PD-AAJ-499

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APPLIED RAINFED RESEARCH METHODOLOGY

A Report to USAID/Thailand

by

International Agricultural Development Service

As a Component to the

RAINFED AGRICULTURAL INTENSIFICATION (RAI) PROGRAM

AID Project Number 493-0328

PN-AAJ-127

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November 10, 1982

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The team is deeply grateful to many persons for much help, patience, and kindness. We are especially grateful to Khun Preecha Suriyapan of DOA and Dr. Chulhathep Pongsroypech of DOAE for their excellent assistance whether as tour guides or travelling seminar leaders.

LIST OF ACRONYMS

AIT	Asian Institute of Technology
DLD	Department of Land Development
DOA	Department of Agriculture
DOAE	Department of Agriculture Extension
DOLD	Department of Livestock Development
IARC	International Agricutlural Research Center
IBRD	International Bank for Reconstruction and Development (World Bank)
ICRISAT	International Center for Research in Semi-Arid Tropics
IRRI	International Rice Research Institute
MOAC	Ministry of Agriculture and Cooperatives
OAE	Office of agricultural Economics
RTG	Royal Thai Government

EXECUTIVE SUMMARY

The Department of Agriculture has primary responsibility for research for all crops in Thailand. There are many stations scattered throughout the country, but most are not adequately staffed to conduct research work. Essentially all of the Ph.D. holders as well as a large percentage of the M.S. degree scientists are located in Bangkok. Under a World Bank loan, 19 research stations will be upgraded to centers, each with primary responsibility for research for a particular group of commodities. The Australian Government is planning to train 140 scientists to the M.S. level and 30 to 40 to the Ph.D. level over the next 5 years.

With the exception of rice, there does not appear to be much profitable technology for other crops. Technology for the management of soils, particularly in the Northeast seem to be lacking as evidnced by the great variation in crops within a field even on the experiment stations. There appears to be little interchange between extension and research workers and little cooperative involvement in local verification trials.

Library materials at the research stations were essentially non-existent. Even the major rice stations did not have IRRI publications, that are readily available. There seemed to be little opportunity for researchers to do investigative reading related to research activities.

Economic analysis of research activities seems to be almost completely lacking. This is a real need if the research is to have practical application for farmers.

The team recommends and examines technical assistance in the following areas:

1. Improvement of information and library facilities.

2. A substantial effort to develop improved soil management tehnologies for the problems soils of the Northeast.

3. Training program for center directors and their deputies to help them do the job the new system will require.

4. A program to enable DOA to contract within Thiland for research for which it does not have the resources.

5. An effort to help the Farming Systems Research Institute both to develop a national program of farming systems research and to provide specific support to each center's program in that field.

Over the five year life of the project, the assistance planned would total $9,160,000 for substantial improvements in the above areas. Major categories of the assistance would be: technical assistance (480 person months) $3,625,000; commodities, supplies operation expenses $3,750,000; and training (6 Ph.D., 15 M.S., 50 short term to third country and approximately 100 in-country workshops with outside consultants) $1,775,000.

I. INTRODUCTION

This is one of a pair of reports prepared by the IADS team for the USAID Mission to Thailand. This pair of reports has two purposes. One is to help the USAID identify opportunities for helping Thailand improve its agricultural research and extension programs. The second is to develop suggestions for project activities, as specific as is feasible, for the USAID to undertake. This report is on agricultural research, or technology generation, with particular attention to the Department of Agriculture (DOA) of the Ministry of Agriculture and Cooperatives (MOAC). The other report deals with extension, i.e. technology diffusion, with particular attention to the Department of Agricultural Extension (DOAE) of the same Ministry. Although of the same ministry, these two departments are largely autonomous, much more so than is normally expected of two sub-units of the same ministry.

We have assumed that several factors will remain unchanged. One is the fact that there are two autonomous entities dealing with what can be regarded as a single process, the Technology Innovation Process. Starting with the discovery of new information, there must be developed a set of improved technologies which must be tested for utility to the farmer, adapted to distinct ecologies, diffused to farmers, and finally adopted by them. The integrity of that process must be maintained if Thailand agriculture is to be adequately served. When two autonomous entities are involved in serving a single process, certain problems are inevitable. They are clearly evident in Thailand, but they can be solved. Progress has already been made in solving them.

The other fact we have accepted is the re-organization of the DOA, which is just now being implemented. We have not judged that reorganization but rather we have set for ourselves the task of identifying what the Royal Thai Government and the DOA need to do to make that reorganization work and how USAID might help.

In our first meeting with DOA, three problems were presented. How can the Farming Systems Research Institute best be integrated into the DOA program? What needs to be done in the information and documentation program? How can research best be linked with extension?

A. Linkages

There is an intense interest in improving the linkages between research and extension, between the DOA and the DOAE. Linkage has value when it enables an organization to accomplish its own ends. Thus, we have tried to identify those cases in which the DOA needs to collaborate with DOAE in order to accomplish its own objectives or to serve its own needs. It should collaborate with other organizations for exactly the same reason. In addition to identifying the needs we have also presented general formats and alternatives for acomplishing the linkages.

We also emphasize linkages with the farmer. Both DOA and DOAE, as is true for public agricultural agencies everywhere, should constantly remind themselves that the only reason for their existence is to help the farmer do a better job. This concept of service to the farmer will provide each of the two organizations with a "sense of mission," which when shared by all employees is an important asset. It helps to show clearly where linkages will be useful, even essential. Neither DOA nor DOAE can accomplish its mission without the other. Working together also helps make the job more interesting and gives employees a sense of excitement in their work, without which it is difficult, if not impossible, to develop a good program. Personnel will not be strongly motivated without it.

II. OBSERVATIONS

We recognize the limitations faced by a short-term team in understanding an entity as complex as the DOA. The problems involved are further complicated by having to make some assumptions regarding the likely impact of the recent reorganization.

We have relied on much more than the team's evaluation. Some members of the team have had a long time relationship with Thailand research, and thus much was known by team members before we started our work. We have drawn heavily on reports made available by USAID. The system has been well analyzed, and many patterns emerge. We have attempted to understand those patterns and to suggest some alternatives for action.

A. Ideas From the PID

Our observations support some statements in the RAI PID.

1. The applied research, message diffusion, and service delivery competencies of the research and extension organizations need strengthening. The RAI project seeks to enhance the provision of appropriate technical know how at the technical/manager level and to the rainfed farmer.

2. To achieve the 4.4 percent annual production increase assumed by the RAI PID, researchers must obtain an intimate understanding of farm level conditions. It will also require more attention to soil fertility and management, livestock development, saline soil reduction, and production credit.

