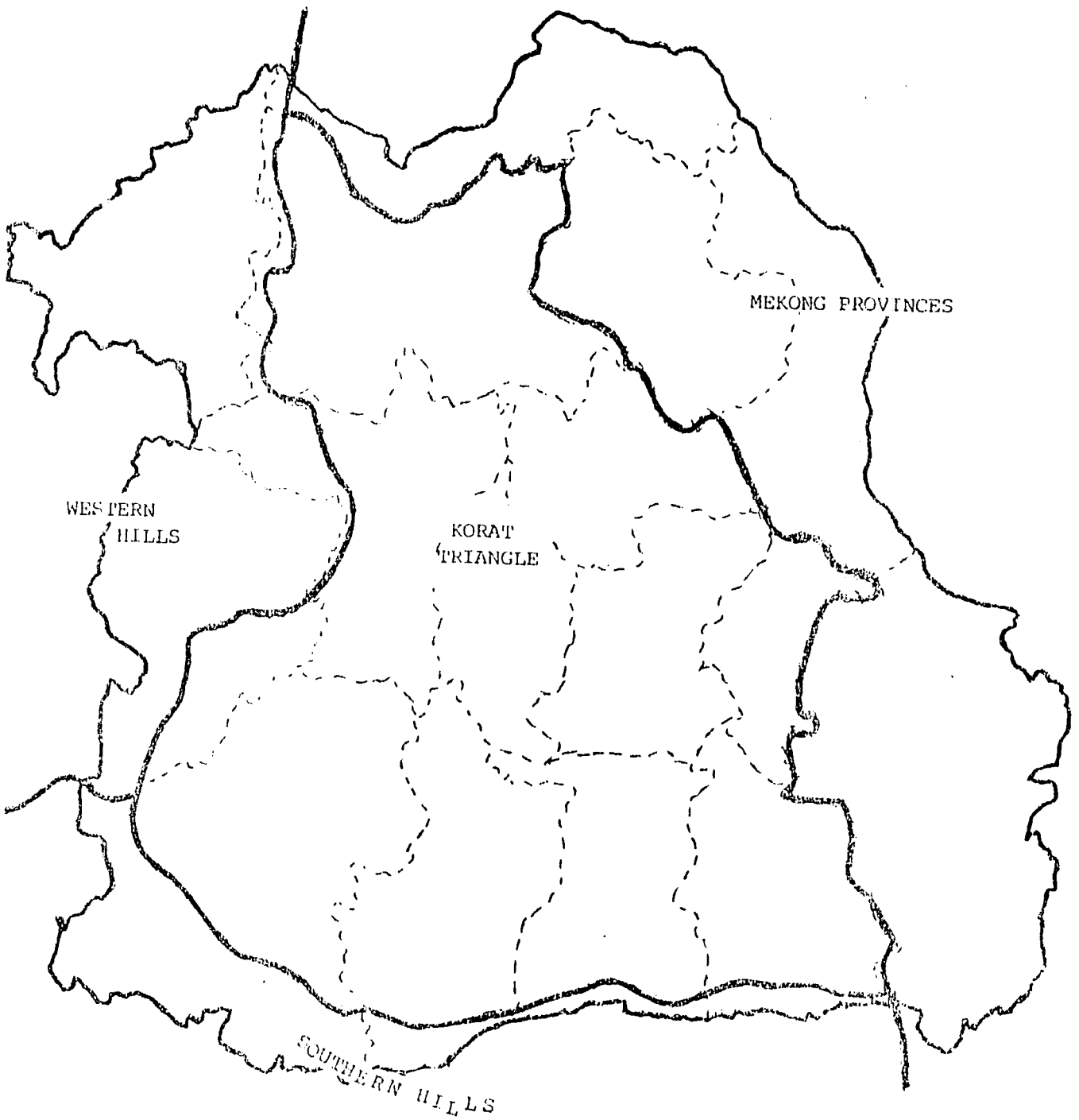


Figure 4-3. The major systems of the Northeast.

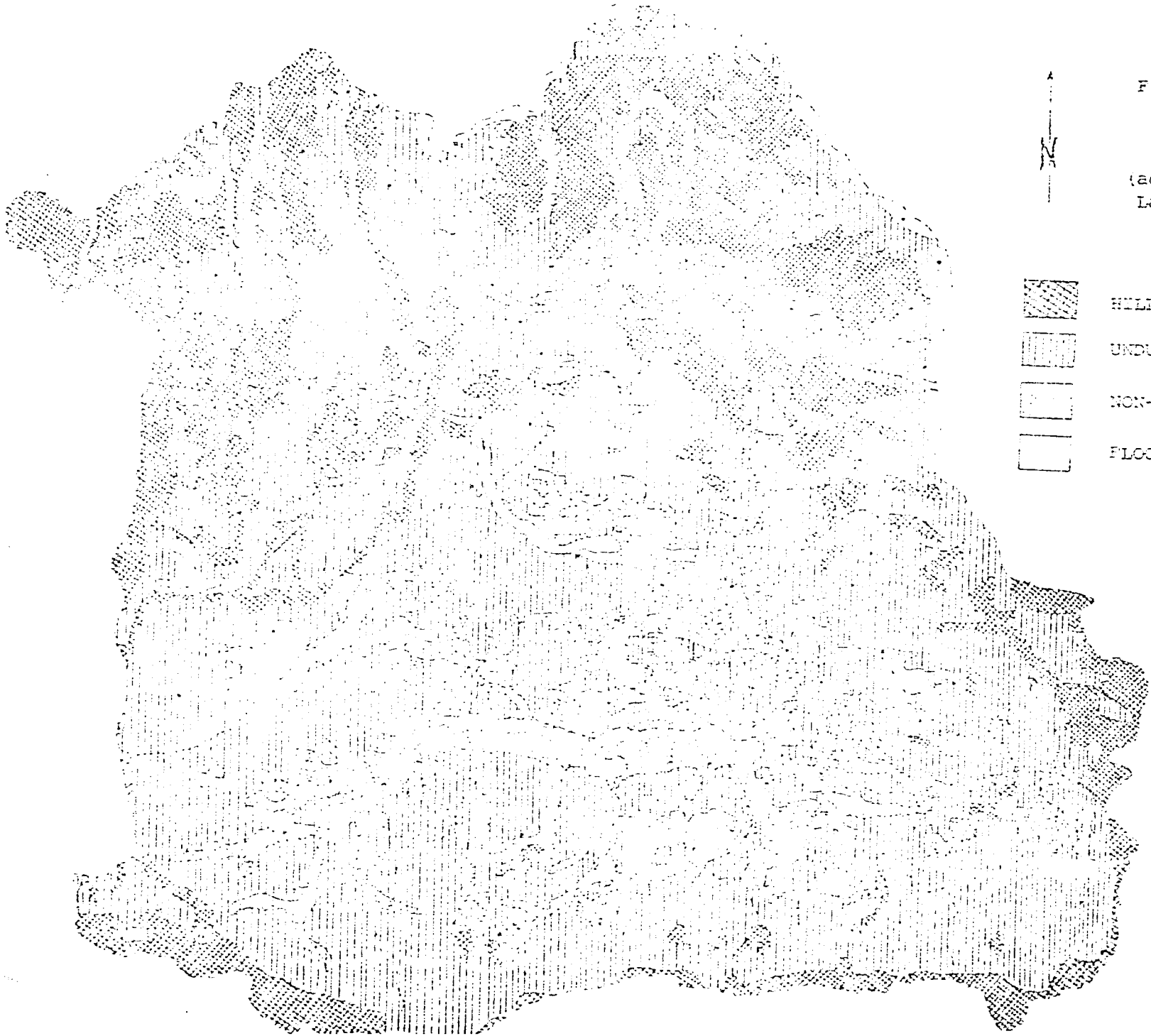


Figure 4-4.
Land capability of the Northeast.

(adapted from Dept. of Land Development 1972.)

Annual rainfall ranges from 1,100 to 1,400 mm and there are 1 to 4 months having a rainfall greater than 200 mm. There is a moderate to high number of drought days during the rainy season. In the north of the Triangle there are five months with rains exceeding 100 mm but six months in the south.

Planted acreage of paddy is moderately to highly unstable and the yields and production vary in stability, being highly unstable in some provinces. Up to 25% of the cultivated land is devoted to field crops, more in the west than the rest of the Triangle. The whole area is very marginal for two crops in a year without use of irrigation.

Administratively the Triangle contains all or parts of 11 provinces (Udon Thani, Kalasin, Khon Kaen, Maha Sarakham, Roi Et, Yasothon and parts of Chaiyaphum, Nakhon Ratchasima, Burirum, Surin and Si Sa Ket). It also contains the main regional administrative center of Khon Kaen and the marketing and trade network centered on the Friendship Highway.

Most of the population consists of Laos Wieng with Thai Korat and various Khmer groups in the South. Population densities are all above $80/km^2$. Gross provincial products per capita vary from very high to very low.

Within the Korat Triangle the next levels down in the system hierarchy are the administrative system of the province and districts (amphoes). However, these are not very powerful or meaningful systems in agricultural terms. Their boundaries, although often following the rivers, do not usually reflect changes in topography, soil type, land capability or climate and thus do not conform with agroecological zones. It is true that the province and district centers are often markets for crops and sources of credit and inputs, but there is considerable movement across boundaries in pursuit of these.

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The most important agro-ecosystems lie one more levels down in the hierarchy. We have identified four such systems in the Korat Triangle--mini watersheds, non-flood plains, flood plains and irrigation systems.

Mini Watershed This is the characteristic agroecosystem of the gently undulating land common throughout the Triangle. Its main features are shown in Figure 4-5

The watersheds may be shallow or fairly deep, measuring from a half to several kilometers across from ridge to ridge and the distance from the lower paddy to the top of the ridge varies from 5 to 30 meters.

The depression at the bottom of each watershed does not support a stream, but the soils usually belong to the paleaquult group and thus have a high enough water holding capacity to retain sufficient water in the rainy season to form paddies. In virtually all years enough water has accumulated, both directly and by run off from the upper paddy and upland areas to allow transplanting in July or August. Farmers also often construct a small pond in the lower paddy area close to the village to retain water from the rainy season. They then use this to hand irrigate a small area after the rice harvest in order to grow vegetables for home consumption.

Cultivation of the upper paddy area depends critically on the rainfall pattern. Only in some years has sufficient water collected by August/September to permit rice transplanting. In the drier years it is usually left idle.

Upland areas are planted each year to cassava, kenaf, sugar cane, watermelons or some other field crops. The soils, being mostly paleustult, have very poor water holding capacity and low fertility, and crop yields are low.

	UPLAND	UPPER PADDY	LOWER PADDY	UPPER PADDY	UPLAND
Soils	Paleustult	Paleaquult/ Paleustult	Paleaquult		
Crops	Cassava Kenaf Sugarcane Water melon	Cassava Rice	Rice followed by vegetables		
Problems	Drought Erosion	Insufficient water			

Figure 4-5. Schematic cross section of a Mini Watershed.

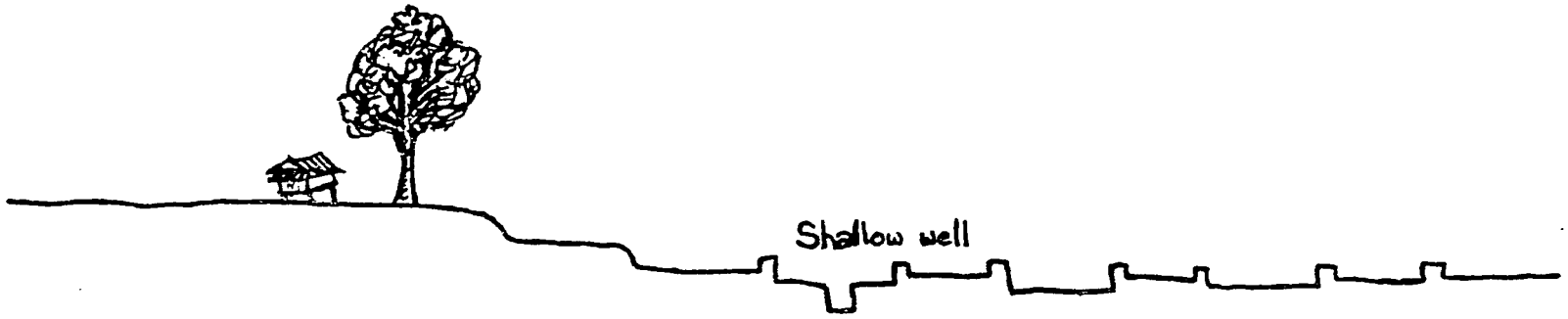
Non-Flood Plain. These occur throughout the Triangle but particularly predominate in the southern part of Maha Sarakham, in Roi Et and Yasothon, and in the northern part of Si Sa Ket, Surin, Burirum and Nakhon Ratchasima. The main features of the non-flood plain are shown in Figure 4.6.

These plains are usually some distance from the village and are formed on the geological lower terrace. They are at a slightly higher elevation than the flood plains, and hence they rarely, if at all, are flooded from the rivers. The soils are usually good paddy soils and in all years there is sufficient water accumulated from rainfall to allow transplanting of rice in July/August.

As in the lower paddies of the watershed, farmers often construct small ponds and use them to hand-irrigate vegetables grown for home consumption after the rice harvest. Some farmers, particularly in Roi Et and Yasothon, also dig shallow wells which may be used for irrigation. In particular this may permit the growing of tobacco after the rice crop.

In some limited areas, for example in Surin, there is sufficient residual soil moisture to permit the cultivation of peanuts after the rice crop. In Burirum a two crops system is follow in which sesame is grown before the rice crop.

Upland areas within the non-flood plains are usually small, of low elevation, and far apart. Villages are sited on them and small areas are planted to field crops such as cassava, kenaf, sugar cane, peanuts and watermelons.



	UPLAND	FLAT PADDY
Soils	Paleustult	Paleaquult or Dystropept
Crops	Cassava Kenaf Sugarcane Peanut Water melon	Rice In limited areas: Rice followed by peanut, or tobacco; Sesame followed by rice; Rice followed by vegetables

Figure 4-6 Schematic cross section of a Non-Flood Plain.

Flood Plain: Flood plains occur along the Chi and Mun rivers in the Triangle. These systems are inundated each year by the annual flood caused by the overflowing of the river. Soils are mostly tropaquept along the rivers but a considerable portion of the flood plains have paleaquult soils.

The pattern of cultivation is very similar to the non-flood plains, rice being the main crop with, in limited areas, a subsequent crop of vegetables, providing the farmers are able to dig shallow wells. A number of small pump irrigation schemes have also been established along the lower reaches of the Chi and Mun. These, however, mostly provide supplemental irrigation to the flood plains in the rainy season. They have little capacity for dry season irrigation.

Between the flood plain and the river there is usually a narrow levee composed of ustifluvent soils. On these the farmers may grow a variety of vegetables after the floods have subsided.

The critical problem of the flood plain is flooding after transplanting.

Existing Cropping Systems

The existing cropping system by land type in the Korat Triangle are described below:

Mini-watershed: If good rains come early then land preparation and the sowing of nursery beds can start from the middle of May. Lower paddies will tend to be transplanted first, from mid-June, with the upper paddies as late as mid-September or not at all, depending on the time it takes for sufficient water to accumulate. Harvesting occurs from the end of October to the middle of December, according to variety.

Varieties planted are mostly traditional tall, photosensitive varieties such as the glutinous rice Niew San Pathong, Kam Pai or in the non-glutinous areas of the south, the variety Hom Malee.

Upper paddies differ considerably from the lower paddies in terms of the main limiting factors. Transplanting is later and the upper paddies dry out faster. They are more subject to drought stress. Some farmers plant shorter maturing varieties, such as Pong Aew, in the upper paddies.

On the upland, cassava may be grown nearly all year round since it is non-photosensitive, providing there is sufficient soil moisture. There are, however, usually two planting periods. From the end of February to the middle of May planting occurs right after the first shower of sufficient size (15 mm). The second period occurs directly after the rainy season, between early October and early December, the duration depending on the availability of soil moisture.

Kenaf, however, is photosensitive and hence has to be planted after the first rain in April or May and harvested, at flowering, from the middle of October to early November. Yields are markedly reduced by late planting or early harvesting.

