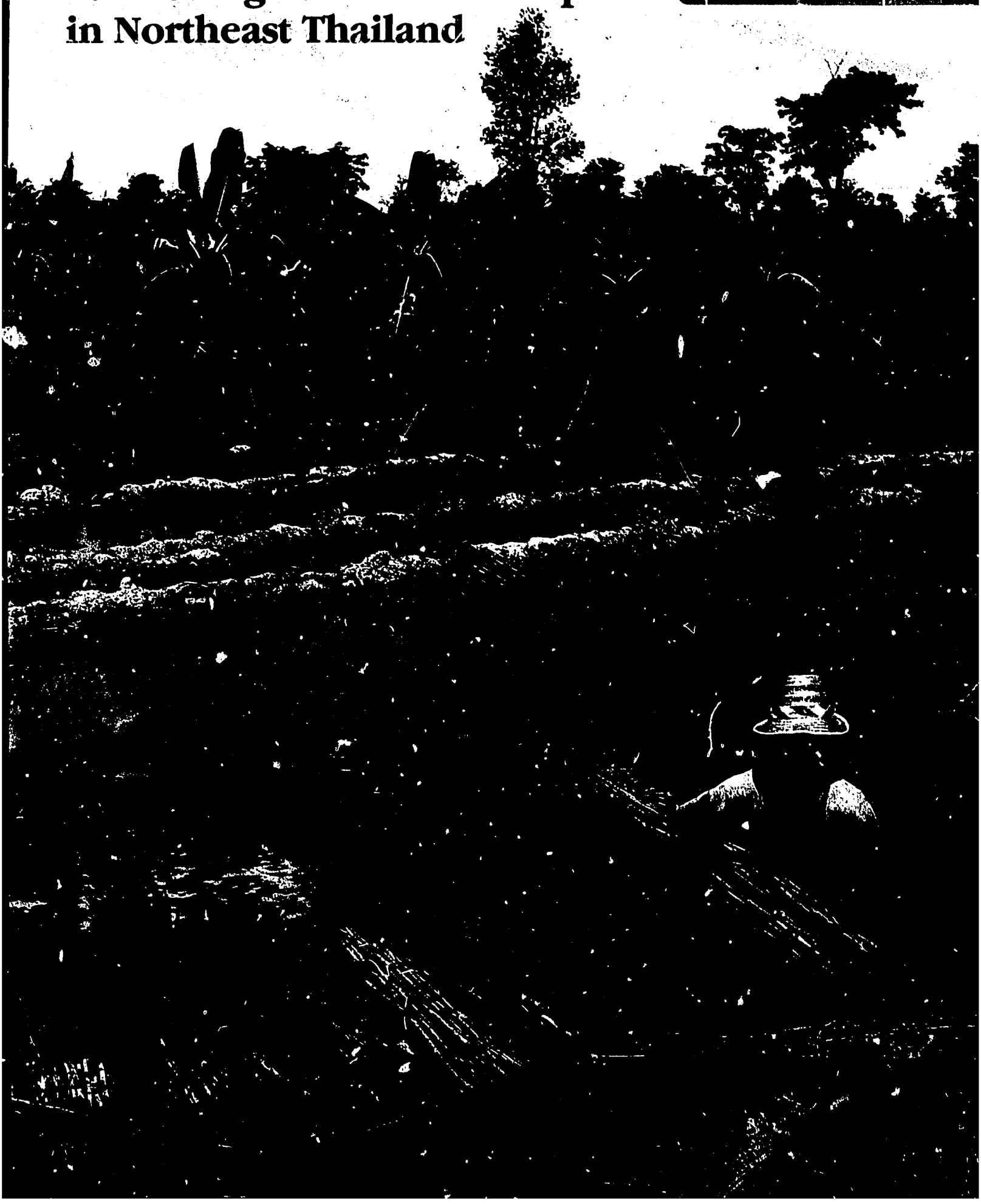
PD-AAX-030

Rainfed Agriculture Development in Northeast Thailand



Rainfed Agriculture Development in Northeast Thailand

Contract Completion Report

for the

Northeast Rainfed Agricultural Development [illegible]

Contract No. [illegible]

between the U.S. Agency for International Development

and the University of Kentucky [illegible]

Project Partners

Farmers of Northeast Thailand

Thai Ministry of Agriculture and [illegible]

U.S. Agency for International Development

University of Kentucky, College of [illegible]

Prepared by [illegible]

Chief of Party

Printed in [illegible]

Department of [illegible]

College of [illegible]

University of [illegible]

Lexington, Kentucky [illegible]

Spring 1987

Faces of the Northeast

Linking the inherent wisdom and coping skills of Northeast farmers with the technological skills of research and extension officials is the aim of NERAD. From the synthesis of these diverse elements are coming improvements that will benefit people's lives.

Rainfed Agriculture Development in Northeast Thailand

Summary

The Problem

Stagnant or declining crop yields in Northeast Thailand led to the beginning of the NERAD project in 1981. The construction of roads and other infrastructure caused rapid forest destruction in the 1970s but also led to large economic benefits from cassava and kenaf production. By mid-1970 it was foreseen that continuing to expand production by increasing the acreages of these crops would be impossible because most forested areas would soon be crop land. Increasing the yields of existing acreages of crops, introducing new crops and multiple cropping were thought to be ways of maintaining economic development.

The NERAD Project

The seven-year NERAD project was started in 1981 to address the needs of the rural poor through an area-based agricultural technology development program. It was established in eight representative tambons with the aim of finding ways to increase productivity and farm incomes that could later be replicated throughout the Northeast. Because no promising backlog of area-specific technology existed, the project was built around existing activities of the Ministry of Agriculture and Cooperatives (MOAC) that could be implemented in more innovative and effective ways. Some research to find new technology was also provided for.

The project has carried out its research and extension activities in ways designed to increase the collaboration of researchers and extension professionals by jointly assessing and responding to farmer needs. The idea was to have top-down technical support and bottom-up decision making with project priorities being set at the village level.

Thus NERAD became a combination project to test, develop and extend technology for a wide spectrum of farming activities jointly identified by farmers and a multi-departmental team from departments of the MOAC. From this farming systems research and extension process were to come marginal gains in producing, consuming, and marketing the various crops and classes of livestock grown in the area. As the more promising technologies were identified in the first half of the project, these were to receive a concentrated effort in the last half of the project. The long-term payoff from this intensive work, with relatively few farmers, is to come from building the capacity of MOAC officials and departments to do more relevant and responsive work.