3. Production execution of the decentralized and applied research pattern embodied in the IBRD-sponsored reorganization plan is highly constrained by the lack of agricultural and social scientists capable of working as parts of multi-disciplinary teams.

4. A methodology for generating farmer accepted technologies is missing but the RAI proposes to remedy this situation.

5. There are several weaknesses in current DOA regional trials:

a. Farmers are not involved in the trials or in their evaluation.

b. Extension workers have little contact with the trials.

c. Each regional level trial usually focusses on a single item, such as variety, fertilizer treatment, or cultural practice, thus not reflecting the diversity of practices encountered in multiple cropping.

d. There is no work on the economics of the trials.

The products of the RAI project should be:

a. To develop a feedback system for ascertaining farmer acceptance (or rejection) of new technologies.

b. To develop a methodological approach for bridging the gap between crop research and extension.

c. To develop a trained cadre of scientists, and an organizational structure within which they can work effectively.

B. Organization of DOA

There are many regional and provincial agricultural research stations distributed throughout the country. For example, the number of field stations for major commodities are as follows: rice--22; field crops--20; horticultural crops--10; rubber--19; and sericulture--19. Thus there are government research personnel scattered throughout the country. However, the team observed that relatively few of the technical staff assigned to field stations had degrees beyond the B.S. Essentially all of the Ph.D. holders are stationed in Bangkok, as well as a large percentage of the scientists with M.S. degrees.

It appeared to the team that operating funds at the field stations were inadequate. How inadequate we do not know but how else could one account for the poor weed control on the experimental plots or the lack of any semblance of a library at the field crop experiment stations.

The team gained the impression that, in general, the results of agricultural research are not being published in terms suitable for use either by the extension staff, by literate farmers or by other scientists. The team was told that an information unit is being established in the DOA. However, at present only one person has been assigned to this office.

With World Bank support, the research facilities (physical plant and equipment) are being greatly augmented, and 19 agricultural research stations are being upgraded to research centers where research will be planned and implemented. When this program is completed, Thailand will have assigned many of its research staff to these centers, thus decreasing the proportion of its research scientists remaining at central headquarters in Bangkhen.

With support from several donor organizations, young Thai scientiest are being trained through the M.S. and Ph.D, thus making the country better able to meet the staff requirements of its research program. Australia alone plans to train 140 to the M.S. and from 30 to 40 to the Ph.D. during the next 5 years.

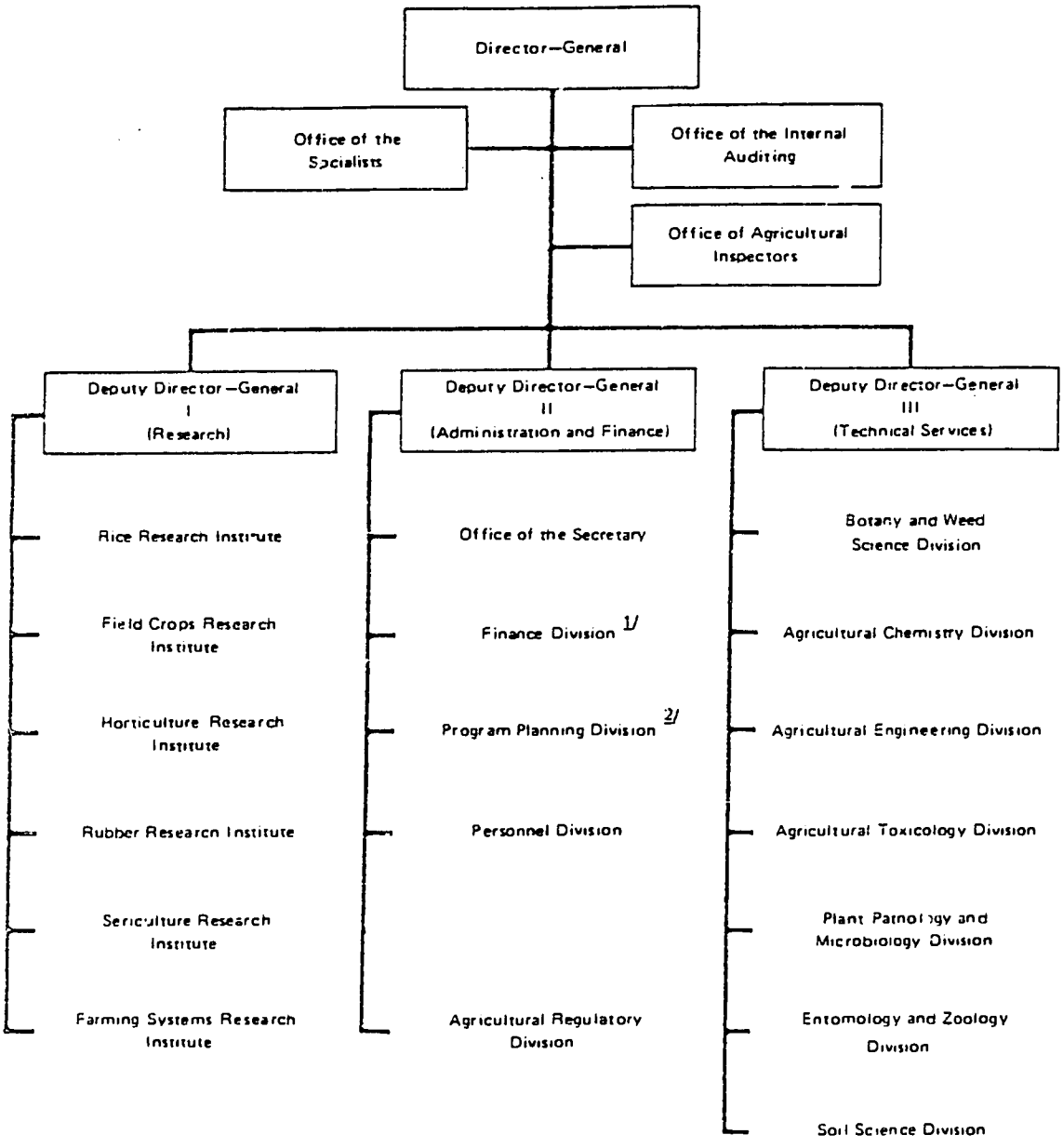
Under the new structure there will be six institutes--one each for field crops, rice, horticulture, sericulture, rubber, and farming systems. Sericulture and rubber are relatively little affected. Three institutes, however, will be transformed--rice, field crops, and horticulture. The new organization plan is shown in the accompanying chart.

There will be six research centers each for rice and horticulture and seven for field crops. Research planning, programming and management will transfer to these centers from Bangkok. All other stations will become satellites of one of these centers.