Following the rice crop in the lower paddy some farmers dig small ponds, close to the villages, which hold over water from the rainy season. These are used for hand irrigation of small plots of vegetables, including green corn, egg plant, tomato, cucumber, chinese cabbage and kale, shallot, garlic and yard long bean.

Non-Flood Plain. Rice is grown throughout the non-flood plain in a similar manner to that used in the lower paddies of the watershed. Transplanting occurs from May onwards depending on the presence of sufficient water, arising directly from the rain or from runoff from higher land. Traditional photosensitive varieties are grown, but wherever double cropping is possible early maturing varieties, such as Pong Aew, are used.

Much of the soil is sandy (paleaquult or dystropept) but in many areas there is apparently a heavy clay layer beneath and the water table is only 1-2 meters below the surface in the dry season. Farmers here dig shallow wells and irrigate vegetables on up to 2 rai, by hand, following the rice crop. The vegetables grown are similar to those in the lower paddies.

In some areas with shallow water tables a second crop is possible without irrigation. Crops include watermelon, pumpkin, sweet potato, peanut and native cowpea. Presumably these are sufficiently deep rooted to utilize the existing, if meager, soil moisture. In Burirum there is a small area where sesame can be grown before the rice crop. The water table is reportedly less than 2 1/2 meters from the soil surface and the sesame seed is direct broadcast after a single ploughing and harrowing at the end of February or March, following the first showers. The crop is harvested in June just prior to transplanting of the rice crop.

Flood Plain. Rice here is broadcast in June or July on to the land flooded from the major rivers and their tributaries. Flooding, however, tends to occur again from the end of September to the middle of October, lasting 1 to 3 weeks. If the second flood is deep or long lasting or if the water is highly turbid the rice crop may be seriously damaged.

In general the same varieties are grown as in the non flood plain. The deep water or floating rice varieties characteristic of the central plain are not grown, presumably because the flooding is normally of a relatively short duration. Some farmers do, however, grow late maturing varieties which are harvested in January.

Vegetables or short duration field crops may be grown, after the rice crop, using water from shallow wells or farm ponds but many farmers find it more profitable to catch fish left over in the ponds and swamps after the floods recede.

Stress and Perturbation

Erratic rainfall, both in intensity and distribution, stresses and perturbs crop establishment and growth in most seasons. This is the main cause of the considerable yield fluctuations which are characteristic of the region.

If the rains are late at the beginning of the paddy season, nursery bed preparation is delayed with consequent late transplanting. The latter may also occur because of a prolonged dry spell after the first rains. Farmers cope with this by transplanting older seedlings (More than 2 months old) direct into the unpuddled soil once it is adequately moist, in the hope that sufficient rain will arrive later. More seedlings per hill will also be transplanted, because older seedlings will produce fewer tillers. In such drought years the Rice Division (DOA) also distributes rice seed for direct seeding into the ploughed land. However fields sown in this way usually suffer from serious weed problems so that the technique is not suitable for farmers with limited labor availability.

Perhaps the greatest perturbation arises when a prolonged drought sets in after transplanting and the young seedlings are killed. This may occur too late in the season for a new nursery bed to be established.

The use of photosensitive varieties seems particularly adapted to drought situations since with these varieties the most drought sensitive developmental stage in rice, from panicle initiation to fertilization, occurs in September when the rains are usually high. The importance of October drought, which is more common, on grain filling is not known.

In general, drought stress is more critical on the upper paddies than the lower paddies and more important in the watersheds than in the plains.

Flooding is not normally a serious problem for rice since the crop has basically evolved to tolerate flood conditions. But prolonged submergence for a long period (7-10 days), particularly in turbid water, results in reduced photosynthesis and damage to the crop or even crop loss. Flash floods of 1-3 weeks often occur on the flood plain from September to early October. Farmers there often broadcast the seed which results in plants with stronger roots, more able to withstand such floods.

Drought does not appear to cause serious damage to cassava or kenaf in the Triangle, as the rainfall is already relatively high for these crops. However they may be seriously damaged by flooding or waterlogging as occurs when they are grown on soils with poor drainage, for example, adjacent to the upper bunded paddy fields. Of the two crops, cassava is more sensitive, and a week of waterlogging may rot the cassava roots below ground.

Other significant factors reducing yields are soil problems (including non-homogeneity, erosion, low-fertility, and salinity), weeds, plant disease and pests.

Decision Making

There is little published information about farmer goals and decision making criteria. Farmers appear to highly value independence and freedom. Producing sufficient rice to feed their families each year is a major goal. Farmers also try to grow sufficient vegetables, fruits and poultry for their own subsistence needs. Livestock, such as cattle and water buffalo, are raised to use for draft power but they also have value as a type of savings account that can be utilized as needed to meet unexpected large requirements for cash. Farmers have also been quick to take advantage of both on-farm and off-farm opportunities to increase their family income.

Given their goals and their relative priorities farmers are abe to adopt one of the small number of strategies which depend on:

(1) the amount, type and ownership status of land available,

(2) the amount and skills of labor available,

(3) the status of moisture that year,

(4) the relative market prices for various crops and livestock products,

(5) opportunities for off-farm employment

Farmer strategies may be roughly classified, although it is important to recognize that these are dynamic strategies and, as circumstances change, farm strategies also change to adjust to new circumstances along the following lines

Conditions	Strategies
1. Less than or just sufficient paddy land or labor for subsistence	1. Subsistence dominated--grow as much rice as possible
a. village or farm labor opportunities,	a. plus extra income from farm/village labor
b. out-of village labor opportunities	b. plus out-of-village employment income
c. livestock production	c. plus livestock sales and trade
d. craft skills	d. plus crafts sale and trade

Conditions	Strategies
2. Insufficient paddy land but large upland area	2. Subsistence dominated--plant all paddy land to rice; plant upland to rice when sufficient water
a. village or farm labor opportunities	a. plus extra income from farm/village labor
b. out-of-village labor opportunities	b. plus out-of-village employment income
c. upland crop production	c. plus upland crops sales
d. livestock production	d. plus livestock sales and trade
e. craft skills	e. plus craft sales and trade
3. More than sufficient paddy land for subsistence	3. Subsistence and cash dominated--rice production technique and varieties reflect portion grown to eat and portion grown to sell
a. upland and labor available	a. upland crops for market
b. water in dry season	b. dry season commercial or semi-commercial cash cropping
c. pasture land and labor	c. livestock for cash sale
d. significant by-products	d. swine and poultry for cash sale
e. craft skills	e. craft sales
f. out-of village labor opportunities	f. out-of-village income
4. Subsistence cropping not a goal (rai)	4. Commercial farmer sells cash crops, buys rice

Within these broad strategies farmers will adopt variable tactics from year to year, season to season and even week to week, based on employment opportunities, relative anticipated prices of the major crops and rainfall.

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Constraints to Farming System Research at KKU

While KKU has, and continues to be, involved in cropping systems, livestock, and social science research, there are a number of constraints that restrict their ability to consolidate this research into farming systems research (FSR). These constraints are not rigid nor is it fair to characterize them as simply being limited to KKU; they are present in almost all academic institutions. However, before presenting a proposed set of FSR activities in the next section, it is useful to first address some of the existing constraints.

Faculty of Agriculture/Department of Plant Science: Staff of the Faculty of Agriculture, particularly staff within the Department of Plant Science, have been active participants in cropping systems research, workshops, seminars and training courses since 1975. During this time they have demonstrated their ability to deal with increasingly more sophisticated research. However, there is still only a limited number of staff that have been participating actively and, of those, many such as Drs. Terd and Aran, hold other university administrative positions. Given the type of work and complexity of FSR there is a continuous need to bring new researchers into the program. To date, primarily due to the limited number of staff in the department, there has not been very much staff involvement from the Departments of Agricultural Economics and Agricultural Extension. Unfortunately, even with the recent formation of a new faculty of humanities and social sciences, there has not been an increased involvement of social scientists in the on-going cropping systems project.

At KKU, like most universities in Thailand and abroad, a real effort is required to encourage cooperation across department lines, not to mention the difficulties of organizing research involving different faculties. Expanding research into the area of FSR, including research on the roll of livestock in the farming system, requires the development of close organizational and personal links between faculty members in the Departments of Animal Science and Plant Science. Given the fact that such research is

complicated and does not have a clearly defined methodological base, organization of this research will take considerable time and commitment. By also including social scientists from outside faculties the situation is organizationally and methodologically made even more difficult.

Present facilities for FSR type research vary from faculty to faculty and from department to department within the different faculties. Transport is a perennial problem, yet, without adequate transport services it is difficult to expect the staff to work in farmers' fields away from the campus. Ability to process data is extremely limited with almost all large-scale computer analysis requiring an extended trip to Bangkok. Laboratory facilities are not particularly good although in some areas they are adequate. Access to the labs at Tha Phra would be a real boost to the staff. Library documentation is a major problem but the cropping systems group has been working the last year to develop a small cropping and farming systems library. It is strongest in the area of field crops and weakest in livestock and village level social studies. As the project progresses another issue that has to be faced is the difficulty in producing English language manuscripts. It is not unusual for professional staff to type their own material. Some type of word processing system is needed if the staff is to write and publish in the English language.

Faculty of Agriculture/Department of Animal Science. Khon Kaen University, like other universities in Thailand, has as its main function that of producing graduates. Research and technical service are secondary. Research, at the present time, is initiated by members who are well-trained and have an interest in research. Also, during recent years research accomplishments are required in order to be promoted in the university. Subsequently, KKU is one of the major research agencies that contributes a large number of research work relating to livestock production in the Northeast. This work was reviewed in previous sections. Many constraints and limitations are encountered as far as KKU livestock production research is concerned.

(1) Animal Science Research Program

(a) There are only a few well-organized research programs in animal production. And, even in the better organized ones, there is a lack of researchers in different disciplines who can devote sufficient time, in order to make the research program useful at the farm level.

(b) Most research conducted in animal production involve a single animal commodity approach. No farming-system type of research is underway at the present time. Many research projects are individual projects initiated by interested individual staff members

(c) There is a lack of technology verification and transfer components in the animal science research program.

(d) There is also a critical shortage of socio-economic studies in animal production at the small farm level. Yet, understanding of such aspects is necessary for farmer adoption of the technologies generated.

(e) Much more information is needed from the livestock production standpoint concerning indigenous knowledge, inputs, and utilization of local resources at the village level. This information is necessary in order to incorporate livestock in the farming systems research and development.

(2) Personnel

(a) Insufficient number of academic personnel who can devote the majority of their time to research. Although there are 25 academic and technical staff in the Department of Animal Science, some of them are engaged in administrative positions and other duties. There is also a lack of personnel for research support due to government budget limits. In effect, this reduces the capability and efficiency of the highly qualified research staff.

(b) Lack of or insufficient communication between most university researchers with field extension officers of the MOAC. This also reduces research effectiveness and impact at the farm level.

(c) University researchers are very strongly discipline oriented, due mainly to their basic training and faculty departmentalization. Many staff members have no interest in village farming conditions. This results in a lack of realization and understanding of actual farm conditions in the Northeast. Many researchers tend to be in favor of working in experimental model farms on campus rather than on farmers' farms.

(d) There is also a problem of workload distribution among the staff in animal science.

(3) Budget

(a) Research budget available for animal production research in KKU has been quite limited and not well distributed. Research funds available through the university budget to animal science research is extremely small. Individual staff members have to search for various sources of research support in order to carry out a research project.

(b) Government research budget generally requires an unreasonable amount of red-tape and is not flexible and suitable for research spending.

(4) Facilities

There are certain research equipment and facilities for animal science research, such as that in animal nutrition and feeding, pasture and forage crops, etc. Some of this equipment and facilities is quite old, and may need major repairs. In certain fields, such as animal physiology or health, additional research facilities and equipment are needed.

(5) KKU/MOAC Relationship

Joint research programs have been organized which bring researchers from KKU and the MOAC, especially those in the DLD, to work together. Research programs such as that under the National Buffalo Research and Development Center Project, the joint project in village poultry and geese production, and the National Swine Research and Training Center allow close relationship among researchers from multi-agencies. However, further improvement at both administrative and working levels is needed in order to reduce unnecessary conflicts and difficulties facing research personnel.

Further expansion of joint and cooperative efforts in livestock production research is needed. Much remains to be learned about inter-disciplinary and multi-agency approach in research under Thai conditions, especially in farming system research.

Faculty of Humanities and Social Sciences and Other Faculties. There are a number of serious constraints on increasing the involvement of social scientists in farming systems research:

(1) Many of the social scientists, particularly those in the Department of Social Sciences, claim that because of their heavy teaching loads they lack sufficient time to do more research. In reality this does not seem to be a real constraint but it does reflect something of the low morale and professional self esteem of many of the social scientists at KKU.

(2) Dispersion of social scientists across several faculties and departments interferes with development of a professional critical mass. Although there are in fact more than two dozen social scientists in KKU they themselves lack awareness of their own numbers. No present mechanism serves to bring them together for professional interactions.

(3) Physical seperation of most social scientists from agricultural scientists impedes inter-disciplinary research. The offices of the Department of Social Sciences are located across the campus from the Faculty of Agriculture, making attendance of social scientists at meetings difficult and reducing opportunities for informal exchanges.

(4) There is a marked status differential between even the most senior social scientists and the leading agronomists. This makes it difficult, if not impossible, for the social scientists to initiate discussions with the more senior agronomists.

(5) The majority of the social scientists hold only masters degrees and do not yet have a strongly developed professional identity or competence. This increases their reticence to advance their ideas to the agronomists.

(6) Methodological competence and experience in designing and carrying out field research is limited. Even those social scientists who are willing to involve themselves in farming systems research may have difficulty in producing the sort of information needed.

(7) Existing social science conceptual models of social system-agroecosystem interactions are on the whole inadequate. There are few published examples of successful farming system analyses to which beginning researchers can turn for guidance.

(8) The social scientists are generally from urban backgrounds and often are not from the Northeast, so they lack knowledge of village life. Not all speak the Isan dialect and thus they have difficulty in communicating with farmers.

(9) The social scientists have little knowledge of agricultural science and therefore have difficulty in understanding the research objectives of the agronomists and in relating their own special expertise to these.

(10) Many of the social scientists have difficulty in speaking and understanding English. This makes communication with foreign consultants, who often play a major role in farming systems research, difficult.

(11) Library resources are limited making it very difficult for the social scientists to obtain needed research materials.

(12) Professional rewards for involvement in farming systems research do not appear to be strong.

Although unquestionably posing serious obstacles to social scientists participating in farming systems research, most of these constraints can be greatly reduced if not wholly eliminated given adequate time, intellectual commitment, and personnel and financial resources. Attendence at short-term workshops and longer-term advanced graduate training can increase research competence and professional self esteem. The new Research and Development Institute can provide a symbolic focus for all social scientists on campus and can help to increase interactions between them. It can also accelerate development of an adequate library.

5. PROJECT DESCRIPTION

In order to respond to problems identified in the NERAD or other rainfed areas in the Northeast, KKU proposes to use a farming systems research approach. Recognizing that rainfed farmers derive a significant percentage of their income from livestock and fishing, the research methodology will integrate animal science into what was previously cropping systems research to develop an integrated farming systems approach. The third corner of the triangle, social science, is to be incorporated from the beginning. If this is not done, it is possible, as has often happened in the past, to develop improved rainfed farming systems practices that do not fit the unique socio-economic and cultural conditions of rainfed areas in the Northeast.

Methodology

Dissatisfaction with the applicability of component, commodity oriented research has led to the development of more holistic systems research models. Farming systems research (FSR) which takes the entire farm as its focus (Seetisarn 1982; Norman 1980; Gilbert, Norman, and Winch 1980; Shaner, Philips and Schmehl 1981) has been developed to recognize the system linkages between the various activities on and off the farm. Figure 5-1 from Norman (1980) illustrates one type of conceptual model employed for FSR.

It can be seen that FSR, as presented in Figure 5-1, focuses on the farm household as the central component of the system and treats farm goals and motivation as "the motor that drives the entire system...." (Gilbert et al 1980). FSR is thus, by definition, an inherently interdisciplinary research enterprise requiring involvement of both social and natural scientists from the initiation of the project.