Achievements

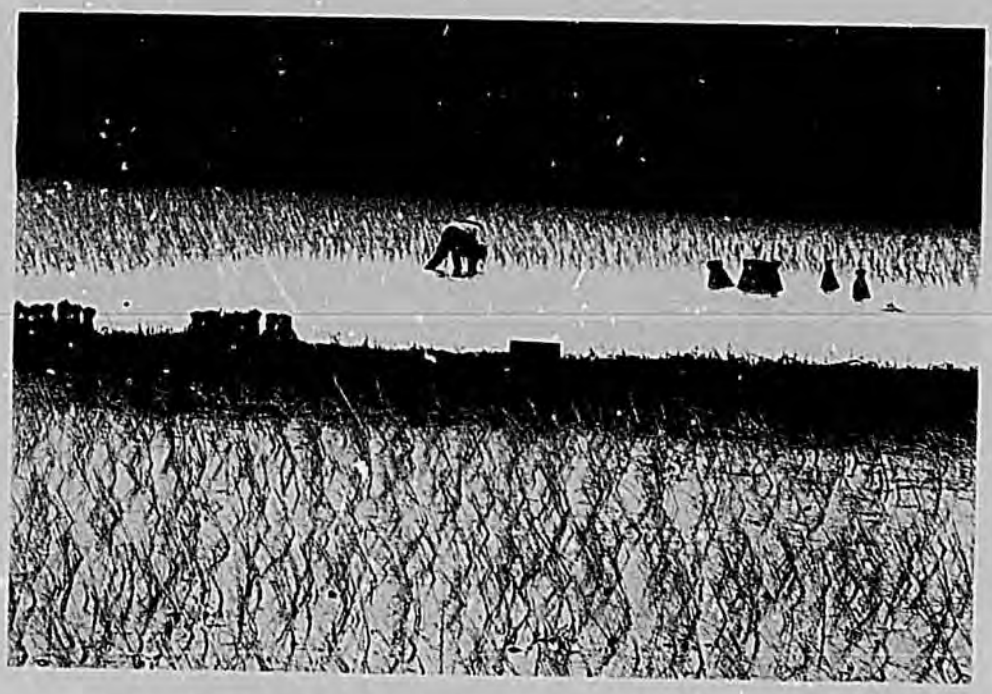
The project has succeeded in identifying and exploiting the potential of certain technologies such as the simultaneous production of fish and rice in rainfed paddies, direct seeded rice in rain-shadow areas, vegetable production around modified shallow wells, disease control in native chickens, and organizing group buying of production inputs. The fish-in-paddy technology perfected by NERAD has been adopted by government officials for implementation throughout the Northeast. And a method of annually evaluating the results of on-farm cropping system trials has been adopted by all regions of the Kingdom.

However, increasing the extremely low yields of the subsistence rice crop and increasing the amount of multiple cropping have not improved the food supply and incomes for many farmers. Sesame and kenaf grown before the rice crop have been the most successful additions to the traditional mono-cropping of transplanted rice.

In the fourth year of the technical assistance contract it was established why increasing yields is so difficult. Most soils in the Northeast give abnormally poor responses to nitrogen fertilizer. The extremely weathered condition of these soils is responsible, and the mechanism blocking the full fertilizer response has been partially explained. This is a crucial problem for the region because the soil's natural fertility is so low

Rice

Transplanted rainfed rice is the backbone of Northeast farming. NERAD has reintroduced direct-seeded rice, coupled with a labor saving mechanical seeder, for low rainfall years and for rain-shadow areas. A large on-farm research and demonstration program has helped the Department of Agriculture achieve rapid acceptance of this technology package. The Department of Agriculture Extension is effectively multipying DOA's efforts through its extension program. Improved rice varieties and an integrated pest management program are also components of NERAD.



that plant nutrients must be added from the outside if yields are to increase. Commercial fertilizer is probably the only practical way of doing this.

The project introduced to the region a green manure crop (*Sesbania rostrata*), which seems to have great promise for solving the problem. This crop is fully responsive to phosphorus and potassium fertilizers and grows vigorously in both droughts and floods. When plowed into the soil before rice is transplanted, the sesbania releases the fertilizer phosphorus and potassium as needed and provides much of the nitrogen required by the rice crop. (The Sesbania species used is a highly efficient nitrogen fixing tropical legume.) Beyond improving crop yields, the Sesbania may become a cash crop as a feedstock for a large paper pulp mill in Khon Kaen. The mill has been chronically short of feedstock ever since it was constructed. Substituting Sesbania for bamboo and kapok would slow the destruction of these woody species in the Northeast.

The capacity of the MOAC departments to assess the farmers' real needs and develop appropriate responses has greatly improved. One cooperative agreement has been signed between departments as a result of NERAD, and others are being considered. Slow progress is being made on reducing the many activities begun under the project to the few with most promise.

Description

BACKGROUND

The people of Northeast Thailand are among the world's best farmers, otherwise they could not survive. Rainfall amounts and distribution are marginal for their subsistence rainfed rice crop. Equally or even more limiting is the extremely infertile soil that covers all but a small fraction of the 17 million hectares comprising the 17 provinces.

Serious development efforts in the Northeast date back to the early 1950s when the Thai government, U.S. Agency for International Development (USAID) and other donors began building modern roads and the infrastructure necessary to change from an almost completely subsistence to a mixed cash-subsistence type farming. These investments, plus the establishment as cash crops of kenaf about 1962 and cassava about 1970, combined to give a large increase in the productivity and economy of the region. Village housing, schools and trade centers were greatly improved.

Because kenaf and cassava are upland crops, the trees from large areas of land were cleared for the first time, or more typically, land changed from shifting cultivation to continuous cultivation. Initially the yields were relatively good, but stabilized after three to four years at one-fourth to one-third of the first year yields. The roads and markets were in place to handle large quantities of these crops, so more land was cleared and the acreages expanded to meet the demand. Sincere efforts were made by the MOAC and the agricultural universities to counter the pressure for new land by improving yields through fertilizer and better crop varieties. Farmer yields did not increase and by the late 1970s most of the forested areas were cleared and being cropped. From 1973 to 1983 approximately 25,000 square miles of forest, or forest with shifting cultivation, were converted to continuous cultivation. Thus in nine years the Northeast forest was reduced by 50 percent.

Project History

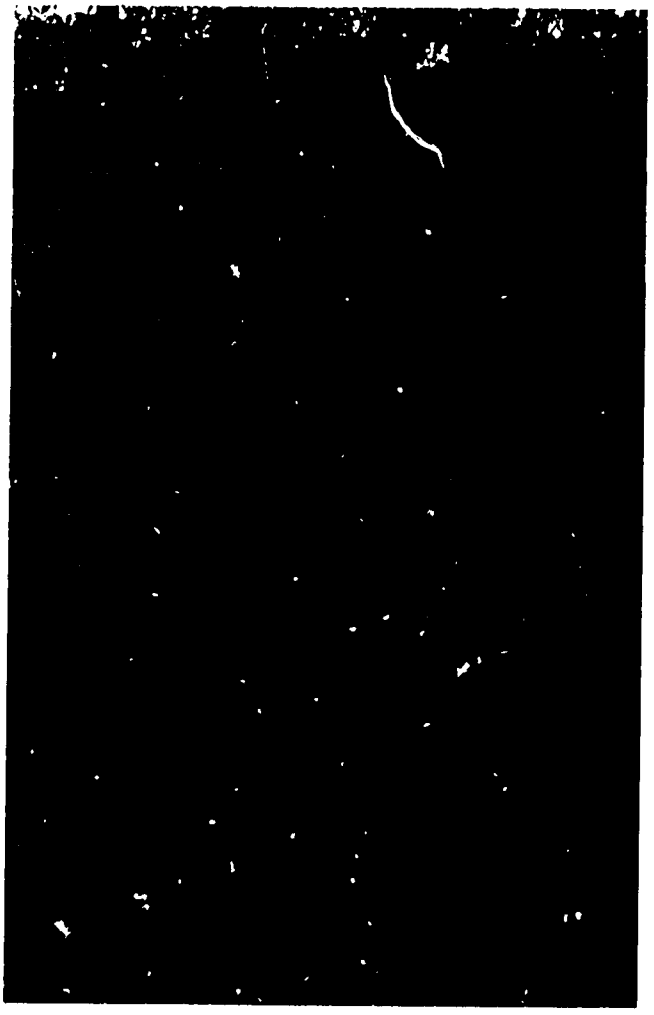
Beginning in 1976, various USAID/Thailand projects were considered in response to the Northeast situation. Ideas for projects such as the NE Rainfed Crops Development, Rainfed Agriculture Edible Oils, and NE Integrated Rural Development coalesced in 1979 with a decision to implement the NERAD project.