The Farming Systems Research Institute is new, and it has not been fully decided whether it will have one or more research centers as will the other institutes.

The technical supporting disciplines, such as soil science, entomology, plant pathology, and others will have no centers of their own. How to relate these units to the institutes and the centers has yet to be determined. It is our judgment that at least research in soil science, entomology, plant pathology and weed control should be an integral part of the research program of each of the crop research centers. Keeping these separate under a different administrative unit could result in confusion with respect to budgetary support and to the assignment and supervision of personnel and thus reduce the effectiveness of these highly important areas of research.

THAILAND
NATIONAL AGRICULTURE RESEARCH PROJECT
ORGANIZATION PROPOSED UNDER THE PROJECT



1/ Includes a Procurement Unit
2/ Includes Monitoring and Evaluation Unit and Library and Information Service

Note
a Organizaton Structure agreed upon in principle during negotiations
b Subject to RTG approval

Also yet to be resolved is the relationship that should be developed between the Farming Systems Research Institute and the commodity institutes. Such supporting services as information and library services are under a third Deputy Director-General who is responsible for administration.

Organizing and activating the Centers and making them major control points will require a considerable out-migration of scientists from Bangkok, which may cause some problems. Living conditions vary widely among the centers. Schooling for staff children will be a major problem.

The team notes three possible problems which may emerge. One is the location of these centers. At best, DOA will encounter problems in moving scientists from Bangkok to the hinterland. There are several cities in Thailand which provide relatively good living conditions. Some centers apparently are being located relatively far from these cities, while at the same time good stations near the cities are being passed by and are not selected for upgrading. This will make more difficult the migration of scientists from Bangkok.

The second problem the team anticipates may develop is the availability of personnel to manage these centers. It is a heavy demand on DOA to come up with 19 persons capable of research management at the level needed.

A third organizational problem has to do with the development of agricultural economists. They are needed in connection with practically all agricultural research, yet the DOA has none. For example, the economics of fertilizer use has not been adequately studied. We heard repeatedly that "farmers cannot afford fertilizer". We don't know whether this (if true) is due to unreasonably high fertilizer use has not been explained and demonstrated adequately.

Studies are needed of the economics of all cultural practices at the farm level, and particular in connection with research on multiple cropping and cropping systems.

Despite this situation, we were told that present RTG policy does not allow assigning agricultural economists to DOA research programs. Yet it is inconceivable that a production agricultural research program, producing production practices useful to farmers, can be developed without the participation of persons skilled in farm management analysis and in the economics of changes in specific cultural pactices. (They need not be full-fledged macro-economists. Persons with basic agronomic and livestock husbandry training could be trained in relatively brief periods of training to conduct the type of micro-economic analysis that most agricultural research needs.)

C. Status of Technology

With the exception of varietal improvement, the team did not identify any significant technologies that the DOA has ready for farmers. We saw some "promising" technologies in process. An example is direct seeding of rice, which with a little more work may become a significant innovation, especially in providing some strategies for dealing with erratic rainfall in the Northeast.

D. The Outlook for Agricultural Production

Farm-gate prices in Thailand have been high for inputs (especially fertilizer) and low for farm produce as compared with other countries in the region. Furthermore, in recent years as per capita food production in the less-developed countries has increased, world prices for rice, maize and cassava (Thailand's important export crops) have decreased.

Thailand has been increasing its total production of rice by expanding the land area devoted to the crop. However, because the best rice soils were already in use, the expanded area has been on less fertile soils subject to uncertain rainfall (especially in the Northeast). As a result the yield per unit of land of rice has been decreasing during the past decade. Thailand is the only country in South and Southeast Asia that has shown a drop in rice yields in recent years.

A recent World Bank study states that unless Thailand makes rather marked changes in its policies and programs, agricultural growth cannot meet the expectations in the government's Fifth Development Plan (1982-1986) of 4.5 percent per annum (the 1975-80 growth rate was only 3.5 percent).

An important element in the World Bank's set of recommendations is that Thailand increase its agricultural research capacity. If this can be achieved, it will contribute substantially toward increasing farm incomes, and agriculture will continue to play its highly significant role in total economic development.

E. Library and Technical Support

Equal to DOA's needs for linkage with extension are those for linkages with other researchers both inside Thailand and out.

The library is one excellent linkage mechanism for this purpose. We found library facilities at all research stations to be woefully inadequate. Even library services at Bangkhen are not adequate.

The international agricultural research centers have as one of their specific responsibilities the support to national research programs. We find that the DOA is not making sufficient use of the IARC publications, especially in the field stations.

F. Utilization of Universities in Agricultural Research

Thailand has made remarkable progress during the last two decades in developing its agricultural universities (Kasetsart, Chiang Mai, Khon Kaen and Prince of Songkhla). Currently approximately 1,000 graduates in agriculture are produced annually. These universities have other faculties besides agriculture, but in each of them agriculture is an important segment. Kasetsart, Chiang Mai, and Khon Kaen universities individually have more Ph.D's on their agricultural faculties than does the entire DOA, yet government support of research at all four universities is less than 5 percent of the total agricultural research budget for the nation.

The research role of the faculties of agriculture vis-a-vis that of the DOA has yet to be properly defined. Much of the research now being conducted by agricultural faculty members is supported by grants from foreign assistance agencies such as the Ford and Rockefeller Foundations, the International Development Center of Canada, and the governments of

Japan, Australia, Germany and the United States. From Thai sources the universities receive only small grants for individual projects from the National Research Council (an agency of the Ministry of Science, Technology and Energy).

The team visited certain departments of Kasetsart, Khon Kaen and Chiang Mai Universities and received an excellent impression of the quality of the staff and of the work that they are undertaking in the agricultural sciences.

The team strongly recommends that the government of Thailand provide substantial and continuing support to the 4 agricultural universities for both fundamental and applied research directed toward increasing productivity and the well-being of the rural population.

G. The Australian Program

Australia has made Thailand a substantial grant to provide assistance to implement the World Bank loan program. Four in-residence personnel are here from Australia, one each in administration, budget and finance, manpower development, and station development, plus short-term consultants. The Australia program includes a manpower development component that will train 140 to the M.Sc. and 30 or 40 to the Ph.D. and it provides funds for agricultural research in Thai universities, where about half of the M.S. students will be trained.

III. STRATEGY FOR IMPROVING THE EFFECTIVENESS OF THE RESEARCH PROGRAM

The strategy outlined in this report is based on the projected organizational structure now being implemented by the DOA, with the assumption that no major changes will be made. It addresses what in our judgment would be the factors most likely to limit the success of the DOA in generating improved technology. The intent is to strengthen DOA, according to DOA's own design rather than to introduce new components.