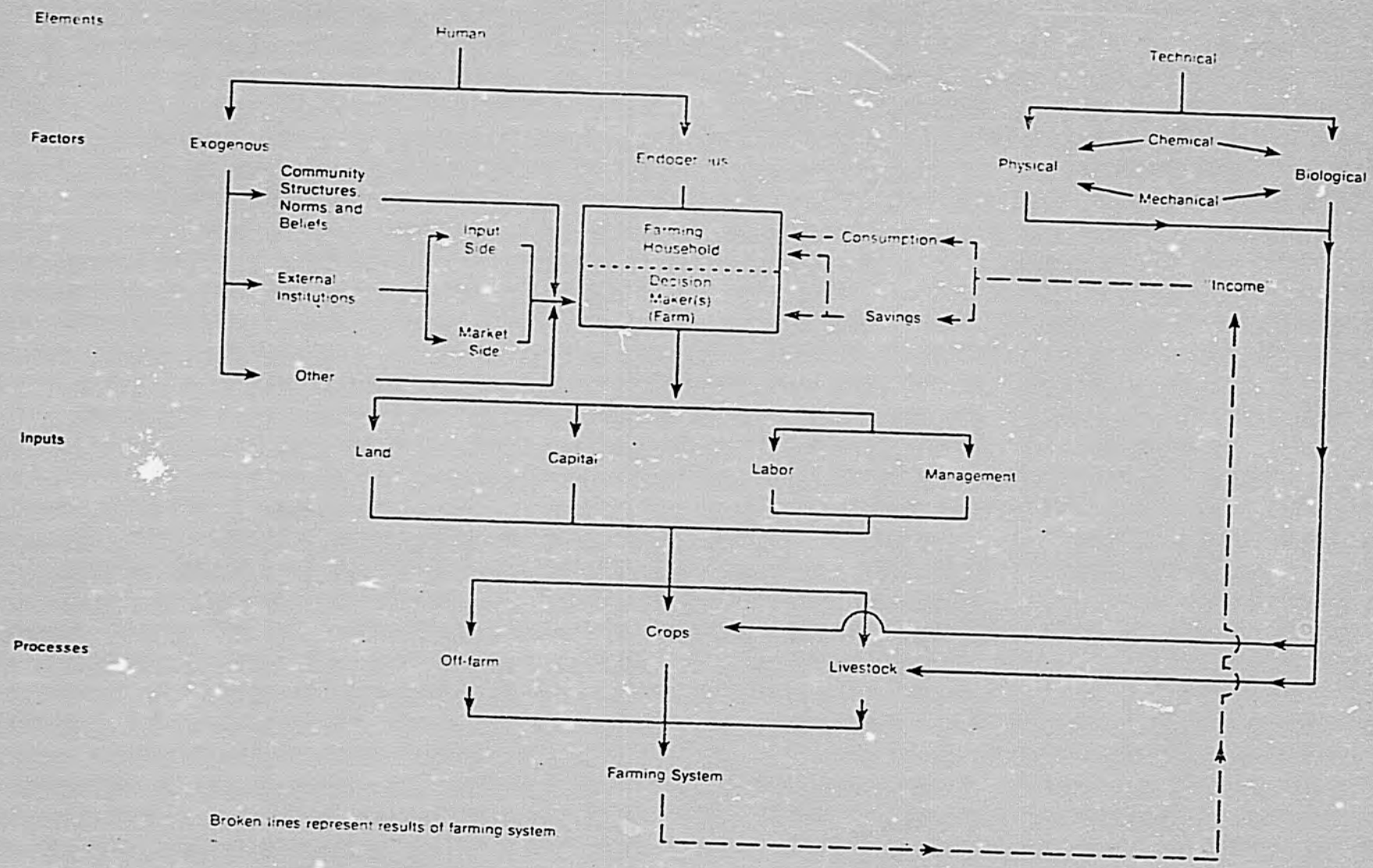


Figure 5-1. Schematic Representation of Some Determinants of the Farming System

Source: David W. Norman. The Farming Systems Approach : Relevancy for the Small Farmer MSU Rural Development Paper No. 5. East Lansing MI : Michigan State University Department of Agricultural Economics. 1980: 4.

As currently applied, much FSR suffers from a number of shortcomings which limit its suitability for use as a research tool in rainfed areas of the Northeast. Two of the most important of these shortcomings are :

(1) Its exclusive focus of the farm as the unit of description and analysis ignores the need to look at systems in hierarchial order; running from the field level, to the farm, village, regional and national level up to the international level (Conway 1982) Each level has its own unique systems properties which cannot be understood simply through study of its lower level components. For example, given the undulating terrain of the Korat Triangle with its series of mini-watersheds, the farm-level system cannot be explained by simply looking at several separate fields.

In the case of the Northeast, Figure 5-2 presents one possible set of hierarchial systems. Of the identified levels the key areas for analysis are the world market, Kingdom of Thailand, Korat Triangle, local agroecosystem (mini-watershed, non-flood plain and flood plain), village, farm, and field plots (Terd Charoenwatana et al 1982) Of these systems, FSR normally is only applied to the last two.

(2) FSR tends to employ essentially static analysis which treat both human society and agricultural environment as an unchanging system The farm household is seen as making management decisions reflecting endogenous and exogenous conditions. No clear linkage between the household unit and the larger social and physical environment is incorporated in the FSR model although the relation of individual behavior and social/physical change is one of the most significant concerns in social and environmental science. FSR models usually explicitly omit identification of changes in the agricultural environment stemming from management practices, e.g. according to farmers in the Korat Triangle (Grandstaff and Artachinda 1982) on-farm pest problems have increased in part because of the cutting of forest to expand the cultivated area which has reduced the habitat for insect-eating

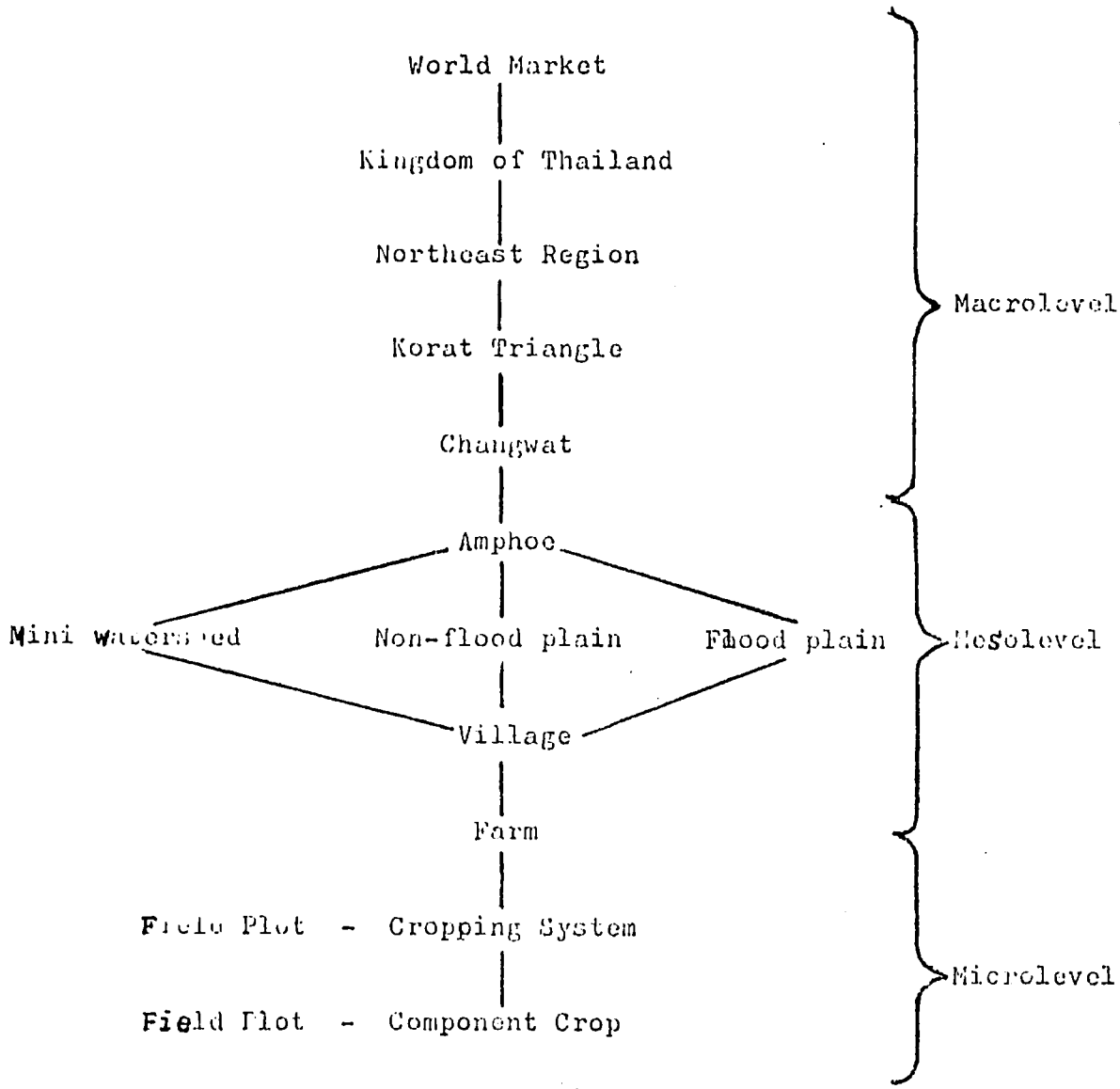


Figure 5-2. The system hierarchy.

Source: Charoenwatana, et.al., 1982:10

birds. Such changes in the agricultural environment force farmers to increase their use of chemical pesticides which lead to further unpredictable ecological changes.

Dissatisfaction with FSR as currently applied has led a number of agriculturalists, agro-ecologists and social scientists to propose alternative models that recognize multiple levels in agricultural system hierarchy and that explicitly incorporate dynamic interactions between human and agro-ecological components (Lefferts 1982, Rambo 1981; Sentisara 1982). Models that treat human social systems and agroecosystems as distinct but closely interrelated subsystems have technical and conceptual advantages over present FSR approaches. This distinction is also useful because it accepts the reality of the existing disciplinary division of labor between social and natural scientists that exists in most universities, but provides an intellectual basis for integrating their research efforts.

Social Science in FSR

In recent years it has become widely recognized that there is a need to incorporate social science into FSR. Zandstra et al (1979) for example, assert that one of the major achievement of the IDRC supported Cegrera rural development project in Colombia was the recognition that socio-economic factors were as significant as biological factors in farmer response to agricultural innovation. Similar conclusions have been independently reached by the KKU-Ford Cropping Systems Project team, a conclusion reflected in their incorporation of increased support for social science research in the RAI proposal.

Unfortunately, however, the conceptual basis for incorporating the human element into FSR is still poorly developed and there are few successful models that can be borrowed for use at KKU. All too often, the felt need for better understanding of farmer behavior has been met simply by tacking

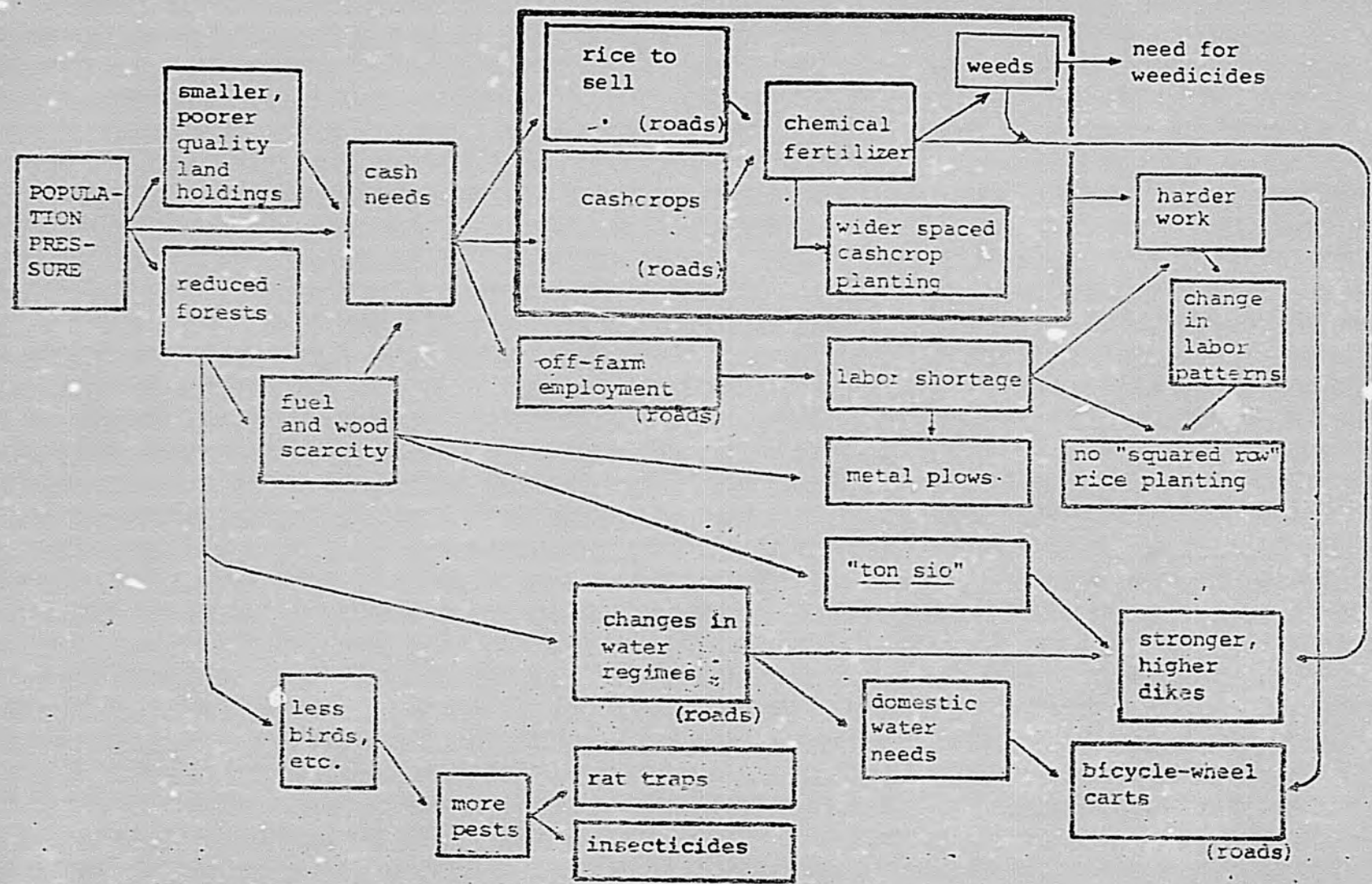
on a "socio-economic" component to the agronomic research project. This usually involves contracting with an agricultural economist and/or rural sociologist to gather unspecified socio-economic data on the farm community. Collected without reference to any larger theoretical model of the total farming system, these data are often of little actual value in understanding how the system works.

Much of the limited amount of social science research in rainfed areas of the Northeast is of this sort. The "social laboratory" project of KKU was initiated with a baseline socio-economic survey of ten villages. A baseline study was also done early in the KKU-Ford Cropping Systems Project. NERAD employed an anthropologist to make such a survey of the eight tambons in its target area. Attempts to utilize these data for analyzing the entire farming system have revealed their short-comings. Yet, the valuable insights have provided by the data reinforced the conviction that social science data, collected to fit a valid conceptual model with a defined purpose in mind, can be a powerful tool for understanding systems dynamics (Grandstaff 1982).

Research of the social scientist in FSR must be much more clearly focused than is the case in most baseline surveys. No systematic work of this sort has been conducted at KKU but the work of Fleckenstein (1980) on farmer time and labor utilization in various rainfed agricultural activities offers an example of what might usefully be attempted. DeBoer and Welsch's (1977) analysis of fluctuations in labor demands for cutting and carrying feed for buffalo and cattle throughout the annual cropping cycle is another such example. Grandstaff and Artachinda's (1982) model of interactions between population, technology, and agricultural change is suggestive of the analytic power of a farming systems approach that truely integrates social and ecological variables (Figure 5-3), while Lefferts (1982) identifies many additional social variables that must be taken into account in FSR in Northeastern Thailand.

FIGURE 5-3.

SOME INTERRELATIONSHIPS HYPOTHESIZING THE NEEDS FOR TECHNOLOGICAL CHANGES FOUND



Source: Terry B. Grandstaff and Supanee Artachinda. The sources and needs for technological change on rainfed farms in Northeast Thailand. Unpublished USAID memorandum, 1982.