In 1979 the University of Wisconsin conducted a pre-project feasibility study. This team of U.S. and Thai consultants recommended a project with an area-based approach designed to improve income and productivity of Northeast farm families. The group discounted the prospects for obtaining the large improvements needed—"based on the simple technology innovations which have fueled the green revolution elsewhere in Asia." This study emphasized an adaptive approach for determining the area's specific needs through on-farm testing, the application of appropriate and adaptable packages of practices, and institutional innovations.

The Wisconsin study and other preliminary studies culminated in 1980 with a team being employed to design the Northeast Rainfed Agriculture Development project (NERAD). The decision to begin the project was based on the premise that yields were low and per capita incomes poor because available technology was not being widely and effectively applied.

Cash Crops from the '60s and '70s

In addition to water buffalo and some handicraft items, kenaf was the first significant cash income producer in the Northeast. This fiber crop was introduced about 1962.



Since the early 1970s cassava, exported to EEC countries as a starchy feed for livestock, has been the single largest cash income source in Northeast Thailand. It has changed agriculture from purely subsistence to a mixture of subsistence and cash cropping. The result has been great economic development along with widespread forest destruction.

Project Development

In 1980 a project design team began its work under the leadership of Dr. H. F. Massey, Director of the University of Kentucky International Programs for Agriculture. The team was to design an area development project integrating "off-the-shelf" technologies from various agencies into extension packages. The design team found very few proven technologies applicable for the production and marketing needs of the Northeast. Accordingly, it recommended that the project be built around existing departmental activities that could be implemented in more innovative and effective manners. Out of this was to evolve a more responsive research and extension system for the long-term benefit of all farmers in the Northeast. Inter-departmental cooperation and a farming system approach were advocated.

According to the project paper, the intent of the project was to maximize contributions of all governmental units that could contribute to improving the agricultural productivity and livestock of low income families in the Northeast. The Tambon Extension Agent (TEA) was visualized as the key person whose effectiveness would be improved by closer association with departments of the Ministry of Agriculture and by intensive work with few enough families to establish mutual trust and acceptance.[1] The NERAD project was to begin in 1981 and run for seven years; however, it was designed to have only four years of expatriate technical assistance. Thus the the university contract ended September 30, 1986. This was intended to test the capacity of the Thai agencies to continue and build on what was done in the first years of the project. Budget constraints were also involved in this decision.

GOALS

The goal of NERAD was to increase the economic well-being of poorer Northeast Thailand farm families. The per capita annual income ranged from $75 to $130 in 1980 and was the lowest of any region of Thailand. Approximately half of the population of 14 million was classified in 1980 as living in "absolute poverty."

The strategy of the project was to demonstrate the feasibility and establish the replicability of a system for improving the economic well-being of farm families in the area. Included in this strategy was a belief that governmental agencies and services had stressed technology for irrigated farms and by so doing had neglected rainfed regions. Ninety-six percent of the Northeast's agriculture land was non-irrigated and only 20 percent was potentially irrigable. Therefore the project paper stated that the purpose of the project was to:

> . . . address the needs of the rural poor in Northeast Thailand by establishing in 8 tambons a replicable, area-based agricultural technology development program for increasing productivity and farm incomes in rainfed agricultural zones. Total expected direct beneficiaries are 65,000 persons.
>
> By the end of the project, the RTG should have adopted an effective, low-cost systematic process for analyzing and resolving the key technical constraints to agricultural production in rainfed areas and be prepared to extend the system beyond the 8 tambons. Components of the process will include the refinement, demonstration and extension of improved farming practices (subsistence/cash-crop cultural technologies, water utilization, animal husbandry) appropriate to rainfed areas; improvement of the extension system and its linkage to research; improvement of the land-water resource base; and the establishment of an interactive means of matching RTG technology development and programs and resources with farmers' needs and problems.

IMPLEMENTATION PLAN

NERAD was to establish a development process which would lessen or remove the major agriculture production constraints in the area, i.e. low soil fertility, extreme rainfall variability, low productivity of farming systems and poor linkages between research extension and the farmers. The project paper suggested a five-part development process:

(a) Provide a suitable process framework for matching farmers' needs to government resources and capabilities;
(b) Establish a research and demonstration program responsive to farmers' needs for continuous development and refinement of rainfed farming systems;
(c) Assist farmers in adopting farming practices suitable for land, climate, and socio-economic conditions of their areas ("farming practices" can relate to cultural practices for crops, water utilization, animal husbandry, fisheries, sericulture, land development and soil conservation as appropriate);
(d) Provide adequate extension and other agricultural services to farmers to support the utilization of the improved practices;

[1]The Department of Agriculture Extension had greatly expanded the number of TEA's with a World Bank loan in 1978. At the same time a Training and Visit (T&V) model was adopted. USAID supplemented this with the Extension Outreach Project in 1979.

Traditional and New Sources of Income

Weaving high quality silk from intricately dyed thread is a traditional source of income, as is salt making from otherwise barren soils. Producing vegetables and fruits is an expanding source of income. Through the Department of Cooperative Promotion and the Office of Agricultural Economics, NERAD is helping market these crops by concentrating enough producers and products to create competition between middlemen.

(e) Assist in the development of available water resources for supplemental agricultural and domestic uses.

A close linking of five geographic levels of administration—nation, region, province, district and tambon—was seen as necessary for project implementation. At each of these levels the individuals responsible were identified as the under-secretary of state for agriculture (now titled the permanent secretary) of the MOAC; director of the Northeast Regional Office of Agriculture; the governor of the province; field managers working at the district (amphur) level; and the tambon extension agent, respectively. As project director, the director of the Northeast Regional Office of Agriculture (NEROA) was given the responsibilities of planning, coordinating and monitoring the implementation of NERAD. This assignment was consistent with NEROA already being responsible for assisting with multi-departmental projects. Throughout the project's design and implementation, efforts were made to avoid creating new organizational structures and personnel groupings by using the existing organizational arrangements.

Twenty-seven project functions were suggested for achieving the goal of the project. These involved eight departments plus the Northeast Regional Office of Agriculture. The greatest challenge of the project was to integrate personnel from these historically independent and isolated departments into an effective and responsive program for overcoming the major problems of Northeast farm families. Thus project tactics included both "top-down" and "bottom-up" approaches. The idea was top-down technical support and bottom-up decision-making that would cause activities to overlap at the village level; priorities would be decided there instead of the more traditional top-down domination.

Technical Assistance

The University of Kentucky provided both long- and short-term technical assistance to NERAD. Long-term personnel included the chief of party, a farming systems specialist, and an agricultural economist. Short-term technical assistants included: marketing specialist, water resources engineer, organizational management consultant, integrated pest management consultant, virologist, and consultant in traditional village-practiced insecticides. Technical support was supplemented by other short-term consultants from Khon Kaen and Chaing Mai universities.

CHIEF OF PARTY

The duties and responsibilities of this position were to:

(a) Supervise and coordinate all foreign consultants in collaboration with DTEC and MOAC.
(b) Advise the project management team on progress of the project, especially technical assistance efforts.
(c) Conduct and/or advise farming systems research and/or extension relevant to his area of expertise. (The Chief of Party's areas of expertise were extension administration, soil fertility and soil chemistry.)
(d) Coordinate technical assistance effort of the expatriate team with both Thai consultants and MOAC departmental officials.

The Chief of Party (John Ragland) emphasized item (d) in the first year of the contract. This required a slow, usually low profile approach to develop the trust required to have advice considered. Helping project management organize two-way information flows in the Research/Extension/Farmer continuum was given the second highest priority. However, the largest amount of time was actually spent studying how the rural population lived and why most were living "in poverty." Considerable soil sampling was also done for laboratory testing, in an effort to rationalize the poor crops so routinely seen.