The activities proposed should apply to agricultural research throughout the Kingdom. However, at the start the project can be oriented to rainfed agriculture with particular reference to the Northeast.

A. The Strategy

The research development strategy for a possible USAID project is presented in five components.

1. Improvement of information and library facilities.

2. A substantial effort to develop improved soil management technologies for the problem soils of the Northeast.

3. A training program for center directors and their deputies to help them do the job the new system will require.

4. A program to enable DOA to contract within Thailand for research for which it does not have the resources.

5. An effort to help the Farming Systems Research Institute both to develop a national program of farming systems research and to provide specific support to each center's program in that field.

We look to the FSRI to carry the main DOA responsibility in:

1. Expanding the program of on-farm verification trials of promising research center results.

2. Improving the communication and cooperation between research scientists and extension specialists.

3. Improving DOA's knowledge and understanding of the farmer and DOA's linkages with the farmer. For this purpose, the FSRI will need a substantial capacity in farm management economics.

These five components of a DOA-USAID strategy seem to us to constitute the points most critical to the success of DOA's program that are not now being addressed adequately. Manpower development is not included because of other donor activity in M.S. and Ph.D. training. However, in-service training is involved in all activities listed. Manpower development is always central to research development.

Each of these components is discussed below:

1. Information and Library Services

Currently, these two activities are assigned to a single unit in DOA. They could be separated, and at a later date it may be well to do so. Currently, even the combined operation does not have division status. DOA and the World Bank plans called for a separate division, but the Administrative Reform Committee (ARC) has placed them as a sub-unit in the Planning Division.

In any event, scientists engaged at research centers and conducting on farm trials must have ready access to information available at national and international centers. An information clearing house system should be developed so that requested information can be quickly dispatched and an effective two-way communication implemented throughout the research network.

One or more short-term consultants may be needed to help develop such an information clearing house system.

a. Information Services

The DOA information service is just getting under way. Our impression is that its future plans are very close to what extension information activities should be. Our judgment is that there should be a workable division of labor and cooperation between the research information service and the extension information service. DOA does not need an information service direct to farmers. That is the role of extension. Research information has other functions to serve.

Five types of research information services need to be considered by the DOA.

(1) The DOA should have a relatively small news release service to report to the press and radio items that are of genuine interest. This would include new findings, the release of new varieties, the development of the centers, awards/and travel of staff, and other items of general news value.

(2) An annual report is almost a necessity. This should present the budget, progress being made, and accomplishment, of all research projects. Most items would be brief. The report should be fairly widely distributed both within Thailand and abroad. It would be written for an audience with a moderate degree of technical sophistication.

(3) A third type of publication needed is the research bulletin, published as a series. The series would have no set schedule of publication. All units of the DOA would participate, and the topics would vary depending on the amount of information available and its usefulness. These publications could be for other researchers and extension specialists.

(4) A fourth type of publication the DOA could provide would be a reference type of publication. An example would be a booklet that helps identify insects, diseases, or weeds. It would be used in vocational schools, universities, in extension, in the DOA itself, and by the private sector.

(5) Recommendations also need to be published on a variety of topics. In some cases these could be published by the DOA. In other cases it may be more practical for them to be published by DOAE. Even in the latter case, research personnel need to participate. A good example of this type of publication is the "Crop Manual" already published for four crops. Many more are needed.

Some expatriate technical assistance may be needed to help organize and initiate the overall information program. Most technical experts needed, such as writers and editors, are probably available in Thailand. If not, the project could provide training.

USAID could help in equipping the information unit. The expatriate technical assistance person should participate in selecting and ordering the equipment.

b. Library Support

Experience of other scientists within and outside the Kingdom is an essential input to a good research program. Thus the DOA must assure that adequate scientific-technological information is readily available to its researchers throughout the system.

An adequate library system would be composed of a central library with a reference service to take care of the special needs of the scientists at the 19 agricultural research centers and their satellite field stations. In addition, each of the 19 centers should have a set of reference books covering such basic areas as crop production, soil science, entomology, plant pathology, climatology, agricultural engineering, and statistics. Furthermore, each of these centers should have the literature emanating from the international agricultural research centers, such as IRRI, ICRISAT, CIAT and CYMMYT.

For the six institutes of the DOA with headquarters in Bangkhen, arrangements should be made for them to have access to the library of Kasetsart University.

The libraries of Kasetsart, Khon Kaen and Chiang Mai universities could provide a reference service for the scientists at the agricultural research centers. For example, arrangements might be made for

these libraries to send photo copies of the title pages from the more important professional journals to the scientists and they could select articles that they wished to have copied for their use. This would be far less expensive than having each center subscribe to each journal in their fields of specialty. A good library program can also give Thailand relatively good access to libraries in other countries. As stated later in this report, a library science expert should be brought in to assist in developing a satisfactory library service for DOA research scientists.

2. Soil and Water Management Research

Intensification of the development activities envisaged for Northeast Thailand will require a strong program of research in soil and water management. The site-specific nature of soil and water problems means that a coordinated regional program which places emphasis on local diagnosis will be required to make use of scientific manpower, facilities and operating funds.

Rationale - Cropping systems and sequences together with planting dates, intercrop or relay crop schedules are directly dependent upon predictable rainfall, residual soil profile moisture and/or ground water. Available monsoon rains are notoriously unreliable in a given areas or even over an entire region. A farmer may have to contend with floods during the monsoon season and still have to rely on residual soil moisture during part of the year, combat droughts and practice irrigation, all in the same year. Risks and uncertainties abound as the farmer faces choices among a multiplicity of crops, many of which are in mixtures.

Rainfall and evaporation analyses for Thailand have been carried out by the Asian Institute of Technology (October 1980). In addition to rainfall probability tables at designated intervals and for selected regions, maps show isohyets and rainfall patterns (intensity, duration and frequency) in sufficient detail for farm planning purposes.

Soil and water researchers, to serve the farmer adequately, must find ways to rationalize the multiplicity of land and water conditions in Northeast Thailand. Regional soil survey reports, soil interpretative groupings and maps, can be used to help select target areas, to plan regional experiment station and on-farm trials that will address major agricultural problems and/or develop irrigated schemes* in selected command areas. In particular, soil fertility and soil testing research may be tied to established soil units and cropping patterns.

a. Pragmatic Soil Research

Based on much data already available on major physical, chemical and biological properties of benchmark soil series, the focus now must be on their successful management. The initial effort must concentrate on identifying what is now known, and with assistance from extension, accelerate improved technology transfer to farmers. Gaps in soil management technology which constrain farm productiuon must be identified and researchable projects rated in accordance with their importance. It would appear that tillage, mulching, the use of green manure crops, soil fertility (including micro-nutrients) fertilizer use and water management on different soils should receive priority. All of these need to be tied to experiment stations and linked to the farming systems program. Emphasis should be placed on use of multidisciplinary teams including soil scientists, agronomists and economists in order to ensure the best use of soils information at the farm level. Soil testing and crop correlation studies have a vital role to play in assisting to develop a sound fertilizer program not merely for mono crops but also for cropping systems.