Use of the systems hierarchy approach is particularly important in integrating social science analysis into FSR (Seetisarn 1982). There are often contradictions between goals articulated at the national level and those at the village and farm household level. Thus, national level planners may interpret the goal of "increasing food production" as meaning increasing the production of a single export-oriented crop, whereas the farmer may be concerned with reducing the risks of failure by diversification of his cropping system, and the village may attempt to check development of greater social and economic inequality by strengthening communal control over productive resources. Such differences in objectives are neither trivial nor easily resolved. They do not simply stem from faulty communications between different levels in the systems hierarchy, but instead often represent fundamental contraditions between the self-interests of decision-makers at different social levels. Identifying such potential conflicts in agricultural development policies is an area where social scientists can make a significant contribution to farming systems research and was recognized as a key research question by the Northeast agroecosystem workshop (Terd et al 1982).

Livestock in FSR

Although often advocated in programmatic dicussions of FSR, livestock production is usually rarely examined in much detail. Zandstra (1982) argues that analyses of mixed farming systems have often missed or ignored hidden contributions by livestock to the crop or off-farm enterprises. Contributions of livestock to the farm include the production of animal products, manure, draft power, a means to save income, provide an alternative market for crops, utilize marginal labor, and meet social obligations. Several of the benefits received by farmers from livestock relate to the interface between crop and animal production enterprises on the farm.

Residues: Crops and livestock are traditionally integrated into farming systems in rainfed areas in the Northeast. Crop residues and non-marketable by-products provide the major source of animal feeds especially that for buffalo, cattle, swine and poultry. It can be shown (Table 5-1) that, in some cropping systems, the amount of by-products, can be as high or higher than the marketable produce. This often goes to waste if not utilized for animal production. As indicated in Table 5-2 the ratio of average household income derived from livestock to crops in the Northeast was approximately 3:7 in the crop year 1977/78. Even here, income from livestock did not take into account other livestock non-cash values such as manure and draft power.

As indicated below large quantities of crop residues and by-products are available in Thaiand.

	Million tons
Rice, hulls	2.72
Rice, straw	17.06
Maize, aerial part without ears, husks sun dried	2.197
Cassava, dry leaves	0.910
Sugarcane, begasse	2.565
Sugarcane, top with leave	3.325
Peanut, aerial part, dry	0.083

In the Northeast rice straw is the major source of cattle and buffalo feed during the critical period of the dry season from late February to early May. Rice bran and broken rice produced in small amounts at household level are generally used for pig and poultry feeding. Given the small amount available from each household in the village these by-products are not suitable for marketing. Crop residues and by-products are fed to animals, in their original form by the villagers, although nutritional improvement could be obtained through use of inexpensive supplements. Very little is known about how the type of by-product produced influences farmers' decisions to adopt a new cropping system.

Table 5-1. Digestible Nutrient Production from Six Irrigated Cropping Systems

System	Digestible Protein		Non-protein Dig. Nutrient	
	Amount (kg/ha)	Marketable (%)	Amount (kg/ha)	Marketable (%)
A	920	29	14,900	39
B	670	64	6,600	47
C	1,260	40	11,800	38
D	720	29	6,700	32
E	810	63	17,000	24
F	770	61	10,200	37

Source: Resource Utilization in Integrated Farming System with Crop as Major Enterprise by D.A. Carandang, FFTC/ASPAC Ext. Bull. No. 150, 1980.

System

A sweet corn, sweet potato or sweet corn
B cowpea, soybean or sweet corn, mungbean
C soybean, sweet potato or corn, sweet corn or mungbean
D sweet potato, sorghum, cow pea or sweet corn
E mungbean, sorghum, sorghum (ratoon)
F. soybean, sweet corn, sweet corn or cowpea

Table 5-2. Average Agricultural Household Income by Sources and Regions

Region	Sources		
	Livestock	Crops	Combined
Northeast	1,574.33* (31.35)	3,334.62 (68.65)	4,828.95 (100.00)
North	1,380.23 (14.74)	7,983.08 (85.26)	9,363.31 (100.00)
Central	4,698.21 (20.37)	18,370.98 (79.63)	23,069.19 (100.00)
South	1,891.89 (23.84)	6,043.39 (76.16)	7,935.28 (100.00)
Kingdom	2,107.90 (21.84)	7,545.25 (78.16)	9,653.15 (100.00)

*Unit in Baht ( ) Percentage in bracket

Source: MOAC Agricultural Statistics of Thailand Crop Year 1977/78.

Draft Power: Demand for draft power for land preparation and other agricultural operations in rice production in rainfed areas is continuing to increase. Rapid increases in fuel costs during the last 6-7 years have reduced the economic feasibility of use of tractors and agricultural machinery in rainfed agriculture under small farm conditions. Small farmers have to depend on buffalo and cattle for work in the rice fields due to their small land holdings. The most intense period of use is during the months of May, June and July when the majority of the rice land is prepared and planted. A pair of buffalo can plow 1 - 1 1/2 rai during a 5-hour work day. On the average in the Northeast these draft animals work around 120 days per year although this varies by year and by location. Each animal can serve up to 10 rai of paddy during a cropping season. Little research has been done to explore the relationship between different farming systems and their draft power requirements.

Manure: It is estimated that at least two tons of manure is produced by a mature buffalo or cattle each year. The manure is generally collected in animal pens under or around the house. Manure is mainly used as fertilizer in rice fields. Manure is also used on other crops or for trees around the household area. Chicken and pig manure is mainly used for vegetable growing or in backyard gardening. However, the available supply of manure is limited but very little research has been undertaken to determine the most economical way to use this manure.

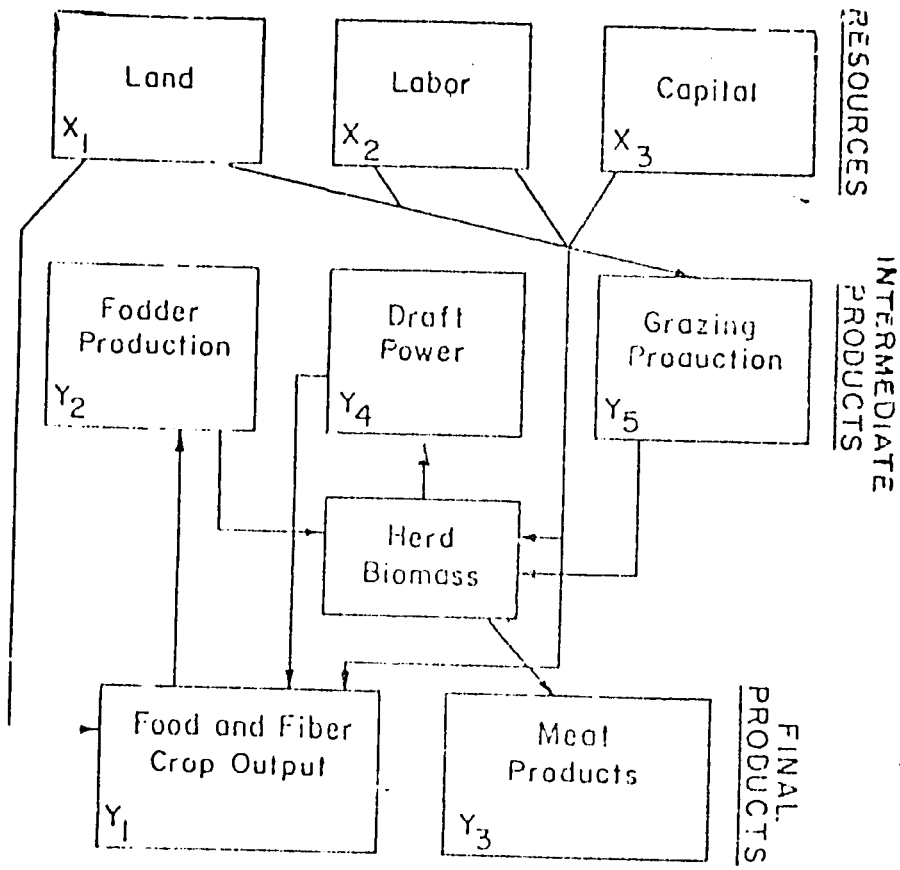
Non-ruminants: Small farmers usually raise 5 to 20 chicken and 1 to 2 pigs around the house. These animals are fed rice bran, broken rice, locally available crop wastes and water weeds. Both for personal consumption and for generating small sums of cash these small animals are very valuable but, again, very little is known about how decisions concerning animal production are made by farmers.

Examples of actual integrated studies of livestock within the farming systems context are few. DeBoer and Welsch (1977) have attempted to diagram the place of buffalo and cattle in the Northeastern Thai village production system (Figure 5-4). Their model ignores the value of manure production although Pendleton (1943) had earlier called attention to its significance in cultivation of mulberry trees and tobacco.

The social aspects of livestock raising have hardly been examined although Fleckenstein (1980) reports that depredations of unsupervised buffalo in garden plots are the cause of much conflict within village society and the need to guard dry season vegetable fields causes a considerable drain on farmers' time. Clearly, a major requirement for IRFSP will be development of a more adequate conceptual model of crop-livestock -society interactions. Chantalakhana's (1980) suggested model of interactions among plants, animals, and man on a typical Thai small farm may prove a useful prototype for such development (Figure 5-5).

Agroecosystems in FSR

System properties are attributes unique to systems which are created by the interaction of the various components. Usually they are not apparent simply from examining the behavior of the components alone. For example, the yield response of a field of rice to fertilizer or to drought is not the simple summation of the yield response of individual plants treated and measured in isolation. Rice plants compete with one another for nutrients and water and this affects the final yield of a rice field in a complex manner. A natural ecosystem that has been partially modified by man to produce food, fiber, or other agricultural products can be defined as an agroecosystem. The transition from the natural system to the agroecosystem involves significant changes. While its boundaries are more sharply defined and its structure simplified through a reduction in the number of its natural or biological components, the inclusion of man and his economic activities reintroduces considerable complexity.



Interrelationships in the allocation of resources and the production of intermediate and final products in Non Som Boon Village, Thailand, 1971.

Figure 5-4. Livestock in the Farming System

Source: A.J. De Boer and D.E. Welsch - Constraints on Cattle and Buffalo production in a Northeastern Thai Village. In Tradition and Dynamics in Small Farm Agriculture. Ames : University of Iowa Press, 1977:123.

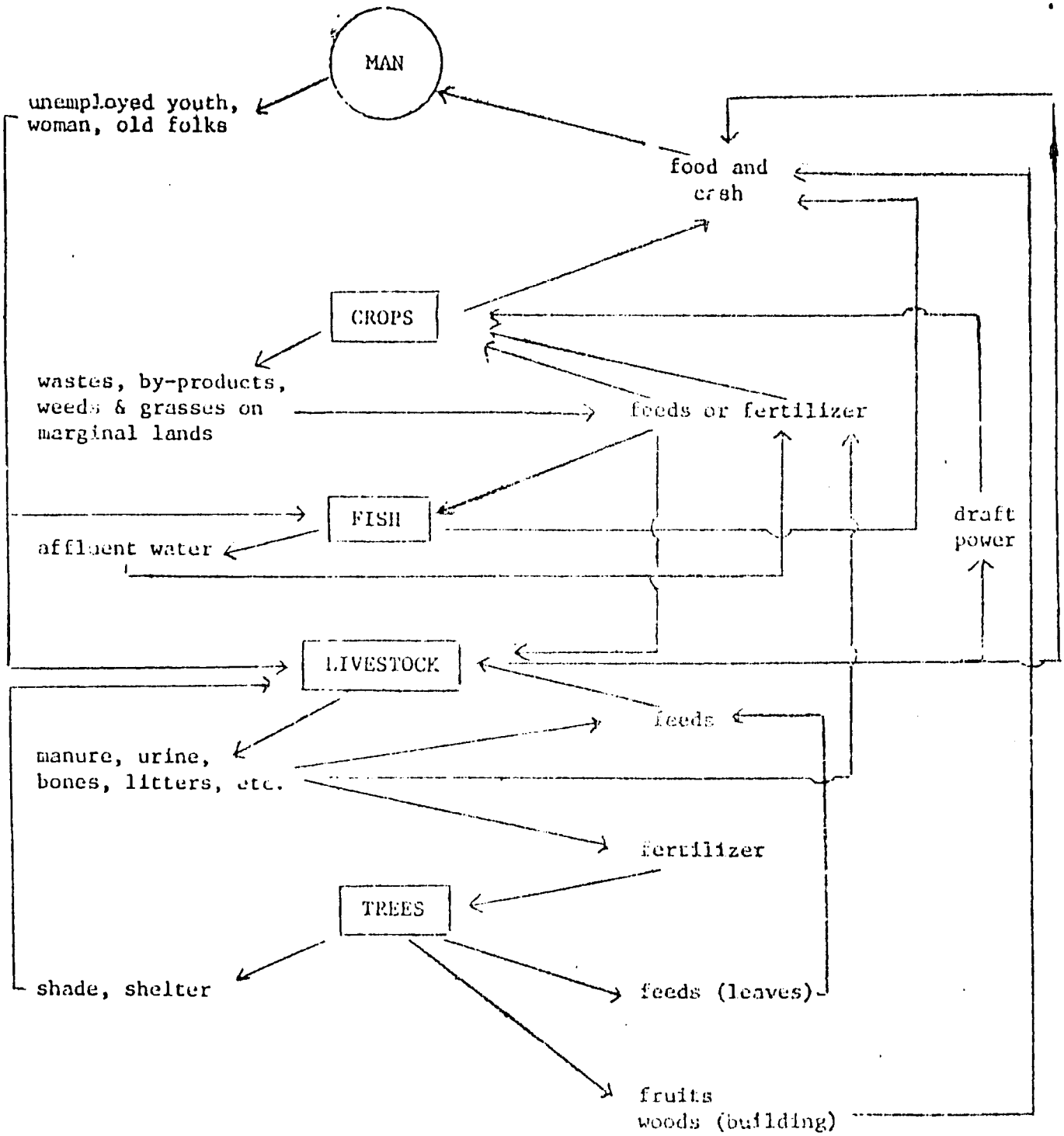


Figure 5-5. Interrelation or interaction among plants, animals, and man on typical small farms in Thai village.

Source: Charan Chantalakhana. Some problems in the development of integrated farming in Thailand. Paper presented at the ANICA Workshop on Integrated Livestock-Fish-Crop-Forestry Production Systems for Small Farmers and Fisherman. Chiang Mai. 9-13 April 1980:3.

The most important properties of agroecosystems are those which relate to the productivity, stability and durability of agroecosystems. By productivity we usually mean the yield or gross production of crops or livestock, or alternatively the gross or net income. Stability is a measure of the variability in yield or income and is usually computed as the inverse of the coefficient of variation of these parameters. Stability is a function of how well a system can resist, absorb or adapt to the stresses and perturbations it experiences. Durability, however, is concerned with the long run performance of the system. It measures how well the system is able to sustain its productivity in the face of repeated stress and/or major perturbation (Conway 1982).

These three properties are interrelated but often conflicting. For example, greater productivity may only be attained at the expense of stability and/or durability. Alternatively, in some situations, greater productivity may not be possible until stability has been increased. These properties also receive different degrees of emphasis at different stages in agricultural development. Thus, in the Chiang Mai Valley, productivity was given priority a decade ago in the construction of major irrigation works, but attention is now turning to the durability of the new cropping systems. In the Korat Triangle there have been increases in agricultural productivity but these have largely been a function of the opening of new land rather than representing increased yields per rai. The dominant feature of the Triangle's agriculture is its instability. It may well be that this needs to be reduced before further major increases in productivity are possible.

Research Objectives

In order to better understand and identify the significant constraints to increased rainfed agricultural production in the Northeast and to develop component technology that allows farmers to overcome these constraints so that they can intensify production, it is proposed to develop an Integrated Rainfed Farming Systems Project (IRFSP). The principle objectives of this project are as follows.

(1) To improve the quality of graduate from KKU by ensuring they are exposed to "real world" problems of rainfed farmers and by immersing them in a program with a heavy emphasis on farming systems research methodology.

(2) To improve the quantity, quality and relevance of the research activities carried out by KKU staff particularly as they relate to rainfed farming systems in the Northeast.