In the second year the Chief of Party spent more time on items (a) and (b) above but also began lime and fertilizer studies carried out with Thai counterparts.

More field and a few greenhouse studies were done in the third year plus preparing summaries for the project's mid-term evaluation.

The final year was spent on item (c) and intensive greenhouse and laboratory work with Thai counterparts. This work was particularly helpful in advising the cropping systems research and extension workers about the unusual set of yield-limiting soils constraints that exists in the Northeast and ways of overcoming them.

FARMING SYSTEMS SPECIALIST

This position was filled by Mr. Iain Craig, who served the project very effectively. Upon joining the project in February 1983, he began helping

New Cash Crops

Sesame, peanuts, and kenat (before rice) are succeeding because of work by the Department of Agriculture. Other new crops will also succeed now that farmer / extension / researcher teams are working together in a program that determines farmers needs and responds through on-farm experiments.

change the project's cropping systems' research methods and priorities. Major alterations included changing the trials and demonstrations:

- from technology driven to basing them on farmer problems,
- from non-rigorous to semi-rigorous experimental procedures,
- from emphasis on large acreages of plots to plot numbers and sizes decided by the purposes of the studies,
- from not reporting results for plots that failed to yield any harvestable product to a complete and manageable procedure for recording and storing the results of all trials, and
- from an overemphasis on testing cropping patterns always treated with only the full recommended rates of fertilizer and other inputs to a range of inputs (zero, intermediate and full).

Progess was made in accomplishing these changes by organizing rapid appraisals, various methodology workshops, annual technology assessments and building a computerized data storage and retrieval system. Only an experienced person of exceptional patience and skill could have obtained the understanding and trust required to improve this central component of the project.

Despite the improvements in the cropping systems procedures, relatively little has directly benefited the farmers. This is mainly because most soils in the Northeast give abnormally low fertilizer responses. This abnormality is due to a unique set of soil conditions that became partially understood in the fourth year of the contract.

The soils of the Northeast are so poor that fertilizer must be added if yields are to be above subsistence levels. The cropping systems trials always included fertilizer additions but yields usually benefited very little. This situation automatically ensured that the farmers' low input methods would be more profitable even though their yields were very low. With the methodology problems greatly reduced and the possibility of correcting the soils problems that have severely limited fertilizer responses, significant benefits to the farmers from the cropping systems program can now follow.

AGRICULTURAL ECONOMIST

There was a strong tendency in the project to complete all activities that had been planned instead of concentrating on those showing the most promise. The economics work helped more than anything else to focus the level of effort placed on activities demonstrating promise.

Craig Infanger and Lee Meyer each served the project for approximately two years in this position. Beyond helping to prioritize activities, the agricultural economists assisted counterparts in organizing and conducting market information programs with farmers and businessmen who buy farm products. Other significant contributions were helping to organize farmer cooperatives for buying production inputs at a lower cost, helping to organize periodic livestock markets, and developing the software necessary to create a database of the cropping systems results.

The first four buying groups (50 members or less per group) have saved their members approximately 100,000 baht ($3500). Five more buying groups were organized in 1986. The agricultural economists were also very helpful in identifying needed improvements in the village fish pond component of the project. Much to the credit of the Department of Fisheries, these improvements came quickly once the problems were documented.

Project Accomplishments

Although evaluating a project from a tabulation of the planned and actual activities is the lowest form of evaluation, it is perhaps the only manageable approach for a project like NERAD, with 9 organizational units implementing more than 100 individually budgeted activities. Accordingly, the following is an alphabetical listing of the departments and an indication of the numbers of people trained, ponds constructed, chickens vaccinated, etc. Data are only being shown here for work actually accomplished. In almost all cases, the activities accomplished equalled or marginally exceeded what was planned.

DOA - Department of Agriculture:

Improved Rice Variety Trials/Propagation — *390 rai*
Cropping System Trials — *124 systems on 928 rai*
Farmer Study Tours of Cropping — *180 farmers*
Fruit Tree Farmer Specialist — *96 farmers trained*
Sericulture Farmer Specialist — *102 farmers trained*
Propagation Plots, Improved Fruit Trees — *62 rai*
Sericulture Technical Service — *200 persons*

DOAE - Department of Agriculture Extension:

Construct Tambon Extension Centers — *8 centers*
Propagation of Improved Rice Varieties — *30 rai*

Water

Although serious floods do occur in the Northeast, usually there is not enough rainfall. NERAD, through the Department of Land Development, provided concrete rings to construct more than 1,500 shallow wells by volunteer village labor. Earthen embankments to impound water for dry season cropping and concrete diversion weirs to push runoff from streams back into the rice paddies are also important parts of the project.

Vegetable Production from Water Projects — *34 rai*
Cropping System Promotion Plots — *148 rai*
Cowpeas for Seed — *13 rai*
Cowpeas for Green Manure — *12 rai*
School Lunch Project — *6 schools*
Mulberry Planting — *212 rai*
Construction of Silkworm Rearing Rooms — *152 rooms*
Fishery Farmer Specialist — *127 farmers trained*
Fruit Tree Farmer Specialist — *96 farmers trained*
Sericulture Farmer Specialist — *364 farmers trained*
Cropping System Farmer Specialist — *202 farmers trained*
Poultry Farmer Specialist — *364 farmers trained*
Buffalo/Cattle Farmer Specialist — *384 farmers trained*
Farmer Specialist Study Tours — *12 tours with 169 farmers*
Farmer Training in Sericulture — *45 villages*
Farmer Training in Pest Control — *320 farmers*
Mobile Training — *32 events*
Field Days — *32 events*
NERAD Radio Broadcasts — *238 times*
Monthly Meetings—NERAD Provincial Staff — *132 times*
Establishing Mushroom Production — *1,313 beds*

DCP - Department of Cooperative Promotion:

Socio-Economic Studies — *1,400 individuals sampled*
Price Surveys — *758 times*
Price Lists Distributed — *29,700 issues*
Group Buying of Inputs — *1,561 individuals surveyed*
Marketing Meetings — *1,048 people*
Training in Cooperatives — *2,291 people*
Cooperative Methods Demonstrations — *9 sites and 450 families*
Study Tours of Cooperatives — *9 tours with 180 people*
Promotion of Business Cooperatives — *4 sites*
Promotion of Farmer Groups — *38 groups*
Cooperative Promotion — *1 cooperative*

DOF - Department of Fisheries:

Village Fish Ponds — *136 established*
Village Fish Pond Committees — *580 persons trained*
Village Nursery Ponds — *36 established*
Stocking Village Fish Ponds — *4,574,480 fingerlings*
Fish Harvest Monitoring — *49 events*
Farmer Fish Production — *740 farmers trained*
Farmer Fishery Specialist — *127 farmers trained*
Fish Farming at Public Schools — *21 schools*
Fish Production in Rice Paddy — *115 farmers*
Private Pond Fish Production — *214 farmers*
Fingerlings for Private Ponds — *525,800 fingerlings*
Monitoring Fish Production — *278 times*

DLD - Department of Land Development:

Land Shaping (paddy leveling) — *2,563 rai*
Land Terracing — *58 rai*
Compost Making — *1,900 farmers trained*
Compost Making Demonstrations — *3,936 tons*
Green Manure Demonstrations — *110 rai*
Swamp Rehabilitation — *33 sites*
Submerged Dam Construction — *2 sites*
Embankment Structures — *12 sites*
Weir Construction — *2 sites*
Concrete Rings for Shallow Wells — *1,545 wells*
Modified Shallow Well Construction — *11 wells*
Water Filter Systems — *19 systems*
Pond Construction — *1 project*
Saline Soil Amelioration — *1,292 rai*
Shallow Well Research — *140 wells*
Weather Data Collection — *6 stations established*