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*In this report, irrigation refers only to the storage and use of rainfall on farms or to use of well water.

b. Water Management Research

The development of knowledge and data on how best to conserve and utilize water falling on land as rain and the most efficient means of supplementing soil moisture by limited irrigation would provide the central thrust in water management research. However, other objectives depending on specific conditions follow, namely:

(1) Where soil water quality (salinity and exchangeable sodium) are problems, studies should include soil amendments, soil and water management procedures and the use of salt tolerant crops.

(2) The development of surface/sub surface water removal systems, or alternatively, the economic design and construction of water conveyance and delivery systems.

(3) The development of land preparation practices to improve water infiltration, reduce erosion and optimize water use efficiency.

(4) The integration of these water use factors into productive cropping systems consistent with farm size and available resources.

(5) The identification of institutional factors (legal, social, economic, religious, credit etc.) that influence water distribution and/or disposal at the farm level.

The team is aware of the fact that plans have been formulated for an expanded program in soil and water conservation through the Department of Land Development and USAID. Therefore, soil management work being herein proposed should be complementary to the DLD project.

c. Dry Land Farming

Great uncertainty exists in Northeast Thailand each year as to the dates of the onset and termination of the monsoon. Unreliable rainfall accentuates farmer risks, including flooding and soil moisture status at critical periods such as sowing, transplanting, tillering and pod setting or grain filling. Dry land farming research is not just water research. It is a combination of soil-water relationships, tillage practices, crop selection, time of sowing, plant population and other factors. It can only be approached realistically in a coordinated cropping systems or farming systems research manner. It must be multidisciplinary and should be carried out in the region for which the research is designed. Hence dry land farming research programs should be located near research centres in the region supported by on-farm studies with farmers and extension workers as partners in the field testing. Before research studies begin, surveys of farmer resources, practices, problems and innovations in dry land farming should be well documented.

d. Irrigation Research

While the project is concerned with intensified agriculture under rainfed conditions, an assessment of rainfed irrigation in selected areas of Northeast Thailand is encouraged. Indeed, the Asian Institute of Tehnology (AIT) has published such a rainfed/irrigation assessment prepared by the Committee for Coordination and Acceleration of Water Resoruces Development (Prime Minister Secretariat). The AIT report not only predicts potential planting dates based on the number of stress days and drainage needs but assesses the potential for rainfed irrigation by predicting the number and frequency of stress days and periods of heavy rainfall.

The present 2 percent area of Northeast Thailand under irrigation has potential for expanding. Rainfed irrigation research should be preceded by studies and use of agroecological and rainfall-evaporation published reports. Identification of predictable available moisture (an integrated index of 75 percent rainfall probability with seasonal residual soil moisture flux) and super imposed cropping systems with calculated consumptive use needs to be done. Figure 1 below illustrates how dependable rainfall has been used in the Philippines to plan cropping seasons. Thailand has data which can be used for the same purpose.

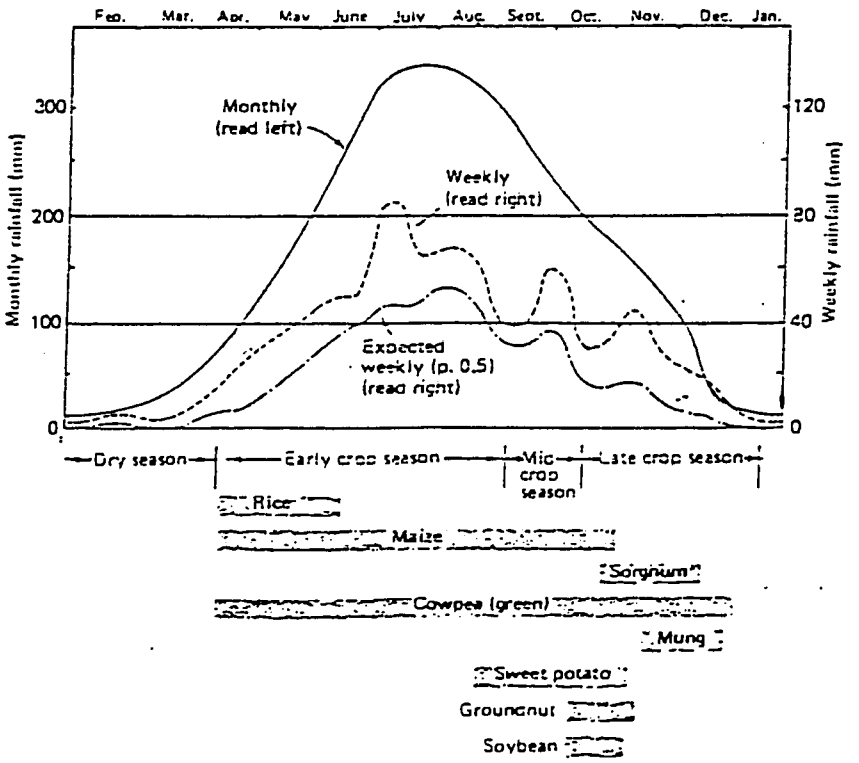

Figure 1. Water availability and field crop patterns for upland rice farms of eastern Batangas, Philippines

The selection of multidisciplinary teams--irrigation engineers, agronomist, soil scientists, sociologists and agricultural economists--to work at the farm and village level to identify major problems and potentials in management of soil water including supplementary rainfed irrigation should provide the basis for guiding research. Soil and water management research then would more likely address gaps in present knowledge/technology and focus on priority problems.

e. Soil and Water Research Program Projects and Needs

The generation and farmer adoption of improved cropping (farming) system technology for Northeast Thailand, will be developed on sound soil and water management.

Multidisciplinary and interinstitutional research is required while rapid adoption will depend on both farmers and extension personnel working as partners in soil and water research and development.

A summarized work plan is presented in Table 1 to illustrate the interaction of soil and water research programs, project content, responsibility, location and resource needs.