(3) To improve KKU's ability to provide basic and applied research assistance and support to help RTG research and development agencies especially those of MOAC.

The project, to be located at KKU, proposes to use FSR methodology as the main technical device to ensure integration of the various research activities.

Research Strategy

The major agricultural feature of the Korat Triangle is the great instability in rice production. As noted in the previous section, major increases in productivity are difficult until a remedy for this instability is found. Initially the aim of IRFSP researchers should be to describe and understand the functioning of the various systems as they are presently operating. Particular attention needs to be paid to the establishment of a basis for longitudinal measurement of changes, both annual, and longer term. Such information is necessary for developing appropriate new systems and also for assessing the impact of subsequent attempts to modify existing systems.

It is suggested that IRFSP research be concentrated at the meso and micro levels. Two tambons within the Korat Triangle will be selected for intensive study. One should be located close to the university and the other may be a NERAD tambon (either in Chaiyaphum or Roi Et). As the Cropping Systems Project staff at KKU has already held a workshop and published an agroecosystem analysis of the tambons in Roi Et and Chaiyaphum, selection of the target tambon will not be a problem. Within these tambons 3-4 villages may be selected for detailed study. This research will be at the mini-watershed, village, farm and field plot levels. Other research, as required, will be in laboratories on campus or on university farms where it is possible to control more variables.

Key Questions

The December 1980 workshop on Agroecosystem Analysis in the Northeast identified a number of topics for future research. These key questions provide an excellent set of interdisciplinary research issues although they do not establish priority among them. At the beginning of this project it will be necessary to have another workshop to examine in detail the key questions and start to establish priorities between these for research. This workshop should be held in cooperation with the IRFSP Research Committee.

A tentative set of key questions is presented here but it must be recognized that these will be modified as the IRFSP staff starts to work together. The column at the right of the "key question" pinpoints which groups will be involved (*) and which one should assume a leadership role (**).

Mesolevel	Crop	Livestock	Social Science
1. How can the mini-watershed be best managed as a system?	**	*	
2. How can the upper paddy area be best managed?	**	*	
3. What is the precise nature of the interactions between the various land uses in the watershed?	**	*	*
4. What is pattern of distribution of land types of individual farms?	**		
5 Describe a range of typical farms as resource systems, paying particular attention to identification of all key components and important human management inputs required by each of these.	*	*	*
6. What are critical limiting factors (capital, labor supply, water, etc.) for expansion or intensification of use of various components of farm resource system e.g. why don't farmers raise more ducks or chickens or silkworms than they do now?	*	*	**
7. How does the use of the upland areas in the watersheds affect water supply to the paddy areas and can improved systems of water management be designed which optimize the performance of the watershed in all years.	**		
8. Would contouring and reconstruction of the bunds improve the overall performance of the typical watershed?	**		
9. What role have small ponds or reservoirs to play in improving the performance of the watershed?	**		
10. How can farmers best respond to flooding after rice transplanting in the flood plains?	**		

	Crop	Livestock	Social Science
11. What is the nature and extent of communally managed resources (grazing land, water, forests, etc.)?	*	*	**
12. How are these communal resources actually managed and individual access to them allotted?			**
13. How are conflicts over access to resources dealt with?			**
14. Will the loss of communal linkages in the villages seriously threaten the durability of the village in the face of crop instability and if so which linkages should be strengthened?			**
15. What are the attitudes, values and goals of farmers in the Triangle and how do these determine the choices of subsistence and cash strategies?	*	*	**
16. What are the best mixes of crops, livestock, farm crafts and off-farm employment for promoting productivity, stability, and durability of farm income?	*	*	*

Microlevel

1. What are the ranges of soil moisture storage potential under the Korat Triangle rainfall regimes and how can they be best exploited for more intensive cropping?	**		
2. How can the climatic pattern be most appropriately classified for agronomic purposes and what extra parameters and analysis are required to do this?	**		
3. What are the specific desired characteristics of upper paddy rice varieties; Does Pong Aew meet these fully and, if not, is it desirable or feasible to develop special varieties for upper paddy cultivation?	**		*

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	Crop	Livestock	Social Science
4. How can low yield in the upper paddy due to late planting be improved?	**		
5. Can rice varieties be developed which will give more stable yields under the variable flood conditions of the flood plains?	**		
6. What are the principal causes of micro-variability in Northeast soils and can cropping practices and systems be devised which will overcome the instability of yields this creates?	**		
7. Are there cheap and effective means of erosion control in the upland areas?	**	*	*
8. What are the actual crop losses due to the major pests and diseases and their associated probabilities of occurring?	**		*
9. Under what circumstances are pesticide applications likely to prove economic and when should they be made?	**		*
10. What cheap and effective biological and cultural controls exist for major pests and diseases?	**	*	*

The workshop did not make an in-depth analysis of the role of livestock in Northeastern farming systems although the participants explicitly recognized that greater attention should be paid to livestock in future research. The following key questions at the meso and micro levels pertaining to livestock should be addressed:

	Crop	Livestock	Social Science
1. What is crop residue and by-products availability pattern of village households?	*	**	
2. Economics of using animal draft in rainfed agriculture in the Northeast vs. mechanization	*	*	**

	Crop	Livestock	Social Science
3. Socio-economic role of livestock in villages in relation to other sources of income.	*	*	**
4. Relationship between scale of livestock raising with crop production and socio-economic status of the farmers.	*	*	**
5. Could existing farm tools utilizing animal draft be improved to increase crop production yield?	**	*	
6. Why are existing techniques for improved utilization of crop residues accepted or not accepted by the farmers?		**	*
7. What constraints exist at the small farm level for the effective implementation of the village poultry disease prevention programs?		**	*
8. Implications of livestock breed improvement for utilization of feed resources resulting from crop production.	*	**	
9. How to organize farmers in order to effectively receive livestock services such as A.I., bull loan, or buffalo bank?		*	**
10. Success or failure of buffalo bank, if successful, what is the impact on crop yield and farmer's social attitude?	*	*	**
11. Economic and social aspects of rural livestock markets in relation to small farm livestock production.		*	**
12. What are the economic and social effects of community fish pond development?		*	**
13. What are the explanations for widely varying intensity of silkworm production between villages in the Northeast?	*	*	**

Specific Research Activities

At this stage it is difficult, and even potentially damaging, to define specific research activities too concretely. IRFSP staff will have to work closely with the IRFSP Research Committee as well as other staff from other projects such as NERAD and the World Bank funded Pasture and Livestock Improvement Project to develop research priorities. A mechanism for determining actual village needs and feeding these back into the research program must also be developed. Taking this into account, the following set of possible research activities mmust be accepted as tentative, subject to future review and modification as deemed necessary.

Early in the first year an observation-type survey will be conducted by a team of social and physical scientists in order to gain a better understanding of existing farming systems. This survey will study different type farms such as those predominated by rice or field crops, by livestock production, or by off-farm income sources. The purpose is to learn about different kinds of strategies and tactics employed by farmers to best utilize their land, labor and capital resources.

Social Science Research: Possible social science research includes:

does not a real need exist for research? Indeed is the near need?

(a) Village and household demographic structure and dynamics.

(b) Health and nutritional status including food habits and dietary pattern; particularly as they relate to cropping and livestock production patterns.

(c) Labor resources and utilization over time and space by on-farm and off-farm activity.

(d) Social factors affecting control and utilization of resources in integrated farming systems.

(e) Farmer values and decision-making related to various crop and livestock production practices.

(f) Farmer knowledge of agricultural technology and understanding of farming systems.

(g) Sources of income and relative profitability of alternate on-farm and off-farm activities.

(h) Quantity of rice produced, consumed, and stored as a safety measure against drought. Yields of other crops and marketing strategies.

Animal Science Research: Livestock research projects will be formulated in relation to the problems and needs of the small farmers who largely subsist on crop production with livestock, including poultry, as an integral part of their integrated farming systems. The following general areas of research should play important roles in improvement of animal production under small farm conditions.

(a) Research on animal nutrition, feeding and management. Village livestock feed supplies encompassing quantity and quality, as well as year-round fluctuation, needs to be examined. Constraints and limitations on animal feeds and feeding in villages including investigations on the performance of village livestock, should be conducted. It is necessary to identify suitable ways and means to improve the utilization of crop residues and by-products in order to increase village livestock production.

(b) Research on prevention and control of livestock diseases and parasites at village level. Practical and effective vaccination schemes against serious infectious poultry diseases are to be devised and tried in the village. Practical inexpensive health measures need to be studied for pig, cattle and buffalo raising. Traditional animal health care techniques practiced by the villagers should be examined for their technical value.

(c) Village livestock production system. During the first year, monitoring of village livestock production dynamics in relation to crops, man and other village environments is to be carried out in order to be able to identify problems and needs of the villagers. Studies on the development of integrated crop/livestock systems or other studies concerning village livestock production deserve real attention.

(d) Livestock breed improvement. Production performance of various livestock under village conditions is to be examined. Effects of crossbreeding on village pigs, or cattle will be studied. Possible breed improvement by crossbreeding through A I. or natural mating suitable for village conditions will be examined. Bull loan or buffalo bank or other livestock services will be evaluated, if available, or they will be instituted if not.

(e) Improvement of animal-drawn farm implements. The efficiency of work by animals in crop fields could be greatly increased by the improvement of traditional farm implements and harness systems. Different research problem will be indentified and commissioned to research workers in engineering.

(f) Research in fisheries. Wherever small farm ponds exist in the village, selected species of fishes could be raised. Studies on the integration of fish into the crop/livestock system will be carried out.

Details of activities and personnel are presented in Table 5-3.

Table 5-3. Livestock Research Plans and Personnel

Research Area	Relative Importance	Location & Research	Disciplines	Availability of Personnel	
				Avail.	Need
I. Nutrition & Feeding					
- Improved utilization of crop residues	H	U & PV	R. Nutr.	(A)1 Ph.d	(B)1 MS
- Utilization of locally available crop products as animal feeds	M	U & PV	S. Nutr.		(c) MS
- Integration of fodder crops	H				
- Improve feeding of cheap crop by-products to poultry and pigs	H	U & PV	S. Nutr.	(A)	(C)
- Nutritional supplements such as minerals	M	U & PV	R. Nutr.	(A)	(B)
II. Disease and Pest Control					
- Development of effective & practical vaccination program for village poultry	H	PV & NV	Vet., An.Prod.	(D)1/2 Ph.D.	(E) 1 MS
- Effective measures for carrying out vaccination in buffalo and cattle	H	PV & NV	Vet., An.Prod.	(D)	(E)
- Village animal parasite & pest control	H	U & PV	Vet.	(D)	(E)
- Traditional health care	H	PV & NV	Vet.	(D)	(E)

Table 5-3. (cont'd)

Research Area	Relative Importance	Location & Research	Disciplines	Availability of Personnel: Avail.	Availability of Personnel: Need
III. Livestock Breed Improvement					
- Cross-breeding of cattle to Brahman & A.I.	M	PV	An. Br.	(F) 1MS	(G) 1MS
- Dairy crossbred heifer production	M	PV	An.Br.	(F)	(G)
- Village Chicken cross-breeding	M	PV	An.Br.	(F)	(G)
- Geese	L	PV	An.Br.	(F)	(G)
- Buffalo Bank	M	PV	An.Prod.	(F)	(G)
IV. Animal Production System					
- Village livestock production monitoring	H	PV	An.Prod.		(H) 1 MS
- Development of integrated system for livestock & crops	H	PV	An.Prod. & Econ.		(H)
- Socio-economic studies of village components affecting animal prod	H	PV & NV	An.Prod. Soc.Sci. & Econ.	(I)& (J)	(H)
- Traditional animal cares (also under disease)	H	PV & NV	An.Prod. Soc.Sci.	(I)	(H)
- Livestock marketing system (rural market)	H	PV & NV	An.Prod. Soc.Sci.	(I)	(H)
- Dynamics of livestock production	H	PV & NV	An. Prod. Soc.Sci.	(I)	(H)
V. Improvement of Farm Tools Utilizing Animal Draft	M	U & PV	En. & An.Prod.	(K)	(H)
VI. Fisheries					
- Appropriate species					
- Integration of fishes into other component	H	U & PV		(L) 1 MS	(H)

Plant and Soil Science Research: Component research in agronomy and soil science will form a core set of information for field and farm level work. A significant amount of the work during the first year will be in monitoring on-going systems. This will also be accompanied by component research testing new systems as well as research in response to identified problems from NERAD and other projects. Much of the component research will be conducted by a team of researchers from different fields collecting data from the same experiment or surveys. This is necessary as many of the individual components interact with each other. This type of research will help individual members of the research team to understand the overall picture of any experiment or existing systems of farmers much better than in the past. It should also accelerate the identification of new cropping techniques and systems that fit into existing, physical and socio-economic conditions of rainfed areas.

Agronomy: The number of component experiments will be kept to a minimum. However, some of the critical component technologies such as land preparation, seeding technique, etc. will still be studied. Additional trips will be made to areas such as Surin and Buriram, where a number of the proposed cropping systems are already in use, in order to study management techniques and identify skills required for cropping.

Agro-climatology: The significant impact of early and late rainfall during the monsoon season, particularly in relation to planting of field crops, will be closely studied. It is not known at present how many millimeters of rainfall are sufficient for different types of land preparation and planting on various soil types and topographic positions. The relative significance of various environmental factors such as climate, land form, soil physical properties, etc., will be studied to see how they relate to actual crop production.

Soils: Studies on soil moisture potential distribution as affected by topographic position, soil types, water tables, as well as techniques of land preparation, will be the major focus of soil research during the first two years. Soil researchers will also make intensive studies on the chemical and physical properties of the soils found in the locations where field crops are actually grown either before or after the monsoon season. These studies will be in relation to soil moisture, required fertility, and compaction. An MS candidate will pursue research on soil micro-variability as part of his thesis work.

Plant Protection: Monitoring infestation of insect pests and plant diseases will be a major part of the plant protection research program. Studies will be conducted to develop low-cost but effective ways of controlling key pests, particularly beanfly for mungbean and subterranean ant for peanuts.

Budget

The budget for IRFSP is developed by research area (i.e. crops, livestock and social science) as this simplifies separating out equipment, research, consultancy and training requirements. However, to promote integration within the total farming system framework, funding for programs such as workshops is included under the core budget of the Office of the Project Coordinator. A summary total of the entire project budgetary requirements, both for Thai and USAID funds, over a five year project period is presented in Table 5-4. Tables 5-5 and 5-6 divide this into support required from USAID and funds expected from the RTG, respectively.

Table 5-4. Budget Summary in U.S. Dollars (5 Years)

	Category	USAID	RTG	Total
I.	Salaries/Compensation	840,344	405,550	1,245,894
II.	Research Operation	597,000	149,500	746,500
III.	Travel	124,200	20,000	144,200
IV.	Training	471,000	-	471,000
V.	Workshop	40,000	-	40,000
VI.	Consultancy	384,000	-	384,000
VII.	Building Construction	260,000	-	260,000
VIII.	Equipment	478,650	30,000	508,650
TOTAL		3,195,194	605,050	3,800,244

Table 5-5. USAID Budget Summary in U.S. Dollars (5 Years)

	Category	Core	Crop	Livestock	Soc. Sci.	Total
I.	Salaries/ Compensation	96,700	228,200	350,444	165,000	840,344
II.	Research Operation	46,000	208,500	266,000	76,500	597,000
III.	Travel	-	55,000	42,200	27,000	124,200
IV.	Training	-	170,000	144,000	157,000	471,000
V.	Workshop	40,000	-	-	-	40,000
VI.	Consultancy	-	77,000	17,000	290,000	384,000
VII.	Building Construction	200,000	35,000	25,000	-	260,000
VIII.	Equipment	40,000	249,000	140,050	49,000	478,650
	TOTAL	423,300	1,022,700	984,694	764,500	3,195,194

Table 5-6. RTG Budget Summary in U.S. Dollars (5 Years Total)

	Category	Core	Crop	Livestock	Soc. Sci.	Total
I.	Salaries/ Compensation	32,800	164,500	88,250	120,000	405,550
II.	Research Operation	-	74,500	50,250	25,000	149,500
III.	Travel	-	10,000	5,000	5,000	20,000
IV.	Training	-	-	-	-	-
V.	Workshop	-	-	-	-	-
VI.	Consultancy	-	-	-	-	-
VII.	Building Construction	-	-	-	-	-
VIII.	Equipment	-	20,000	10,000	-	30,000
	TOTAL	32,800	269,000	153,250	150,000	605,050

Justification of Request for USAID Supported Budget

Salaries and Compensation Salary budget is to hire research assistants, office staff such as secretary, typist and clerk, field technicians, field laborers Compensation is for the project director, and the coordinators and researchers who will work overtime, during the weekends, and/or in the villages

(a) Project Director

The project director fills an administrative requirement to have some type of fiscal control over the entire project

(b) Project and Section Coordinators

The coordinator is necessary to maintain liaison between the researchers in the different sections and the rest of IRFSP and to assist in better integration of activities between the sections One assistant coordinator is also necessary to provide administrative back-up to the coordinator Section coordinators are responsible for overseeing all research and other activities in their respective sections.