DOLD - Department of Livestock Development:

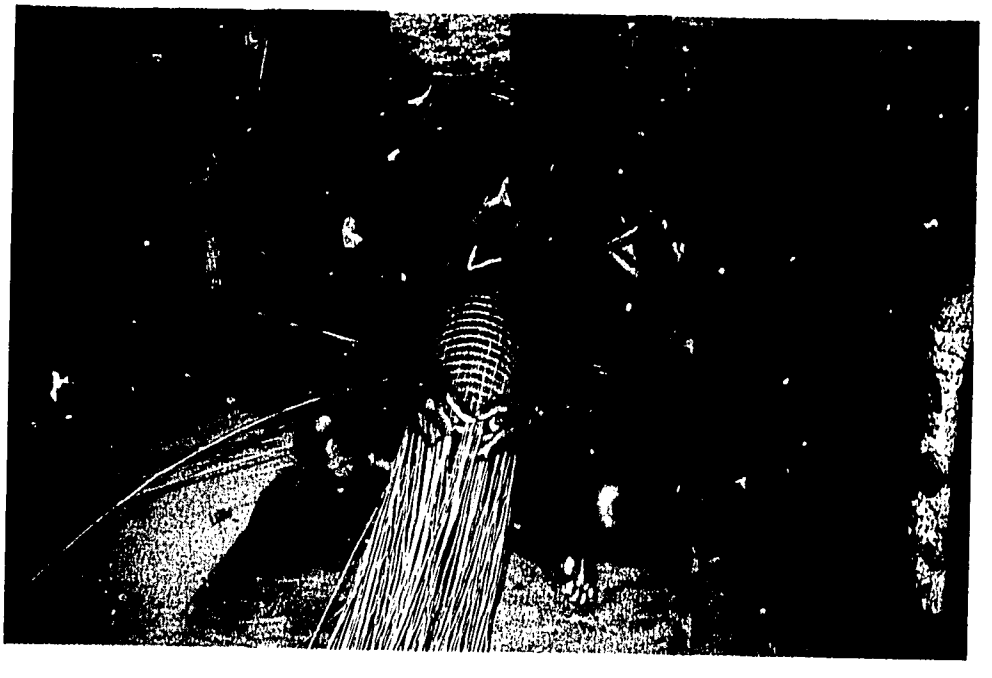
Select Poultry Producers for NERAD — *512 families*
Poultry Farmer Specialist — *364 farmers trained*
Poultry Vaccinations — *981,117 birds*
Select NERAD Cattle/Buffalo Producers — *192 farmers*
Cattle/Buffalo Farmer Specialist — *384 farmers trained*
Cattle/Buffalo Vaccinations — *64,386 doses*
Cattle/Buffalo Disease Treatment — *1,936 animals*
Pasture Improvement — *384 farmers trained*
Pasture Improvement — *2,671 rai*

NEROA - Northeast Regional Office of Agriculture:

Rapid Rural Appraisals—Cropping — *18 villages*
Rapid Rural Appraisals—Water — *18 villages*
Soil Fertility Trials — *5 sites*
Green Manure Trials and Demonstrations — *100 farmers*
Minimum Tillage Trials — *1 site*
Soil Testing — *5,000 samples*
Red Onion Production from Seed — *35 rai*
Virus-free Papaya Seedlings — *16,000 plants*
Virus-free Papaya Production — *304 farmers trained*
Cross Protection Disease Research on Papaya — *1 program*
Native Chicken Genetics and Nutrition — *36 demonstrations*
Chick Mortality Reduced by Vaccination — *48 farmers*
Chick Mortality Rate Reduced — *from 90 to 30%*
Farming and Cropping Systems Demonstrations — *18 villages*
Modified Shallow Well Construction — *36 wells*
Cropping at Modified Shallow Wells — *35 wells*

Fish

Fish is the most important source of dietary protein in the Northeast. Declining supplies of this vital food led the project to begin fish farming through its village fish pond and fish-in-the-paddy activities. Ditches dug into the paddies make the production of fish possible in the drought-prone paddies of the Northeast. This technology was developed under NERAD and is being spread throughout the region by the Department of Fisheries cooperating with the Department of Agriculture.



NERAD Changwat Staff
Meeting — *4 changwats/month*
Monitor/Evaluate All Project Activities — *3 times/year*

OAE - Office of Agricultural Economics:
Farm Record Keeping — *270 farmers for 3 years*
Economic Analysis of Farming
Systems — *285 families*
Market Surveys — *2,495 interviews*
Organized Group Buying — *Cooperated with DCP*
Study Marketing of Ag
Products —*vegetables/cottage industries*
Mini Evaluations — *7 evaluations*

Priorities

There has been no problem with NERAD participating agencies failing to meet activity goals. Everyone is to be complimented in this regard. Having met goals, however, two questions follow: (1) How beneficial was each activity to the overall project objective? (2) Has the project narrowed its activities to the ones giving the largest benefits? The project management group made a continuing effort to prioritize the contributions of each activity by holding technology assessment workshops and requesting write-ups of each agency's "most promising technologies and activities." Despite success in getting agreement on the highest to lowest priority activities, success in dropping project components has been difficult to achieve.

Partly responsible is the tradition that once planned and budgeted, an activity must be implemented regardless; in other words,"policy over reason." Another big constraint to narrowing the project is the long lead time required by the budget making process. With one and one-half years lead time, the need for flexibility to make changes is obvious. Technically such changes are possible but usually the paperwork required is so complicated and moves so slowly that departments learn not to ask. Although formidable, the above reasons are not the most important one. Project managers, like everyone, respond to pressures. The greatest pressure in a development project such as NERAD comes from the participating agencies instead of from the intended beneficiaries: the farmers. The social and political structures leave the farmers at a disadvantage to push for what they need. Although everyone wants to help the farmer, in the final analysis NERAD has responded to the larger pressure, the pressure to preserve each agency's activities and budgets. Therefore the narrowing process moves slowly. Realistically the narrowing to high payoff activities is more likely to occur after the project is completed and the MOAC agencies decide which NERAD components to continue with regular departmental funds.

The NERAD project is succeeding in its efforts to improve the capacities of departments to effectively implement agricultural development activities. Farmer and village needs assessments, interagency planning and implementation of the trials and demonstrations to address the needs, annual technology assessments and prioritizing are examples of building the capacities of the cooperating departments. The planning units of the MOAC and individual departments are drawing heavily on the NERAD project director and the departmental coordinators as they plan for the future. Given the project's substantial contributions in this regard, there should be less concern that the project has not narrowed its technology development and demonstration activities as much as recommended by the expatriate technical assistants.

Lessons Learned

PROJECT IMPLEMENTATION

It is very difficult to implement an interdepartmental project, but possible. For the first two years of the project (1982 and 1983), interdepartmental needs assessments, planning sessions and reviews were jointly held but each department, except for the Northeast Regional Office, did its part of the project much as if the other departments did not exist. This was probably due more to the long lead time required to get funds budgeted for an activity than to a lack of understanding or an unwillingness to carry out what was jointly planned. Budgets were so detailed and approved at such high levels that no one seemed willing to vary from the plan, even though everyone may have agreed that a better way had since evolved.

Also there were clearly understood penalties for not following the budget plan. Promotion patterns suggest that innovativeness and professional productivity are rewarded in the MOAC but no clear rules are promulgated as in the case of the penalties for not following the plan.