Table III-1

Soil and Water Research Program, Projects, and Resource Needs

Program	Projects	What	Where	When	Who	Needed Resources
Soil Management and fertility	A	Improved planting methods and weeding practices for major crops and cropping patterns	Selected research stations/centers, University and On-Farm Trials	1983-88		Field machinery, tools and laboratory facilities
	B	Soil nutrient and crop yield correlation studies including micro-nutrients	Selected research stations/centers, University and On-Farm Trials	1983-88		Laboratory/field equipment chemicals and supplies
	C	Use of plant/animal residues and crop productivity	Selected research stations /centers, University and On-Farm Trials	1984-88		Land preparation and residue handling equipment
	D	Development of appropriate tillage planting and weeding tools	Selected research stations/centers, University and On-Farm Trials	1984-88		Good workshop and testing facilities and trained manpower
	E	Water and Soil Management practice interactions	Selected research stations/centers University and On-farm Trials	1984-88		Trained multi-disciplinary manpower with data processing competency

Program	Projects	What	Where	When	Who	Needed Resources
Water Management	A	Agro-climatological Studies and moisture budgeting for Crops Systems	University and Meterology and DOA	1982-88		Meterological records, analytical data processing scil survey reports/data
	B	Improved tillage and mulching to maximize water use	Selected research stations/centers university and on-farm trial	1983-88		Field machinery and tools, drought power
	C	Irrigation system management and institute agency linkage	Selected research stations/centers university and on-farm trial	1984-88		Institute/Agency legal/policy ordinances water law/policy documents
	D	Development of on-farm water equipment and water management practices	Selected research sations/centers university and on-farm trial	1984-88		Flumes, water measurement, pumps distribution systems etc.

3. Center Director Training

Currently research on rice, field crops, and horticulture is managed from Bangkok, in three decision-making programming centers. After reorganization, there will be 19 decision-making programming centers. One of the economies of a centralized system is that scarce management talent can be extended throughout the system. Decentralization makes a heavy demand on the supply of management capability. DOA is faced with increasing its supply of management talent quickly. Many organizations would have trouble providing this greatly increased supply of management talent so quickly. DOA likely will have also.

While it is not clear to what extent managers can be trained, there are some skills that can be developed. Center managers will need two types of management capability. One is conventional management, comprised of those skills common to all managers. The other category of management is that specific to applied research establishments.

It is our assumption that the research center managers will be included in the administrative training component of the RAI project. Certainly few if any other MOAC managers are faced with more important management responsibilities. However, there will be some needs that may not be covered in that component.

Under this heading, several elements could be included.

a. Expatriate, in-residence technical assistance could be useful, not only to center directors but also to institute and division directors and other senior executives of DOA. The Australian aid program is providing some assistance, but more may be needed, especially after the Australian program ends. Short-term consultants in various administrative management fields can also be made available. Although the emphasis is on center directors, the broader management problems of DOA can be addressed also.

b. Extended observation visits either to an international agricultural research center or to an established, well run national research organization would also be helpful. The latter could include a U.S. land grant university or a good research program in another country.

c. The project could also provide consultants who could help present a series of week long seminars in Thailand for DOA's research managers.

d. Finally, the DOA could use consultant or even in-residence assistance in developing the 19 stations which are to be upgraded.

The new DOA decentralized system will require management capability diffused throughout the system. Instead of thinking of giving only 19 directors training in research management, it would probably be useful to train two per center, plus Bangkok executives, perhaps a total of 50.

4. Contract Research

DOA currently does not have an adequate number of well trained persons to discharge its responsibilities. In the next several years, many of its personnel will be involved in training and not available for research. In the meantime there is a capacity for research in other Thailand organizations. DOA can gain valuable time if it can contract and deploy some of this domestic talent in furthering its own program.

USAID, either alone or in collaboration with RTG entities, could provide funds for this purpose.

5. The Farming Systems Research Institute (FSRI)

The concept "Farming System Research" needs some explanation. As a term it lacks precision and is used around the world with a variety of meanings. The word "system" itself defies definition, since everything is eventually related to everything else. Every user of the term, especially in program management, must define it or describe it to fit his own needs. This section defines "Farming Systems Research" to serve what we consider to be the most urgent need of DOA. (See also Appendix C).

Ideally, Farming Systems Research would study the total farm, its environment, and the people dependent on it. Then it would develop a combination of farm enterprises--crops, livestock, fisheries--that would use all resources most efficiently and effectively in meeting the wants of the people dependent on it. This ideal, obviously, cannot be achieved, since DOA does not have the resources to treat each farm as a farming system, which it is.

DOA can orient its program to be consistent with this concept of the ideal. That would require two lines of activity. (1) A study of farming systems (or types of farming) predominant or important in an area. This study would be done at a level of generalization and at a degree of thoroughness consistent with the time, finances, and personnel available. (2) The second line of activity would be to generate technology that is relevant and appropriate to the general systems described in the first line of activity. Research does not have to address the entire farming system. It does have to address a factor or factors that are relevant to that system. Tehnology generated in the research must be tested or verified in that system, i.e. on the farm. As the capabilities and resources of DOA increase it can take on an increasing number of the enterprises that are found in the farming systems, and it can improve their specificty.

An important role of the Farming Systems Institute is to maintain linkages with the farmer. This involves a continual improvement in its

understanding of the farmer, the testing of improved technologies in each common farming system, and indications to the DOA of research the farmer needs.

FSRI is envisioned to play a key role in the implementation of the strategy described in the previous section. There are three reasons for this. First, the institute is mandated to do research on the combination of farm enterprises that can increase farm productivity. Second, its staff has had experience in conducting on farm trials, an activity that needs to be expanded. Third, the institute is newly organized and is free from rigid organizational traditions. This section describes the research focus and organizational structure of FSRI.

a. Research Focus

The role of FSRI can be examined in two ways. First, the term "farming system" can be formally defined and used as a basis for specifying the research activities that FSRI should perform. Second, on the premise that agricultural research must eventually increase farm productivity, the focus of farming systems research can be on those factors that are most critical in increasing farm income. In this report we have opted for the second alternative. We do this since the usual definition of farming system is so broad that it can be and has often been used to justify any and all types of agricultural research.

We agree with the current perception of the FSRI which has been stated as follows:

> "Within the past decade or so, Thailand has developed much useful research information for farmers, but this is scattered among various research agencies and organizations. The immediate task of the institute will, therefore, be to package these materials and try them on farmers' fields."

In this context we identify three critical research activities that the FSRI must quickly address. These are:

(1) The development of technology packages that are expected to be superior to existing farmers practice.

(2) The testing of technology packages in farmer's fields in order either to verify their superiority over the existing practice or to determine what work still needs to be done on them.

(3) The testing on research stations of new and innovative technology packages. These packages are first evaluated in research stations and only the promising ones are placed in on-farm verification trials.