(c) Research Assistants

7 research assistants at B S level are required to manage on-farm crop experiments in the three project villages (3) and to assist the research associates in their specialized fields (4)

5 research assistants with M S degree are needed to manage livestock experiments in the project villages in different fields.

3 B A level research assistants will provide on-site supervision of village-level social system monitoring and also assist in data processing.

(d) Field Technicians

4 field technicians with B.S. degree will provide close supervision of various specialized livestock services related to research, such as vaccination of village chickens or artificial insemination for cattle and buffaloes.

1 technician will work at the Central Office.

(e) Student Trainees

- Graduate Trainees

8 graduate trainees, 4 in plant science and 4 in animal science, will be employed each year to conduct research and to work as trainees in villages.

- Undergraduate Trainees

4 Undergraduate trainees in animal science are needed each year to collect and study village livestock production dynamics concerning poultry, pigs, cattle, and buffalo.

(f) Village Workers and Laborers

2 high school graduates will be employed for the duration of the project to carry out longitudinal monitoring of village socio-economic activities.

6 field laborers are needed to manage and handle experimental animals, such as feeding, caring, etc. For similar purposes, 6 village workers and 6 field laborers are needed for crop section.

(g) Secretary

3 secretaries, preferably with English language proficiency, will run:

- Central project coordinator office (1)
- Livestock project coordinator office (1)
- Social science coordinator office (1)

(h) Clerical Assistants or Typists

4 Typists are required by Central Office, crop, livestock, and social science sections to prepare project manuscripts, etc.

2 Clerical assistants are required by Central Office (1) and social science section (1), to handle accounts and data tabulation. a financial officer is needed for the Central Office.

(i) Drivers

2 drivers will be needed by the Central Office and 1 driver by livestock section to take care of transportation of research personnel, equipment, and materials to villages.

Research Operation:

(a) Fuel and Vehicle Maintenance

This includes fuel costs and vehicle maintenance for project pickups and microbuses as well as motorcycles to transport research personnel and laborers from the university to project villages.

(b) Field Supplies

Includes miscellaneous items needed for field work such as fertilizers, photographic supplies, etc.

(c) Publications and Books

For purchase or subscription of books and periodicals related to crop and livestock systems research along with materials on the Northeast as well as social science materials relating to agriculture and peasant societies.

(d) Xerox Rental and Operation

A small xerox machine will be obtained on a lease basis.

Travel:

(a) Regional Travel

Funds will be used to support staff participation in international conferences concerning integrated farming systems as well as social science.

(b) Local Travel

Funds will support attendance at conferences in other Thai locations. Trips will also be made to study traditional farming systems in the Northeast.

Training:

(a) In Service

Two training workshops will be organized for social scientists participating in the IRFSP. The first, lasting approximately 6 weeks, will provide training in research design and field data collection methodology. The second, lasting approximately 1 month, will focus on data analysis and report writing. Senior foreign and Thai social scientists will be employed to conduct these workshops

Similar short-term in-service training will be provided for selected research personnel in crops and livestock.

(b) Long-term Graduate Degree

Three social scientists will be supported for Ph.D. training in the United States or appropriate developing country institutions. They will not be sent until the third year of the project to avoid the problem of stripping the effort of manpower in its initial stages. Selection of fields of study should be done in consultation with the social science consultant and the Fulbright Professor

Three outstanding researchers from crop production will be selected for further study (Ph.D.) after the third year of the project. Three candidates will also be selected from livestock section, 2 for Ph.D. study, 1 for M.S.

Workshop:

Various workshops will be held to look at integration of different disciplines into farming system research.

Consulting:

(a) Short-term

Funds will be used to employ short-term Thai and foreign consultants as needed.

(b) Long-term

A senior foreign social scientist with experience in farming system research and preferably, Thai language capability, will be employed for a 36-month period.

(c) Local visiting professors from other Thai institutions will also be invited to work with the project as consultants.

Equipment:

(a) Pick-up Trucks

Necessary for field transportation of research equipment, materials, and personnel.

(b) Microbuses

Needed for transportation of group of research personnel to villages and other locations in the Northeast.

(c) Motorcycles

Necessary for daily routine operation of the project both in villages and on campus.

(d) Laboratory Equipment

Laboratory and field research equipment is needed to support the various basic and applied research activities.

(e) Computers/Word Processors

Small micro-computers such as Apple II's or IBM Personal Computers with scientific as well as word processing capacity are needed to facilitate data analysis and report writing.

(f) Office Equipment

Typewriters, calculators, mimeograph machines, telephones, file cabinets, tables, tape recorders, are all needed to operate the various offices.

Building Construction.

(a) Project Coordinating Office

About 600 m^2 for administrative office, key staff rooms, a room for mini-computer, reading room, and a conference/meeting room is necessary for the IRFSP. Extension of the present plant science building is required.

(b) Livestock Experimental Barn

A livestock barn for buffalo and cattle nutrition and feeding research is required.

6. ORGANIZATION, SCHEDULE, LINKAGES, AND INSTITUTIONAL CHANGES

Levels of Organization

Organizational structure of the project must be examined at three levels: (a) Project operation level; (b) University level; and (c) National level. Each of these levels is very important for the success of the project and therefore will be discussed separately although it must be recognized that, in fact, they all are interrelated.

Project Level: Coordination at the project level is necessary for smooth operation of the various research components of the project. Day-to-day operation procedures, use and maintenance of the vehicles, budget allocation, joint research studies, resolution of any conflicts, establishment of internal policy, etc. all must be done at the project level. In order to facilitate this coordination a Working Group made up of the heads of the three sections (crops, livestock, and social science), senior scientists from the major research activities and the coordinator will be formed. The accountant may also be an ex-officio member as many issues will involve financial matters. As required, other researchers and scientists can be invited to group committee meetings.

University Level: Coordination at the university level, particularly between faculties and other university projects and organizations is extremely important. Project budgeting, establishment of rearch priorities, and relationships between staff from various faculties requires the creation of an IRFSP Research Committee. Possible composition of this committee is as follows:

1 staff member from Kasetsart University (multiple cropping, livestock, fisheries, agricultural economics, etc.)
1 from Chiang Mai University
4 from KKU IRFSP - coordinator, 3 section leaders

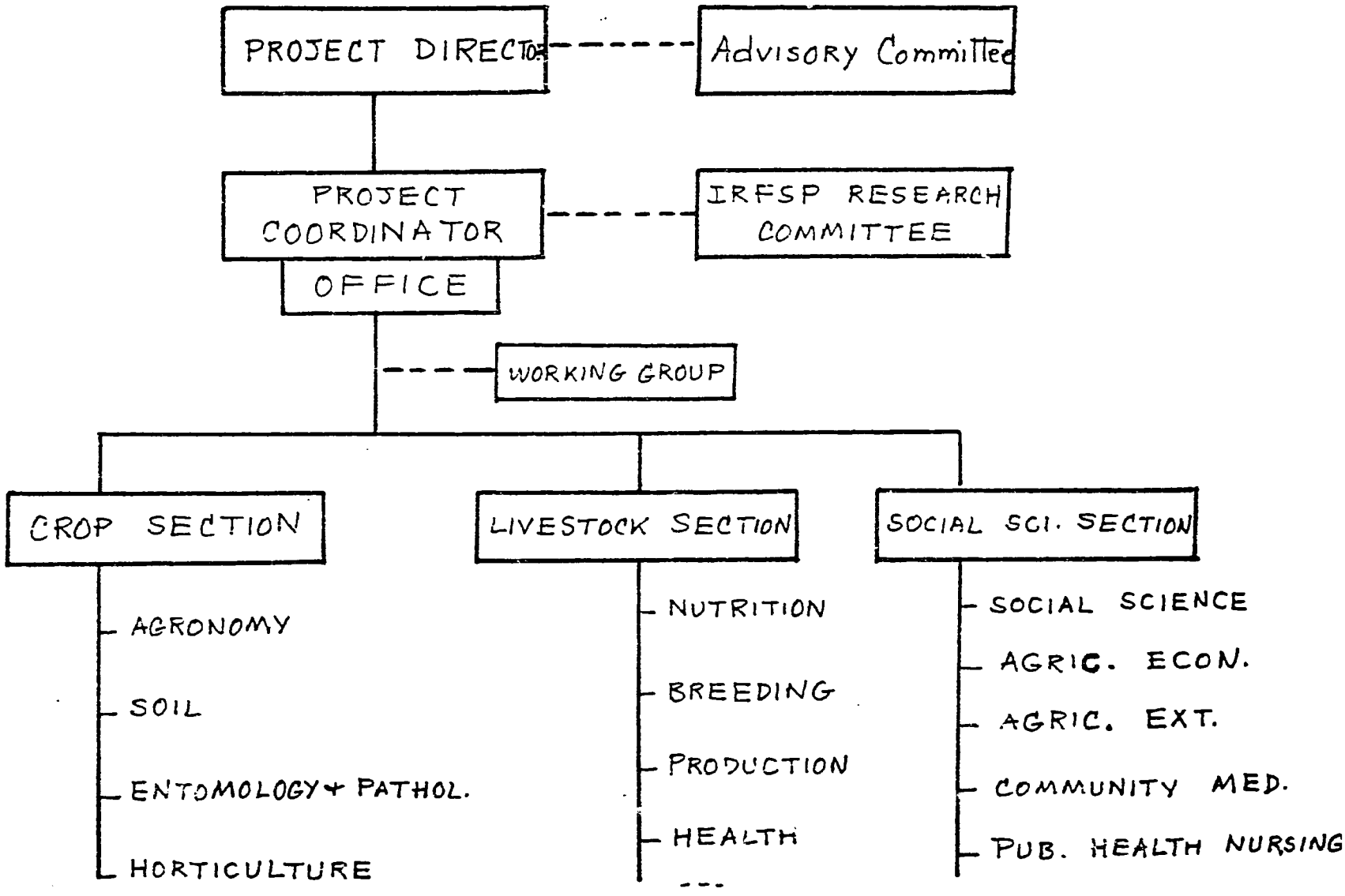
1 from NERAD
1 from NELDP
1 from RAI/DOA
1 from Social Science Association of Thailand

In order to minimize inter-faculty disputes and to establish policy related to questions such as allowances, use of vehicles, per diem, etc. the IRFSP Research Committee is necessary. By including a number of members from other on-going projects in the Northeast it is expected that research priorities established will meet the needs of these projects. Members from KU and CMU will help to link the project to on-going research at other Thai agricultural universities.

National Level: Coordination at the university senior administration level as well as with the Office of the Under Secretary--MOAC, NESDB, DOAE, DOA, DLD, DOAE is also important In order to bring about this administrative coordination, an Advisory Committee is to be established. This committee should be chaired by the Rector of KKU with the IRFSP Coordinator as secretary The suggested composition of this comittee is as follows:

Rector, KKU - Chairman
IRFSP Coordinator - Secretary
Dean - Faculty of Agriculture
Dean - Faculty of Humanities and Social Sciences
Department Heads - Plant Science, Animal Science, Social Science, and Community Medicine
Director of Institute of Research and Development
NESDB (Regional Office)
MOAC (Tha Phra)
DLD
DOAE (Office of Extension, NE)
DOA
Private Sector - Adam's Tobacco

FIGURE 6-1. PROJECT ORGANIZATION ; KKU-IRFSP



This advisory committee should meet at least once a year to discuss items of more general interest and to keep each other informed about project activities. This committee is not expected to set specific policy, which is the function of the IRFSP Research Committee, but is to advise the project coordinator as needed

Suggested overall project organizational structure, including the level of contact with the different committees and groups, is illustrated in Figure 6-1.

From this chart it can be seen that the Project Director may be the Dean of the Faculty of Agriculture The project should be organized so that monetary disbursement require two signatures; that of the Project Director and that of the Project Coordinator. All large projects at KKU are organized in this manner and the system has proven itself and is acceptable to all parties concerned.

Organization of Social Science Research within IRFSP

The dispersion of social scientists across at least 4 faculties and 6 departments within Khon Kaen University poses obvious difficuties for integrating social research into the farming systems project. Unlike the cases of the crop and livestock component , it is impossible to simply work on the basis of the existing departmental structures. A new organizational mechanism is required for social scientist to effectively participate in IRFSP.

As a result of discussions with the RAI Design Team's social science analyst, a group of interested KKU staff have formed a core group for social Science and Farming Systems Research This core group includes approximately 25 social scientists from the Department of Social Sciences, the Departments of Agricultural Economics and Agricultural Extension, the

Department of Community Medicine, and the Faculty of Nursing. A coordinator has been selected who will function to ensure close liaison between the social scientists and the project coordinator as well as with the crop and livestock components of IRFSP.

Schedule (General)

It is proposed that the project have at least a five year duration. Such length is necessary if the objectives of producing better qualified graduates and operationally useful research results while also up-grading KKU staff research competence in FSP are to be achieved. A detailed schedule cannot be drawn-up until the project has reached a more operational stage, but a basic outline has been formulated.

Year 1: Selection of study village(s); making of base-line observations of all components (crops, livestock, socio-economic) of farming system.

Year 2: Monitoring of systems behavior; testing of new cropping and livestock systems; identification of key questions for applied component research; preliminary studies of MERAD village(s)

Year 3-4: Continued monitoring of system' behavior; development and testing of new systems, component technology research; applied research and extension in MERAD village(s).

Year 5: Identification and broader dissemination of appropriate new system.

Social Science Schedule

The IRFSP social science component involves scheduling of three types of activities:

a. Training, both short- and long-term

b. Research, both baseline description and monitoring of farming systems dynamics, and

c. Exchange and dissemination of information.

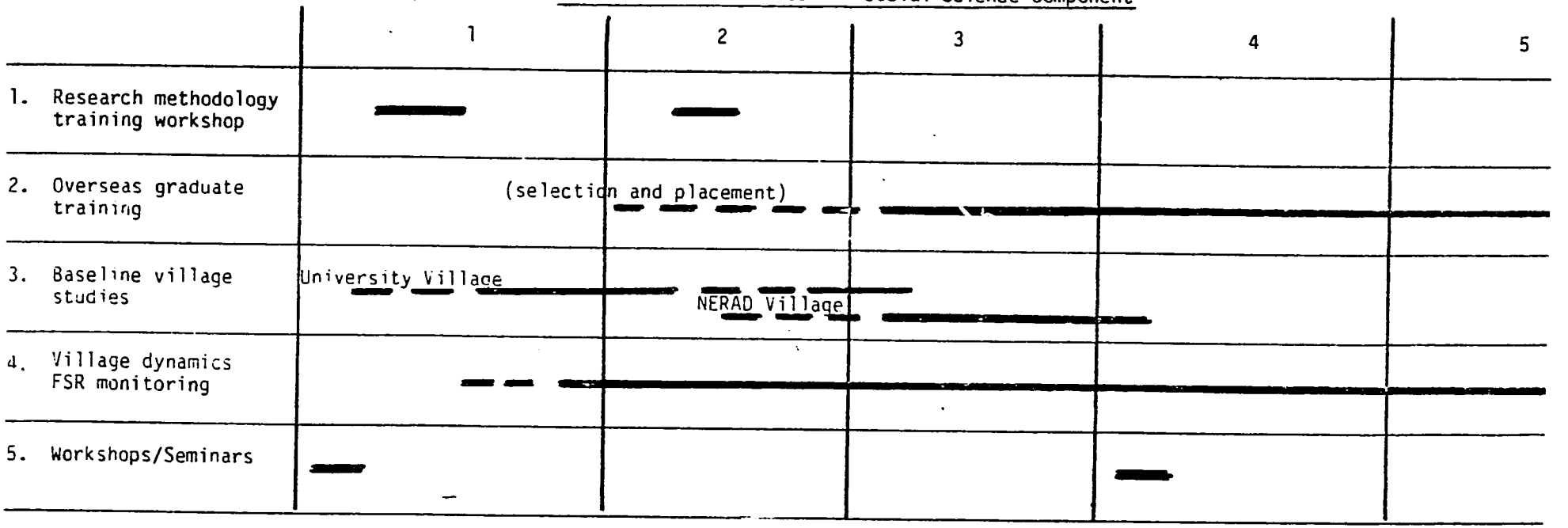
The scheduling of these activities is indicated in Figure 6-2.