Inter-departmental implementation as well as planning was much more frequent after the first two years, either because budgeting and activity planning became more synchronized or because project management convinced the department representatives of the need. In 1986, NERAD was the

Livestock

Surplus buffalo, not needed for work in the Northeast, are traditionally driven southwest and sold to Central Plain farmers. Through NERAD the Department of Livestock Development is improving poultry and livestock production. The vaccination of native chickens, parasite control, and better feeding of buffalo and cattle are being emphasized.

impetus for a Memorandum of Understanding between DOA and DOAE for cooperative implementation of all their programs. NERAD personnel were asked to help prepare the plan for implementing this understanding.

Despite this and other cooperative beginnings, it will require years of a concerted effort by the managers of the government bureaucracy to change the concept of "equal but separate" into a truly cooperative and responsive spirit. Dr. Utai, the NERAD project director, often said it will take 25 years to build good interdepartmental cooperation throughout the whole MOAC. NERAD has developed a healthy beginning on this task. It will continue and grow if the MOAC maintains its present encouragement.

FARMER PARTICIPATION

Developing a sense of project ownership by villagers is slow and very difficult. The project paper states that:

> The Project accordingly aims at assuring the full understanding, cooperation, and participation of villagers in Project activities so that they will feel a strong sense of involvement and Project "ownership" and will want to continue activities after the conclusion of the Project. The Tambon Council, TEA, Contact Farmer and Specialist Farmer are key figures in these activities, in addition to the CD worker, teacher, and the chief district official. The Project will also seek the involvement of local private sector agricultural interests in the informative extension components of the Project in order to assure consistency in what is transmitted to the farmer. The Project will emphasize the strengthening of these existing institutions as the best means for reducing complexity and in order to provide a readily understandable, replicable process.

As the project began, activities had to be planned in relative isolation from the villagers to meet deadlines for budget requests. All budgets must be submitted one and one-half years in advance of the time for carrying out the activity. Later genuine efforts and progress were made in obtaining local decisions about which activities to fund and how they would be carried out. These efforts began with the tambon councils and were fitted into the area development planning process.

Soon the project management group began to doubt that the ideas and decisions from the tambon councils truly reflected village priorities. As a result, a two-week period was scheduled between the initial and final planning sessions with each tambon council. Council members were encouraged to have village development committees review the tentative tambon plan during this period. Changes suggested by the villagers that seemed justified were then made by the tambon councils before approving a final plan for the NERAD project.

Working with tambon agents, the project's training specialist, Paisal Chouangcham, sought to develop leadership and decision-making skills in the village councils. However, the time consuming nature of this work limited these efforts to only the Sri Saket tambons. Except for these tambons, the village committees found it difficult to develop a sense of project ownership. Traditions of deferring to elders and governmental officials seriously impede local decision making. These traditions are deeply embedded in the society and are not likely to change rapidly. Although it is a very slow process, the NERAD training approach in the Sri Saket tambons may be the best approach.

SIMPLE MECHANIZATION: A KEY TO ACCEPTANCE

Combine mechanical and biological technologies. The large numbers of people living on farms in the Northeast suggest a surplus of farm labor. But at peak periods such as crop planting and harvest times, this is not the case. Therefore, successful changes to the farm system must recognize labor constraints. Direct seeded rice has long been recommended by DOA for the Northeast but has not been accepted. Direct seeded rice is a major advantage in approximately half the years when there is not enough rainfall for transplanting the rice seedlings but enough for direct seeding.

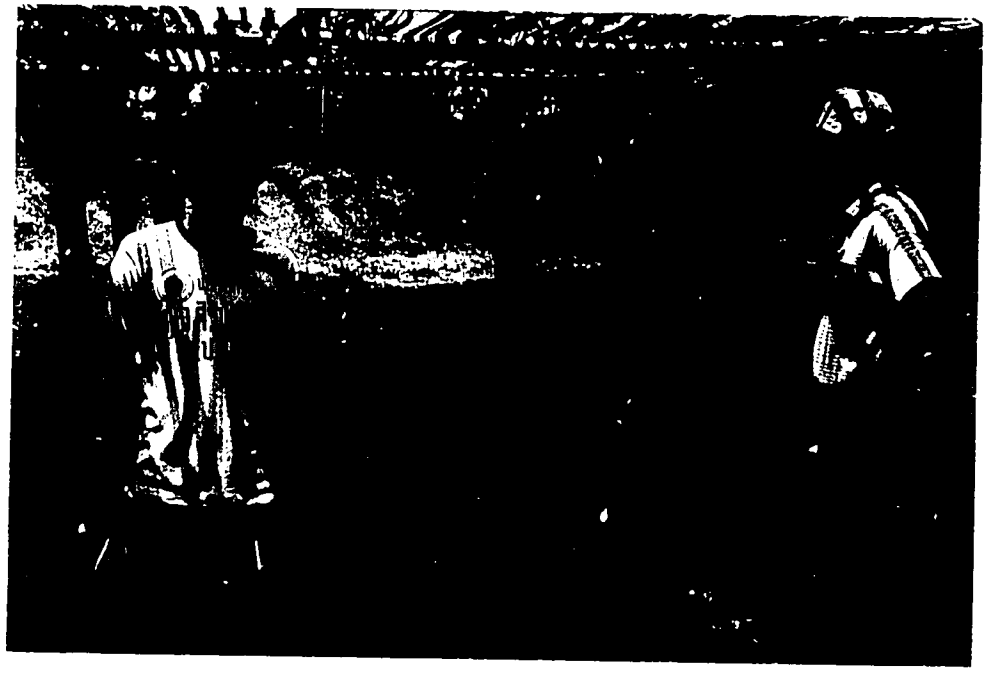
When NERAD reintroduced this technology to the tambons in Chaiyaphum province, it was combined with the introduction of a simple two-row mechanical seeder. As a result of this combined approach, direct seeded rice is now being widely adopted in Chaiyaphum and Roi Et provinces. With the mechanical seeder, direct seeding can be done quickly and weeding is much easier because of the evenly spaced rows. Seedbeds and transplanting are still preferable for most farmers, but now there is an alternative when the rainfall is insufficient or not timely. Yields from the two ways of planting the crop are comparable except in years with inadequate or poorly timed rainfall. In such years the farmer may not produce any rice if he relies entirely on transplanting seedlings.

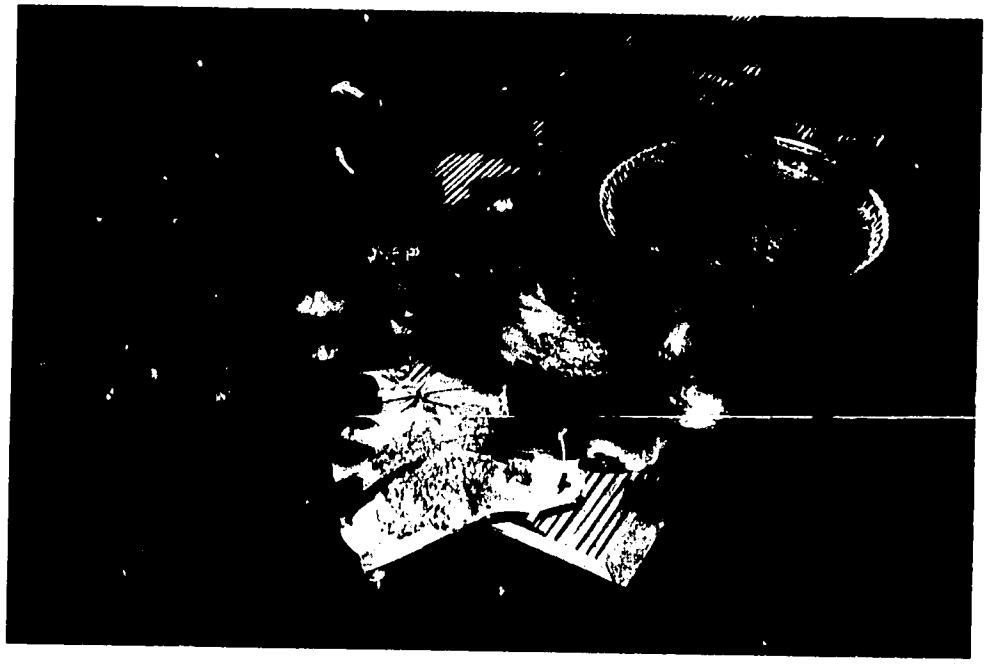
FISH IN THE PADDY

Fish can be produced in the rice paddies of the Northeast and rice yields improved as a bonus. The Department of Fisheries (DOF) first did this