In addition to the above three research activities, it is envisioned that FSRI shall take primary responsibility for regularly convening (probably every six months at the start and yearly thereafter) a farming systems workshop of professional FSRI staff at all DOA centers and researchers from others institutions working on the three above mentioned activities. In this workshop the results of the previous year's activity should be reported and the program of activities for the next year decided upon. Such a workshop would be expected to:

(1) improve the planning and implementation of research,

(2) facilitate the interchange of research information and

(3) develop an informal coordination of research activities both within and outside the FSRI.

b. Organizational Structure

On the premise that the farming system research described in A, requires that experiments be conducted on many research stations and in farmers' fields all over the Kingdon, the organizational structure of FSRI must insure that its professional staff is located, not in Bangkok, but in the most important agricultural regions. To implement this rationale, we suggest the following guidelines:

(1) The FSRI could establish its own network of research centers (in much the same way as the other research institutes). This alternative, however, would be very expensive, and more importantly could isolate FSRI from the commodity centers, which are the primary source of component technologies for the technology packages. Thus, it is more practical and efficient to assign the FSRI staff to commodity centers. In this way the FSRI staff will have a chance to collaborate with the commodity-oriented researchers in addressing farm problems.

(2) To be effective in influencing the direction of the research and the utilizaion of the research of the commodity centers, the FSRI staff must be accepted as full nembers of the center staff. They must not be looked upon as frequent or infrequent visitors from Bangkok. Consequently, they must reside in the center and report to and take direction from the center director. In return, the director must give them full status as members of his team. They should participate in research evaluation and research planning of the center program. With this arrangement the FSRI directorate in Bangkok would minimize its administrative supervision over its center-assigned staff. Instead, its leadership should derive from its technical support and from its management of the semi-annual or annual workshops.

(3) Packaging the technology and verifying it on farms is the critical process. The packages of technology must reflect the farming system or systems common in the area. This requires gathering information from farmers. Technology for the packages can come from any source--DOA, DOAE in some cases, other agencies, and good farmers themselves. This packaging should involve extension since it is continually in contact with farmers. However, DOA needs its own knowledge of farmers and interaction with them. It can take leadership but in cooperation with others. Extension should play a major role in the trials designed to verify the packages, but not an exclusive one. Many packages will not be verified and will need more research. For this reason DOA must be involved.

(4) Implementing the technology packaging and verification process will require the development of procedures with some degree of standardization as well as the development of some essential skills. The semi-annual workshops will be useful in the development of procedures. There has been much experience in Thailand and elsewhere that can be fed into the workshops.

One skill that will need special attention is farm management. Understanding the farm business and how it is managed is critical both in designing the technology packages and in evaluating the results of the verification trials. Some of these skills could be learned in intensive short courses in Thailand.

(5) There should be at least three FSRI staff assigned to each center with training in agronomy and farm management economics. If agricultural economics staff are not available, all agronomists should be put through a short training course in farm management.

If the existing personnel in FSRI is inadequate to staff all the 19 research centers, the priority centers should be fully staffed first before the others are considered.

It needs to be emphasized that the FSRI teams at the centers will be a major DOA resource in developing linkage with extension. They should be charged specifically with the responsibility to work with extension. Collaboration between the teams and area extension specialists will help not only to perfect farm technology, it will also make it much easier for extension to take over and promote DOA's technology. Unless linkage develops at this interface, both the DOA and the DOAE programs will suffer.

B. Beneficiaries

The beneficiaries of this project are literally all Thai people who have a stake in the success of Thailand agriculture. That includes consumers even low-income consumers who have an interest in a low-priced, dependable supply of food. While this project will aim its original efforts to the Northeast, it literally is a national program. The library-information component automatically serves nationwide. The scheme of organizing and deploying the Farming System Research Institute adds no cost to DOA operations (except to the inadequate support costs). Thus, it can go into effect immediately. The network concept will help the entire country benefit from the TA in this project. These two components aim specifically at strengthening the research program nationwide, as does the center manager component.

The soil management component will aim specifically to serve the Northeast. Thus it will tend to benefit farmers in that area more than in other areas. The benefits could spread, however, through two channels. One is that some of the soil types found in the Northeast are in other areas of the Kingdom also. We found the Korat soil series, for example, in the Chiang Mai area. The second channel could be through the Soil Science Division and its work Kingdom-wide, feeding off the Northeast experience.

While the net benefits of technology innovation in agriculture are positive, the impact of technology is not uniform. Some producers will benefit more than others. Thus some stress on the producing sector almost always results from significant technology innovation. Given the current state of the art, we know no way to avoid this problem.

The only costs this project would add to DOA's operations are those considered essential for an adequate research organization, such as library and information service, so spread should be facilitated.

IV. IMPLICATIONS FOR POLICY

It is the team's judgment, that although the task Thailand has accepted in rejuvenating the DOA in collaboration with the IBRD offers great potential, it is considerably more formidable than may be recognized. Chances for success will be greatly improved if the risks and opportunities are thoroughly analyzed by joint action involving various entities of the RTG and several donor agencies and some long-range plans are developed.

A. Implications for RTG

The RTG must make a full and unqualified commitment to the development of a national agricultural research program if it wants to improve chances for success. A limited or qualified commitment increases the risk that relatively little will be accomplished. The actions listed below are some we have identified that would be consistent with that commitment and which we think are virtually essential.

1. Support Funds

Thailand is not investing as many resources in agricultural research as the importance of the agricultural sector justifies. (See section on Financial Feasibility.) This underinvestment is dramatically illustrated in the Northeast which is considered a depressed area. As such, there are heavy RTG investments in extension and rural development activities in the Northeast, but relatively little investment in research to develop a soil management technology. Most development efforts dealing with agriculture will have limited success until a soil management fertility technology is developed. The chances for success in developing such a technology appear to be good.

2. Relationships Within DOA

While the new structure of DOA may facilitate conducting research that is more relevant to the farmer, organization alone will not be sufficient. If the centers are to be effective, their directors must have control over both personnel and financial resources.

The Farming Systems Research Institute should assign its personnel to each of the 19 centers under the administration of the director of the center. In exchange, the center should give them full rights as members of the center, including full participation in such activities as research result evaluation and research program development.

Such a method of operation within centers will not be sufficient. Inter-center collaboration will also be needed. For this purpose a national network, involving personnel assigned to centers, will be necessary in farming systems, soil management, and perhaps other types of research. Organizing and maintaining these networks will be functions of the parent institute or division. Another important function will be collaboration with the information and library sections in providing support to their personnel assigned throughout the country.

The RTG needs to give DOA the administrative discretion and flexibility to work out the most productive relationships.

3. Agricultural Economics in DOA

Earlier in this Report we stressed the need for the services of agricultural economists in the DOA and pointed out that to place them there would require a policy decision of the MOAC. These economists are needed in connection with most agricultural research projects. They are needed especially for the Farming Systems Research Institute to help both in

getting solid information from farmers about their cropping systems and to help evaluate the new cropping systems being evaluated.