Training: The project will be initiated with an intensive 4 to 6 week workshop for participating KKU social scientists on research design and field data collection methodology. A second 1 month workshop, focusing on data analysis and report writing should be held at the beginning of the 2nd year of the project, giving KKU social scientists training in full range of methodological skills needed for them to effectively participate in the IRFSP.

Long-term overseas graduate degree training will not be initiated until the 3rd year of the project although selection of candidates and their placement in appropriate foreign universities must be done in the 2nd year.

Research: Research in the first year will primarily focus on collection of base line information in the village(s) chosen for intensive study by the whole IRFSP team. Beginning late in the 2nd year comparable data may also collected in the village(s) in the HEDAD tambons.

Figure 6-2. Schedule of activities - Social Science Component



Along with collection of baseline data, monitoring of longitudinal fluctuations in key social systems variables will be initiated in the project's 1st year and continued for the duration of the research. Selection of variables will be done in close consultation with crop and livestock specialists to ensure their relevance to understanding the dynamics of the farming system.

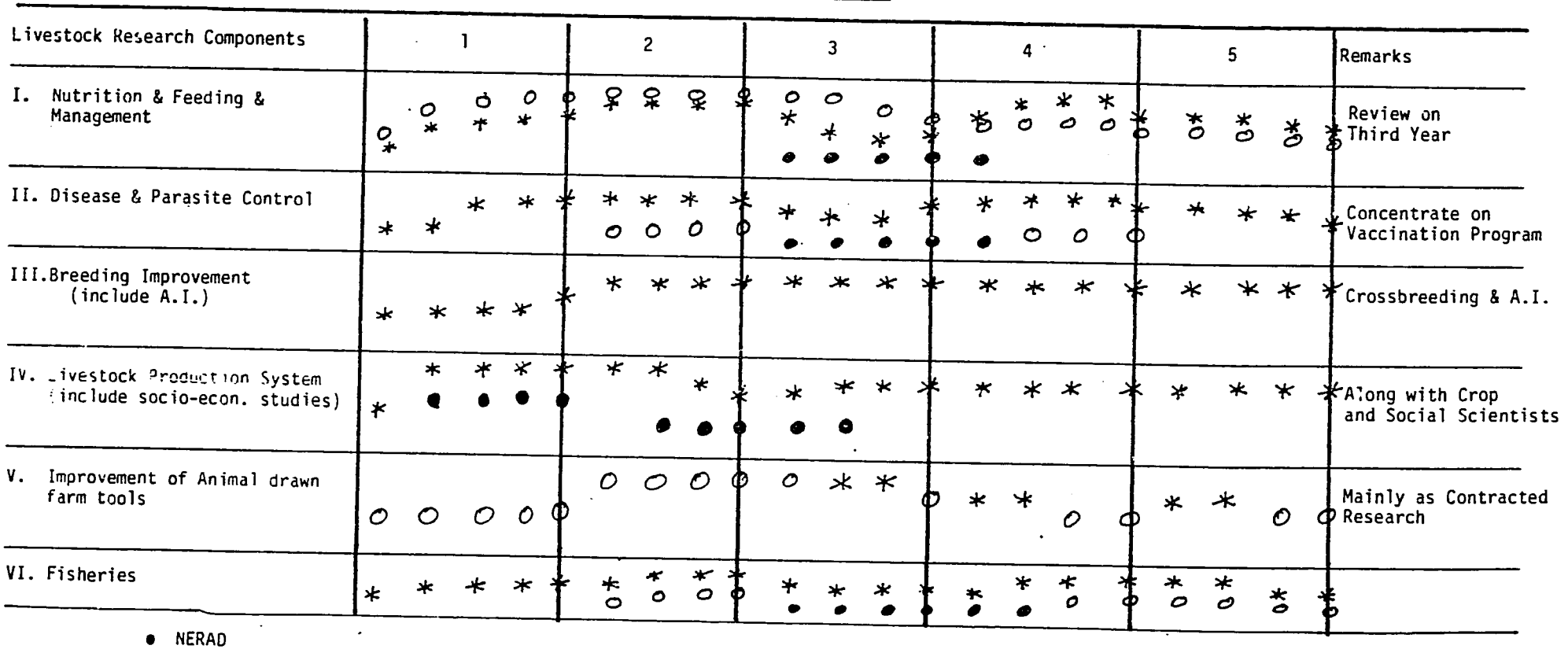
Exchange and Dissemination of Information: Three workshops are scheduled during the course of the Project. The first, held at the initiation of the project will bring together social scientists from other Thai universities and government agencies with experience in farming systems' research to share their knowledge of FSR with the KKU social scientists.

Two subsequent dissemination workshops are planned, one in the 3rd year and one in the 5th year of the project. These workshops will provide the opportunity for KKU social scientists to report on the progress of their research to participants from other universities as well as interested government agencies such as MOAC.

Livestock Schedule

The IRFSP livestock component includes intensive research activities both in the project villages and on campus, monitoring of village livestock production dynamics, both in the project villages and in certain NERAD villages, providing certain livestock services in relation to village research activities such as vaccination services, offering training to both farmers and personnel from various agencies as well as workshop participation. Scheduling of activities is indicated in Figure 6-3.

Figure 6-3 Year/Research Activities



● NERAD
o On campus
* At project village

Research: Livestock research activities in different disciplines in relation to crop production will begin as soon as possible during the first year. The most active component in the first year, however, will be the study of village livestock production in order to learn more about problems and needs of the farmers concerning livestock production. Research in other areas will become more intense from the second year on.

Livestock services, such as vaccination and A.I. services, will be provided in order to promote and support village livestock research activities. More intensive service activities will begin before the end of the first year if possible.

Training of Farmers and Other Field and Research Personnel: Certain training programs in livestock production for research and field personnel such as those in the NERAD project could be offered in the second half of the second year. Other training courses can be provided, if requested, after the second year of the project. Farmer training for certain livestock techniques can be offered from the second half of the first year on if necessary.

In-service Training and Advanced Training for Project Personnel: Various in-service training at different times and places for project personnel will be supported, while advanced-degree training for certain selected project research staff will not be initiated until the third year of the project.

Exchange of Information: Research workers in livestock production will participate in various research network meetings and activities outside the IRFSP as well as workshops organized by the IRFSP. Extension bulletins will be produced by the IRFSP livestock research group for use of other projects such as NERAD or other RAI projects.

Crop Schedule

The IRFSP crop component will involve three types of activities namely research, training and exchange of information: (Figure 6-4)

Research: Year I - Analyze the pattern, both in terms of structure and dynamics of the existing cropping systems together with interrelationships with other components of farming systems as well as other income generating activities. Flow of labor and cash among components of farming systems as well as other income-sources should be closely monitored. Timing in operating various activities is also critical.

To gain better understanding of the key factors determining farmers' decision making in the target villages. It is likely that decision makers in choosing to grow particular types of crops, kinds of cultural practices, as well as levels of inputs applied will depend on the existing resources of that particular household.

If possible, farm households should be classified after the survey into various types which will facilitate introduction of appropriate technologies.

Year II - Select a few representative household cases and design appropriate cropping systems for them based on experience obtained from the previous Cropping Systems Project (CSP). Different kinds of crops not tested previously in experiments CSP may be introduced. Research on some component technologies may be needed or even the type of cropping systems may have to be altered.

Year III - IV - Continue component technologies research and new systems testing in both experimental and rented fields.

Figure 6-4. CROP SCHEDULE : YEAR/ACTIVITIES

		1	2	3	4	5	Remarks
Research:	Analysis of existing cropping systems						
	Identification of improved cropping systems						
Training							
Exchange of Information:	Seminar Worksnops						
	Publication						

Year V - Continue to identify appropriate cropping systems and disseminate information about the new systems proven to be accepted by the farmers to appropriate government agencies.

Training: Short-term training programs in cropping systems for agricultural extension agents and farmers by KKU staff was started a few years ago. This activity will be continued and expanded.

Exchange of Information: Information and knowledge on cropping systems should be exchanged among research workers through a series of seminars, workshops or conference organized either by IRFSP or other organizations. Technical and extension bulletins as well as annual reports will be produced by the IRFSP crop research group for use of other projects.

Linkages

Linkages and cooperation between IRFSP and other projects in the Northeast are seen as a major benefit of the project. In addition, at national, regional, and international levels, it is expected that a number of informal and formal linkages will be established. In fact, many of these linkages already exist through various component or commodity oriented projects at KKU. IRFSP should serve to strengthen these linkages and also bring more focus and cohesiveness to the assorted activities.

Close cooperation between IRFSP and on-going KKU projects, such as the Pasture Improvement Project (ADAB), Semi-Arid Crops (IDRC), Cassava Nutrition (IDRC), Cropping Systems (FF), will be of value to all parties. As funding for these projects winds down, such as for Cassava Nutrition, Cropping Systems and Pasture Improvement, it should be relatively easy to incorporate their activities under the larger farming systems umbrella. Joint research activities with new projects like the Groundnut Improvement Project will also be enhanced through technical cooperation among research scientists in various disciplines.

IRFSP reserach, including that by graduate students, in NERAD tambons and areas served by other RAI research activities, will serve to strengthen working relationships between all researchers. IRFSP will provide technical expertise not available from most agencies both for actual field research and for training and seminar/workshops. IRFSP can help organize and provide staff assistance for joint long-term monitoring programs in certain areas, including NERAD tambons.

IRFSP staff already have a close working relationship with staff at the Multiple Cropping Project at Chiang Mai University and the Cropping Systems Project at Kasetsart University. The use of farming systems methodology including livestock and a strong social science component gives IRFSP a powerful tool that, once perfected, can contribute to the projects at CMU and KU. As part of their component research IRFSP staff will cooperate with researchers from other programs such as DLD's NBRDC project, KU's National Corn and Sorghum Improvement Center and the NRC's National Vegetable Research and Development Committee. IRFSP can offer its services and facilities in workshops and training programs.

Of major importance is how IRFSP links to other MOAC activities particularly those related directly to rainfed agricuture in the Northeast such as RAI. At this time, as RAI is still in the design stage, it is difficult to predict exactly what types of linking mechanisms will provide the most productive organizational and professional linkages. At the least, as suggested at the recent workshop "On the Role of Thai Universities in Rainfed Agriculture" held in Khon Kaen (May 10-12, 1982), there should be a National Coordinating Committee for Rainfed Agricultural Research and Development. However, perhaps more productive than that would be an attempt to ensure that IRFSP researchers are represented when the other elements of RAI are designed. In addition, before the RAI Project Paper is written, all interested parties should be brought together to define a common universe for research and development and to discuss how various R&D activities within that universe are to be identified and assigned to individual organizations.

IRFSP staff already have active exchange programs with IRRI, ICRISAT, CIAT, AVRDC, EAPI, and SEARCA. These programs include exchange of information, exchange of plant or animal germ plasm, exchange visits of scientists and, in certain cases, such as IRRI, ICRISAT, EAPI, and SEARCA, training programs. In the past, donor organizations, including IDRC, ADAB, JSPS, Ford Foundation, etc., have provided funds for a number of projects that now are encompassed by much of the expected IRFSP research. In the future, as these agencies explore new cooperative activities with KKU, the overall structure of IRFSP shoud simplify the task of identifying areas where additional support and/or training is required. Figure 6-5 illustrates how the different agencies link to IRFSP.

Social Science Linkages

In addition to the institutional linkages of IRFSP as a whole, a number of specific social science linkages both in Thailand and at the international level are anticipated. The Social Science Association of Thailand has already organized a research methods training seminar for the KKU Department of Social Sciences and can be expected to have a continuing interest in the professional development of KKU social scientists. On the institutional level linkages may be established with:

Chiang Mai University Multiple Cropping Project Social Science Component: The Multiple Cropping Project (MCP) at Chiang Mai University (CMU) already has significant participation by social scientists including anthropologists, agricultural economists, political scientists, and sociologists. Of particular interest is an attempt by some of these social scientists to work together with MCP agronomists in a longitudinal study of a single village. This experience may generate useful guidelines for use by the KKU project.

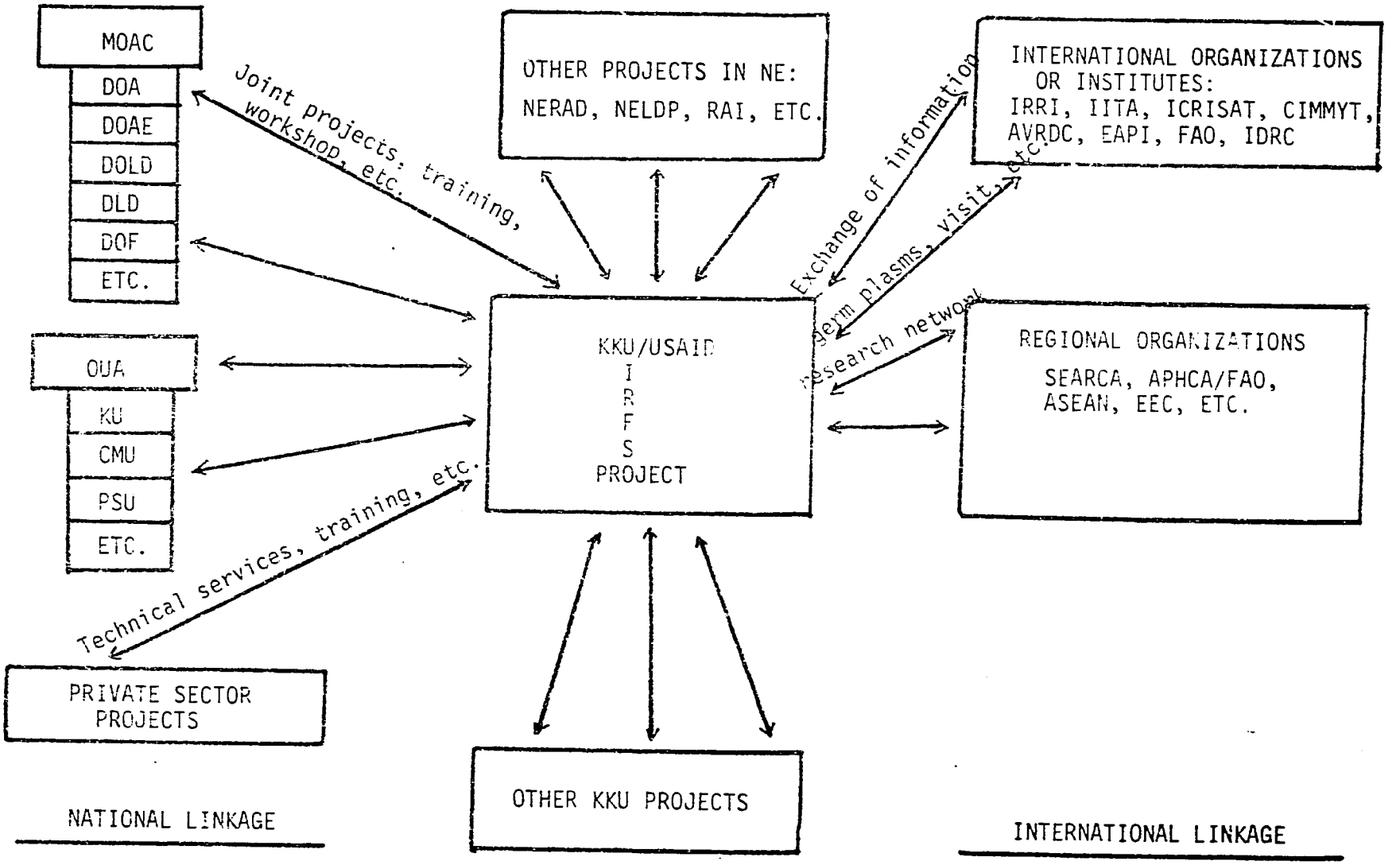


Figure 6-5. IRFSP Institutional Linkages

The planned CMU master's degree program in Farming Systems will incorporate a major social science component in its "Development" option. Curriculum materials being generated for this option may be of value to KKU social scientists. There is also the possibility of having KKU social scientists do masters degrees at CMU.