Forest and Tree Fruits

An important part of the project was nurseries for seedlings to reforest common lands. The Royal Forestry Department has done an excellent job training villagers in producing, transplanting, and caring for tree seedlings until they are established. Forestry is also cooperating with the Departments of Agriculture and Agriculture Extension on tree fruits.





project activity for NERAD as a demonstration but quickly learned that the technology, worked out for the Central Plains irrigated rice condition, required modification to succeed in the Northeast.

DOF and DOAE cooperated very closely in this enterprise. The Tambon Agents reported that rice yields were increased in paddies where fish were also being raised. At first this was dismissed as a fertilizer effect from the small amounts of rice bran and vegetables fed to the fish. Later these reports were taken seriously, because similar results were being reported throughout Asia.

Presently DOF, DOAE and DOA are successfully promoting fish in the paddies throughout the NERAD project area and attempting to learn why rice yields are increased as well. Much to the credit of DOF and the farmers, they have made this practice work well. The enthusiastic support of the farmers for this activity is probably due to the tradition of harvesting wild fish and aquatic animals and insects from paddies. Now specialist farmers are teaching other farmers this fish-in-the-paddy technology. The Department of Fisheries has developed and is promoting both technical and simplified handbooks for fish production in the Northeast paddies. The greatest limitation appears to be inadequate supplies of fingerlings to stock the paddies. Artificial fertilization of fish eggs, as a way to expand fingerling production, is being taught to selected farmers in the project.

EXTENDING FARMER INNOVATIONS

Developing and extending farmer innovations can be a valuable component of a farming systems development program. Holes approximately 1 meter in diameter and 1-2 meters deep are dug in the paddies after rice harvest. This is the traditional water supply for growing dry season vegetables. Later in the dry season the perched water tables that feed water into these holes disappear and shallow wells 5-10 meters deep must be available if dry season cropping is to continue. In Sri Saket the shallow wells cannot be dug deeper than approximately 5 meters because of a layer of hardened laterite that exists in most of the area. Therefore shallow wells commonly fail in the last half of the dry season when the demand for vegetable crops is still high. One innovative farmer solved this problem by hiring a commercial well driller to bore a small diameter hole through the laterite layer at the bottom of his shallow well.

The laterite layer was only a few meters thick and when it was penetrated, a strong flow of water came through the hole and quickly filled the shallow well to within 1 to 1.5 meters of the surface. The NERAD field manager for Sri Saket convinced the project management group and USAID/Thailand that this was not an isolated condition but was likely to be sufficiently widespread to warrant a moderately large test. Thirty-six modified shallow wells were dug in the test and 35 provided an abundance of water. From these wells dry season vegetable production and shipment to Ubon and Korat has substantially increased. Such wells are now being privately funded in Sri Saket and installed experimentally by NERAD in the other three provinces of the project area.

Everyone is now encouraged to be alert for similar innovations that can be exploited to help develop the agriculture of the area. Building on farmer innovations such as the modified shallow well is usually easier than getting acceptance of technology coming from research. The shortcoming of this approach is that the cause of many problems is hidden. In these instances efforts are placed on the symptoms instead of the cause. A balanced development program must give equal emphasis to the cause and to the cure.

RECONCILING CONVENTIONAL WISDOM AND FARMERS' KNOWLEDGE

When the farmer's knowledge is at variance with conventional wisdom, valuable information may be found by reconciling the two. The village needs assessments, done early in NERAD, revealed widespread farmer knowledge of commercial fertilizers but guarded acceptance and minimal use: "Fertilizer is good but it makes the ground hard;" "Fertilizer is good if used with compost or animal manure;" "Fertilizer will not pay". This reluctance flies in the face of research results from around the world which show that soils as infertile as the ones in Northeast Thailand routinely give large and profitable responses to commercial fertilizers. The relatively small amount of fertilizer response data for Northeast Thailand is a mixture of moderate responses to no responses with half or slightly more being no response. For more than 30 years the typical expatriate soils specialist reaction to these data has been:

- Insufficient water prevented full fertilizer responses.
- Perhaps weeds took the plots.
- There were not enough replications of each treatment.
- The data were mixed at, or subsequent to, harvesting.
- The soils are so acidic that the fertilizer response is prevented.

Soils

IERAD seems to have discovered ıe mechanism responsible for the egion's extremely poor yields and ow to overcome this barrier by cluding a tropical legume Sesbania rostrata) *in the cropping ystems as a green manure crop. he Department of Land evelopment and Technical ection of the Northeast Regional ffice of Agriculture have taken e leadership for this important ırt of the project. Compost is an fective soil amendment but the ıantities of plant residues ailable for compost making are ıt sufficient to provide a serious ack on the problem.*

So certain were these specialists, including the NERAD soils specialist, that the infertile Northeast was an ideal situation for profitable fertilizer use, that the data and farmer reluctances were mostly rationalized away. Typical feelings were expressed in 1956 by Dr. Ernest Staker, who stated, "It is inconceivable that thousands upon thousands of farmers in Thailand can continue raising crops with such low yields when by using small amounts of fertilizer and other practices they can increase yields from 50 to 200 percent."

Learning Why

After three years of soil fertility assessment, library research and crop growth trials, the NERAD soils specialist was forced to conclude that commercial fertilizers, applied to Northeastern soils, give abnormally small responses. The farmers were justified in their lack of enthusiasm for commercial fertilizers. Nevertheless, it was essential that work continue on how to use commercial fertilizers because plant nutrient levels in most of these soils are so low that substantial crop yields are impossible without adding plant nutrients from some source.

A very large set of nitrogen response data on rainfed rice had been collected from 1978 to 1983 by Dr. Chob Kanareugsa and his staff of the Rice Branch of the Division of Soil Science of the Department of Agriculture. Mr. Keith Fugli, a University of Minnesota agricultural economics Ph.D. candidate, summarized these data while working on the USAID funded Farming Systems Project at Khon Kaen University. Mr. Fugli gave a copy of his summary to NERAD in mid-1985. It showed an economic response to nitrogen fertilizer on only one of the soil types tested. This soil type was a high clay, high organic matter soil that constitutes only a small fraction of the agricultural land in the Northeast. The other soils were representative of the soils used for rice in the region and none showed profitable yield responses to nitrogen fertilizer.

At the time Fugli shared his work, the NERAD soils specialist continued with the mind-set that commercial fertilizers must give yield response when added to such infertile soils. He was attempting to obtain fertilizer responses by first correcting soil acidity with lime and/or soil flooding. Accordingly the Fugli analysis was filed away since it did not fit the TA's preconception, even though he had collaborated with Fugli in gaining access to the data.