MCP staff may also be able to provide research assistance in the initial stages of the Farming Systems Project. One CMU lecturer in agricultural economics is already planning to do part of her Ph.D. dissertation research in Khon Kaen in cooperation with the CSP. Such linkages between Chiang Mai and Khon Kaen university social scientists are likely to receive further reinforcement through the participation of both institutions in the Regional Network of Agroecosystem Research Projects in Southeast Asia.

The Regional Network of Agroecosystem Research Projects in Southeast Asia: This network was organized in 1980 as a collaborative effort of the Chiang Mai University Multiple Cropping Project, Khon Kaen University Cropping Systems Project, Bandung (Indonesia) Institute of Ecology's Rural Ecology Project, the University of the Philippines at Los Banos Program on Environmental Sciences and Management, and East-West Environment and Policy Institute's Program on Human Interactions with Tropical Ecosystems. Its purpose is to increase the interchange of information between participating research projects and to encourage development of integrated interdisciplinary research on tropical agroecosystems. Particular emphasis has been placed on increasing the participation of social scientists in farming systems research.

The Regional Network has organized a number of joint workshops bringing together social and natural scientists to develop improved research strategies. The first was held in Chiang Mai and Khon Kaen in December 1980, the second in Honolulu in May - June 1981 and the third in Los Banos in November - December 1981. A forth workshop will be held in Honolulu in

May - July 1982 and a fifth workshop is planned for Khon Kaen in 1983. Social scientists from Khon Kaen University have participated in most of these workshops.

The Regional Network also plans to hold conferences on agroecosystems research where natural and social scientists from participating institutions will present papers describing their research results. The first conference will probably be held in Bandung, Indonesia, in early 1983.

As part of its contribution to the Regional Network activities, the social scientist coordinating EAPI's agroecosystem research program visits each project in Southeast Asia, including KKU, twice each year to consult with local social scientists about problems they may be encountering in their work. It is anticipated that this service, which is partially funded by the Ford Foundation, will be continued for at least five more years, ensuring some continuity in the availability of external social science consulting for IRFSP.

Other International Linkages: The International Agricultural Research Centers have been giving increasing emphasis to social science research. ICRISAT has developed a particularly active program of village studies in support of its cropping systems. Experience gained in this program may be valuable in helping KKU social scientists develop their own research program. Although a number of ICRISAT staff have already visited KKU, it may also be useful to invite ICRISAT social scientists to visit Khon Kaen to discuss their research activities. Such a linkage might also help to serve ICRISAT's out-reach interests in Northeast Thailand. IRRI is also developing a strong interest in social science research in the cropping systems research context and several KKU staff have already attended workshops at Los Banos. It is anticipated that such linkages will be strengthened as KKU social scientists gain in numbers and research experience.

Institutional Changes

Since IRFSP involves staff members from a number of faculties and departments in KKU, as well as creating contacts with outside projects such as NERAD, RAI and NELDP, it is expected that the project will have significant impacts on the university. When IRFSP is functioning, involved staff members will be in constant contact with each other. In contrast to the present situation where staff members among the various departments and faculties rarely know about research by other staff members, IRFSP staff will have an opportunity to observe and participate in research by staff members from other departments. As much of the research will follow a farming systems approach it expected that this methodological technique will also be used on other projects. This is critical as rural development requires an interdisciplinary or integrated-systems approach to generate technologies appropriate for both the biophysical and socio-economic condition of rainfed farmers in the Northeast.

Research by IRFSP staff, research assistants, and students offers a good opportunity for them to learn about and understand existing farming systems and the social and economic factors that constrain Northeast farmers. This experience should lead to changes in courses, curricula and teaching ability of the staff as they try to present material more relevant to the needs of small farmers in rainfed areas. Future planning of student training and/or other in-service training should also be favorably affected by the university's experience in IRFSP. If successful, IRFSP will demonstrate that interdisciplinary and multi-faculty, multi-department research produces more meaningful and useful results relating to the needs of small farmers at the village level. Long and constant contact with farmers, looking at both technical and social requirements, will lead to deeper understanding of their real problems.

Service to Private Sector

With the facilities developed and experience gained by IRFSP, KKU staff will be better prepared and more confident in their ability to offer technical advice, training services and laboratory assistance to the private sector. KKU will also be able to play a greater role in bridging activities between the private sector and other government programs in rural development in the Northeast.

Impact on Social Sciences

IRFSP will have a major impact on social science teaching and research at KKU. It will certainly enhance social science capabilities at KKU, particularly in rainfed agricultural research in the Northeast. Anticipated positive impacts include:

a. Shifting of the orientation of the social science teaching curriculum towards the unique problems of the Northeast as a region with special emphasis on its rural population: As social scientists gain research experience in rural villages in the Northeast they are likely to increasingly try to incorporate these new perspectives into the curriculum of their departments, increasing the relevance of their courses to the students who are predominantly Northeastern in origin.

b. Feedback from research into teaching: It is expected that reports written by KKU social scientists on research done in IRFSP Project will provide a new corpus of materials for teaching purposes, supplementing the current heavy reliance on translated western texts.

c. Upgrading the professional competence of KKU social science teachers and researchers. Practical experience gained in carrying out research in IRFSP will increase the capability of KKU social scientists to teach methodology courses. Their increased knowledge of rural conditions should also improve the quality of their general social science teaching.

A pool of experienced social science researchers will also become available for work on future agricultural development projects in the Northeast.

Possible negative impacts may include:

a. Diversion of scarce staff resources from teaching to research. The primary function of the KKU social scientists is undergraduate teaching. Staffing is currently inadequate to fully meet desirable teaching standards. At least in the short-term, involvement of social scientists in IRFSP may result in a reduction of attention paid to teaching duties.

b. Distortion of social science research priorities. The various social science disciplines have their own research priorities reflecting current theoretical concerns. These may not necessarily correspond to the research needs of IRFSP which will have a high demand for base-line socio-economic surveys and monitoring. The financial attractions of doing such work may draw social scientists away from less-well rewarded basic research within their own disciplines. However, FSR does offer a number of very sophisticated theoretical issues that need disciplinary inputs from social scientists and can potentially lead to attractive new areas of research.

7. MONITORING, EVALUATION AND DISCUSSION ISSUES

Monitoring and Evaluation

Internal project monitoring within the University is nominally the responsibility of the Project Director (probably the Dean of the Faculty of Agriculture). In fact, however, it is the Project Coordinator who will monitor day-to-day operations of the project. Without a strong Coordinator the project will not function very effectively. The Design Team is unanimous in recommending that Dr. Terd Charoenwatana should be Project Coordinator. With his demonstrated ability to work across a number of faculties, internal monitoring is not likely to be such a problem.

The Working Group can also play an active role in monitoring on a month-to-month basis. It is at the level of this group that working relationships, including monitoring field research activities, are coordinated and monitored. At the end of each working year the entire project should have an annual review. At this review all the research activities by the various researchers should be presented, discussed, and feedback should be provided both from IRFSP staff and from the Research Committee. The final outcome of the annual review should be an annual report similar to that now published by the Pasture Improvement Project, the Semi-Arid Crop Project and the Cropping Systems Project.

Evaluation should be the responsibility of an outside evaluation team with results conveyed to the project via the Advisory and Research Committees. At the end of the second year an evaluation team composed of individuals from organizations such as the following should be appointed:

National Institute for Development Administration
Social Science Association of Thailand
Kasetsart University
National Research Committee
Faculty of Medicine Mahidol University

If USAID feels it is necessary, there could also be an individual from USAID on the evaluation team but that individual should be Thai speaking and have prior research experience in Thailand.

This team should spend approximately one week meeting with individual researchers and research section leaders. It should also go out to the field sites and discuss with villagers their reactions to the IRFSP activities. A critical measure of success for the project, particularly at the end of the second year, will be how well the departments and faculties are able to work together using FSR methodology. If the evaluation team simply finds a number of individual component research activities with little evidence of inter-disciplinary cooperation the project will not be meeting all of its objectives. After completing its evaluation the team should prepare an evaluation report, including any suggestions for improvement, that it can share with the IRFSP staff and researchers. It should then discuss its findings with the Advisory and Research Committees.

A second evaluation team should visit the project at the end of the fourth year. This evaluation team would examine on-going research more thoroughly for quality and appropriateness. At this time, as it is assumed the IRFSP researchers will also be much more active in a second tambon, the evaluation team should interact with some of the outside agencies to determine how they perceive the usefulness of the project. This evaluation team can also provide input into the selection process for advanced training and can recommend workshop formats for dissemination of research findings.

At the end of the fifth year it is expected that a final evaluation will be made. During this year decisions concerning continuation of the project and future activities must be made. The final evaluation team can play a significant role in this process.

Discussion Issues

While the general framework of the project has been made fairly explicit, there are still a number of points that need to be clarified. These range from internal organizational issues to external relationships with respect to other research and development activities in rainfed areas of the Northeast. Resolving these issues will require additional discussions with other RTG organizations (in particular with MOAC departments), with other Thai research organizations and institutions, and with other donor agencies.

Internal:

(1) Integration of social scientists into IRFSP remains problematic. Formation of the Core Group on Social Science and Farming Systems Research may provide the needed mechanism for liaison between social scientists from several faculties and the Coordinator of IRFSP. It must be recognized, however, that the Core Group represents the first attempt at KKU to integrate social science researchers from several different faculties into a single common project. It is uncertain how well such a mechanism will function in practice. Therefore, it will require careful monitoring by the Project Coordinator as well as continuing encouragement by all concerned, including USAID.

(2) The relationship between IRFSP and the new Research and Development Institute (RDI) is still not clearly specified. In theory, IRFSP as an interdisciplinary and interfaculty project, should come under the coordinating responsibility of RDI. In practice, since RDI does not yet have a director or staff, such an arrangement is impractical and it is proposed that IRFSP be placed administratively under the Dean of the Faculty of Agriculture. If,

however, RDI should become oeprational in the near future, its role vis-a-vis RDI must be reconsidered and reviewed by the appropriate KKU officials. However, it must be firmly emphasized that RDI is a coordinating body, not a research organization, and therefore the project has been designed to operate from the Office of the Project Coordinator.

(3) Numerous other projects, particularly in the Faculty of Agriculture, have clearly complementary and, in some instances, overlapping areas of research. It is not clear at this time exactly how these projects are going to coordinate with IRFSP nor, as these relatively short-term projects terminate, is there a mechanism to integrate the researchers and research facilities into the larger IRFSP structure.

(4) While the project has resources for utilizing the services of more senior researchers outside the university community there has yet to be established a system to facilitate identification of these researchers nor is there a procedure to mesh the work done by these researchers into other on-going research and training activities at KKU and in other areas of the Northeast.

(5) The budget contains money to send staff from a number of faculties abroad for advanced degree training. The design team did not attempt to identify these individuals just as specific areas of study were not pinpointed. KKU staff will have to establish an internal selection process to handle training selection that is acceptable to all parties. If this is not handled properly it can become a very divisive issue.

(6) During the course of the project it will probably be necessary to change leaders at the project director or project coordinator level and/or at the section leader level. The design team has not attempted to determine how this could or should be accomplished but it seems that some thought should be given to this issue as it could seriously affect the cohesiveness of the project.

External:

(1) It is envisioned that the IRFSP Research Committee will have a major role to play in the establishment of research priorities and budget allocation to support these priorities. Exactly how this will be done and if this committee will have the time and/or the interest to help with this difficult task is not clear. Some additional help may be required and if so, what individual or group of individuals can play this critical role?

(2) The budget contains funds for both long- and short-term consultants. These funds will be used for Thai and international consultants. Identification and recruitment of the long-term applied social science consultant is going to be a difficult task as this individual should have Thai language skills as well as prior research experience in Thailand. In addition, the individual should have previous experience with applied farming systems research or, at a minimum, experience working with an integrated research project that has a strong natural science component. Demonstrated successful experience working within a Thai research organization is another critical requirement. Recruitment of such an individual is not impossible but it will require some type of search committee or search mechanism that is yet to be established. In contrast, selection of short term consultants for assistance in specific areas of research is much simpler. With

KKU's international reputation and its close links with the international research centers, especially IRRI and ICRISAT, as well as contacts with international donor agencies such as IDRC, Ford Foundation, Rockefeller Foundation, the Toyota Foundation and the Volkwagen Foundation, the University has an impressive contact net to use to locate expertise. When their professional contacts in western and Australian research centers and universities are also considered, IRFSP should have no problems selecting the best consultants from all over the world.

(3) In addition to IRFSP activities that are to be funded by USAID a number of other international development agencies are interested in funding projects at KKU. In particular the Governments of Japan and Canada are holding discussions with KKU concerning possible projects in drought research and assistance to the Faculty of Humanities and Social Sciences, respectively. Clearly these projects have a complementary relationship with IRFSP and, in certain instance as presently proposed, have areas of overlap. In the case of program discussions with the Government of Japan (which is much more clearly defined than the Canadian project) there is an argument to combine research in integrated farming systems and drought. As farming systems has a primary focus on micro aspect of rainfed agriculture while the proposed drought research has a more macro viewpoint of the rainfed areas in the Northeast, it is not immediately apparent how these two activities mesh together. This issue will have to be discussed in much more detail before an organizational and technical framework can be devised.

(4) Linkages between the various MOAC departments and Thai agricultural universities tend to be rather ad hoc and with some exceptions, rarely have a well defined, long-term memorandum of agreement that defines the rights and responsibilities of each party. As KKU is to be one element of a larger rainfed agricutural project (RAI), which is principally the responsibility of various MOAC departments, the linkage between the elements needs to be better defined. The creation of a suggested National Rainfed Agriculture Research Committee may provide all the coordination that is required. However, there may be justification for a more formal memorandum of agreement or some other type of document. As RAI is still in the formative stages it is perhaps too early to attempt to define what is the most appropriate course of action, although, the relationship should be established before each separate RAI element is finalized as an independent activity.

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APPENDIX I

KKU/University Council

From the University:

1. Rector
2. Vice-Rector for Administration
3. Vice-Rector for Academic Affairs
4. Vice-Rector for Student Affairs
5. Vice-Rector for Planning and Development (Secretary to the Council)
6. Dean of Faculty of Agriculture
7. Dean of Faculty of Engineering
8. Dean of Faculty of Science
9. Dean of Faculty of Education
10. Dean of Faculty of Nursing
11. Dean of Faculty of Medicine
12. Dean of Faculty of Medical Technology
13. Dean of Faculty of Humanities and Social Science
14. Dean of Faculty of Dentistry
15. Dean of Faculty of Pharmacy
16. Dean of Graduate College
17. Dean of Faculty of Health Science

From Outside:

1. Dr. Vichit Srisa-arn (Chairman)
   (Deputy Under-Secretary for University Affairs)

2. Mr. Chamnarn Potechana (Vice-Chairman)
   (Khon Kaen Governor)

3. Mr. Krit Sombatsiri
   (Former Secretary-General, NESDB, Bangkok)

4. Dr. Krasae Chanawong
   (Former MP from Khon Kaen)

5. Mr. Charubutr Ruengsuwan
   (Bangkok, Senator?)

6. Prof. Dr. Chai Mooktapunt
   (The Royal Institute, Bangkok)

7. Dr. Thalerng Thamrong Nawasawat
   (Under-Secretary, MOAC, Bangkok)

8. Mr. Pokkrong Chyakarn
   (Bank of Thailand, Bangkok)

9. Mr. Vilard Uthaichai
   (EGAT, Khon Kaen)

10. Police Lt. Col. Vipart Vipulakorn
    (Border Police Commander, Khon Kaen)

11. Prof. Sangvien Intaravichai
    (Thammasat University, Bangkok)

12. Dr. Sunt Techakumphut
    (Chulalongkorn University, Bangkok)

13. Dr. Sippanont Ketutat
    (Former Secretary-General, National Education Commission)

14. Mr. Soraj Sutcharitkul
    (Secretary-General, Civil Service Commission).

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