From field, laboratory and screenhouse studies, a picture emerged in the fourth year of the TA contract that the more sandy and lower in organic matter a soil was, the poorer the nitrogen response. Unfortunately sandy, low organic matter soils like the Roi Et and Ubon predominate in the Northeast. The mechanism responsible for the apparent low recovery of fertilizer nitrogen from these soils has been hypothesized and widely distributed to the Thai scientific community. Much testing of the hypothesis is now needed.

Finding a Solution

A big step toward learning how to get normal fertilizer responses from these sandy soils was taken in the last few months of the TA contract. Adding organic matter is not only an obvious need but what the farmers said was required for good crop production in the beginning. The limitation is that there is only enough cattle and buffalo manure to treat rice seedbeds and high value cash crops such as tobacco and vegetables, and to apply to the very poorest spots in the paddies. Compost making can be increased but the quantities of plant residues in the Northeast are too small for any serious attack on the problem.

Growing green manure crops had been a part of NERAD from its beginning but a really effective green manure crop was not found until the third year. The project imported the rostrata species of Sesbania from IRRI, increased the seed supply, and found it to be extremely responsive to phosphorus and potassium fertilizer. Because Sesbania is a legume, atmospheric nitrogen is converted to a form usable for crop growth through the action of rhizobium bacteria. These nitrogen-fixing microorganisms live in nodules growing on the roots and stems of Sesbania plants. Greenhouse tests indicate that, when incorporated into the soil, it will release the phosphorus and potassium previously accumulated from fertilizer and the nitrogen fixed from the air. Apparently, residues of these plants temporarily increase the soil organic matter enough to permit more normal nitrogen fertilizer responses. Adding the Sesbania green manure to greenhouse studies greatly increased rice growth in 1986. The results from field tests started in that year are not yet known.

Soil Studies Continue

The question remains of why low clay and organic matter prevent normal crop utilization of nitrogen added as commercial fertilizer. The project has advanced an hypothesis that the soils of the Northeast are so poorly buffered against fluctuations in pH and oxidation-reduction potential that adding fertilizer moves these factors, especially pH, to extreme values and thus injures the crop. Badly needed nitrogen is prevented from being absorbed. It is the extreme weathering of these soils that causes them to contain so little clay and organic matter in the topsoil.

This nitrogen use problem is a key constraint to the success of NERAD and all other projects to improve cropping systems now being tested in the Northeast. As long as low or no nitrogen responses are occurring in these extremely infertile soils, the traditional low input, low yielding, single crop of transplanted rice will be superior to any multiple cropping schemes. Solving the nitrogen use problem will not ensure rapid agriculture development in the Northeast. However, it seems safe to conclude that such development is not possible until this problem is solved. Yields are only a fraction of what is otherwise possible from the solar radiation, rainfall and labor that is invested each year.

Project Summary and Status

NERAD was conceived and designed on the premise that most people in Northeast Thailand are in poverty because technology has not been effectively delivered to them.

Representatives of nine departments and agencies of the MOAC were organized by the project to create a development model for improving family food supplies and cash incomes. A farming systems approach was used as a vehicle for meeting the project objectives of:

- *improving the capacity and performance of research and extension workers,*
- *improving the linkage of these workers to farmers, and*
- *improving technology through on-farm trials and demonstrations.*

The project's life has two years remaining but the technical assistance contract with the University of Kentucky was completed in September 1986. Accomplishments to this date include:

- *training and indoctrinating a core of workers in the project's objectives and processes,*
- *acceptance of the NERAD development model by some of the cooperating departments, and*
- *technology modification and application that has improved the production and marketing of certain farm enterprises through:*
  - *native chicken vaccinations and feeding,*
  - *home fruit production,*
  - *vegetable production for market,*
  - *direct seeded rice for rain shadow areas,*
  - *combined fish and rice production,*
  - *pre-rice crop production of sesame and kenaf, and*
  - *organizing farmer cooperatives that are reducing production costs by group purchasing of inputs.*

Infertile soil is perhaps the most serious agricultural problem in the Northeast because of the low crop yields that result. This yield barrier is not removed by adding chemical fertilizers and lime directly to the crop. Progress was made through laboratory and screenhouse studies on how to circumvent this limitation. Field testing is planned for 1987.

Acknowledgements

The Northeast Rainfed Agriculture Development Project (NERAD) has the goal of improving the economic well-being of the poorer farm families in Northeast Thailand. The approach is to develop cooperating teams of researchers, extension officers, and farmers who are using farming systems methodologies to implement the project. We anticipate that a replicable program for agricultural development will emerge by the end of the project and be ready for application to all provinces of the Northeast.

This publication covers four years of this seven-year project, which is scheduled to end in August 1988. The University of Kentucky College of Agriculture provided a technical assistance team that worked with the project from August 1982 through September 1986. Although the work of this team is emphasized, we wish to stress that the progress we describe was only possible because of the splendid cooperation and support of numerous individuals in the Permanent Secretary's Office and many departments in the Ministry of Agriculture and Cooperatives and the United States Agency for International Development. With apologies to the many contributors not listed here, the University expresses its appreciation to the following:

Dr. Thalerng Thamrongnasawat, *Permanent Secretary of State for Agriculture*
Dr. Utai Pisone, *Director of NERAD and the Northeast Regional Office of Agriculture*
Dr. Sawat Thammabood, *Assistant Director of NERAD*
Khun Wisooth Amritsuth, *Chief of Project Management Section*
Dr. Waerchark Kongpolprom, *Chief of Technical Section*
Khun Ladda Boonpuckdee, *Soil Scientist*
Khun Paisarn, *NERAD Training Officer*
Khun Withoon Wardhanabhuti, *NERAD Field Manager for Chaiyaphum*
Khun Chulermchai Prasartsee, *NERAD Field Manager for Nakhon Phanom*
Khun Nuttaporn, *NERAD Field Manager for Roi Et*
Khun Sittha Worachinda, *NERAD Field Manager for Sri Saket*
Khun Anan and Khun Songsak, *Planning Division of DOAE*
Khun Chanuan, *Planning Division of DOA*
Dr. Damkoeng and Khun Chalerm, *Farming Systems Institute of DOA*

Dr. John Erikson, *Mission Director, USAID/Thailand*
Mr. Douglas Clark, *Agriculture and Science Director, USAID/Thailand*
Khun Thongkorn Hiranraks, *present Project Officer, USAID/Thailand*

Many individuals formerly associated with the project also contributed greatly. Special thanks are due former USAID project officer Dr. Charles Alton, and Khun Det Trisahd and Mr. David Thomas also of USAID/Thailand. The support and encouragement of the late Khun Kangwan Devahastin Na Ayuthaya, who was deputy undersecretary for the Ministry of Agriculture and Cooperatives, were crucial to the project. Khun Somchai Thammanoonragsa, former director of the Northeast Regional Office, was very helpful to the University of Kentucky technical assistance team.

The University of Kentucky College of Agriculture is pleased to have worked with the NERAD project. We learned much about agriculture production under conditions of extremely poor soil and water resources. More importantly, we hope that the technical assistance provided will result in long-term benefits for the development of Northeast Thailand.

H.F. Massey
Associate Dean for International Programs
College of Agriculture
University of Kentucky
Spring 1987

For a more complete report, including budget information and a list of project publications, contact:

NERAD Director
Northeast Regional Office of Agriculture
Tha Phra
Khon Kaen, Thailand

or

Associate Dean for International Programs
College of Agriculture
N-324 Agricultural Science Building, North
University of Kentucky
Lexington, Kentucky 40546-0091
USA