It has been proposed that this need might be met without having economists in the DOA but with personnel from the Office of Agricultural Economics being seconded to work with the staffs of the Farming Systems Research Institutes. That would work if (a) farm management economists were so assigned; (b) they were put under DOA leadership; and (c) they were kept in their DOA assignment long enough to develop and maintain program continuity.

4. University Involvement

Although USAID support can be important in helping Thailand make better use of university resources in agricultural research, Thailand needs to provide permanent support to the universities and to bring the universities fully into its agricultural research program. Since Thailand currently invests too little money in agricultural research, based on the importance of agriculture, allocating research funds to the universities would be a wise investment. Thailand cannot afford to maintain these resources in universities and not make more use of them in agricultural research.

This could be done in several ways. One would be to provide DOA a fund that could be used only for contracting research with universities. It could provide funds directly to universities. Another channel would be through the National Research Council. There may well be other channels or combinations of channels. Ideally, the DOA should be involved in the general planning for university involvement in agricultural research. This would increase chances that agricultural research activities were coordinated. It would also help to make university involvement in research serve DOA's own interest in achieving a modern research system for Thailand.

B. Implications for USAID and Other Donors

Donors have an opportunity to make a highly valuable contribution to Thailand's development. Thailand badly needs to rejuvenate the DOA and develop a national research system. Donor contributions will be much more effective if they are made in a coordinated fashion that supports RTG efforts. They need to be made in such a manner that they encourage the RTG to make an adequate commitment and encourage the RTG to honor that commitment.

USAID participation in helping coordinate donors efforts in collaboration with the RTG offers an excellent chance for a significant payoff.

V. PROJECT ACTIVITIES

A. Description of Activities to be Undertaken

Project activities will consist largely of expatriate technical assistance and the commodities and operating costs that will enable them to function.

There are four operating components:

1. Research Center Management

2. Information and Library Service Development

3. Soil and Water Management Technology Development

4. Farming Systems Research Institute Support

The fifth component, Contract Research, is not considered an operating program and will require no separate technical assistance.

1. Research Center Management

The major objective of this component is to help the center directors upgrade themselves to be able to handle the task of research strategizing, programming and implementation. This will have to be done with as little interruption to center operations as can be accomplished.

Two types of activities are suggested. Short-term study tours, up to three months, at a U.S. experiment station, at an international agricultural research center, or at a well-run national center in another country.

As many as 50 persons could be included over the five-year period. That would include two from each center, plus up to 12 from the institutes.

The second type of activity would be annual research management seminars, for at least one week, for the same personnel.

A research management expert as team leader would also provide consultation to center and institute directors as well as help manage the study tours and seminars. Training these managers would be a major responsibility.

An administrative assistant to the team leader would be responsible for logistic support to the expatriate team and for counsel to center directors and others on their logistic problems. Two others would help with station development and training.

Other donors are supplying technical assistance related to these items but we think this additional assistance is needed.

It is our judgment that this group should be stationed at Bangkok and work through the Deputy Directors General and the institute and division directors. They should work as closely as possible within the DOA. We can see no need for any specific implementation arrangements.

2. Library and Information Service

This component is largely developmental. Both services are clearly inadequate. We are proposing technical assistance to help DOA equip its central library and its center libraries and to develop a reference service to supplement the library stocks. There will be a sizeable procurement item.

This component should be integrated into the DOA organization. It will require no special administrative arrangements for implementation. It will require budgetary arrangements. If the DOA cannot provide budget to support library services, there will be reduced pay off to the investment in library stocks.

This operation also should be integrated into the DOA with adequate budgetary support but with no specific organizational arrangements for implementation.

Technical assistance, if needed, can be provided by short term consultants.

3. Soil and Water Management Research

This project activity will be straightforward conventional research, and it will be sited in the Northeast. If feasible it should be at one of the research stations to be upgraded to a center. However, this effort will need to draw on rainfall probability data and similar information generated in the Department of Meteorology, Ministry of Communication, and some of the analyses done by the Asian Institute of Technology. The Department of Land Development of the MOAC has also generated data on soil characteristics and the chemical makeup of the soils. Although a center will serve as a base of operations this research needs to reflect the various soil series and rainfall regimes of the Northeast. This will require field experimentation to be located at various sites and participation by all soil scientists of DOA stationed in the Northeast.

It should be emphasized that the purpose of this activity is to produce some very specific techniques to manage soil and water. Simply generating more information is not adequate, although more information will be needed on minor elements and various toxicities which often appear in these soils.

a. Soil Management

Most soil management studies will be carried out in the field either at research centers, experimental stations, or at farmer field sites. However, valuable assistance in research support will require laboratory analyses on soil, water and plant materials. Field and laboratory activities will include:

(1) Identification of plant nutrient deficiencies or toxicities of benchmark soils.

(2) Developing soil nutrient-fertilizer crop response correlation studies based on soil/plant tests for major crops or key soil series.

(3) Improved planting methods and weed control practices for major crops and cropping patterns.

(4) Developing appropriate methods and equipment for improved tillage and/or handling of plant/animal residues.

(5) Investigation of soil.management interactions, especially soil moisture/fertility interactions to establish economically sound practices for farmer use.

(6) Developing soil management practices and cropping patterns that are economically viable for saline areas.

b. Water Management

(1) Establish seasonally plant-available water levels from agro-climatological studies and soil moisture profile flux for benchmark soils in defined climatic zones.

(2) Develop improved tillage, mulching, and planting techniques to maximize use of residual moisture.

(3) Conduct irrigation system management studies to characterize and describe successfully managed command areas and identify institute/agency linkages.

(4) Develop on-farm water equipment and improved water/irrigation management and scheduling.

(5) Characterize water quality, source and capacity in defined areas of Northeast Thailand for potential development.

As with soils, water management research will be conducted as on-farm studies but will require considerable back up support from the research centers and experiment stations as well as from the regional laboratories.

c. Research on Erosion Control

That most of the increased rice and coarse grain production in Thailand during the last two decades can be attributed to expanded acreage rather than increased yields, is well documented. Moreover, much of this expansion has taken place in Northeast Thailand by coverting forested land to cultivated farm land. Unfortunately, this conversion by bull dozer, and by slash and burn methods with subsequent plowing, has set the stage for accelerated erosion as has been vividly reported by Wood et al to USAID 1982, Section III-3, based on Department of Land Development, December 1980, Report on Erosion in Thailand.

Few would dispute Wood's statement (page III-5 from the same reference) that "present resources dedicated to soil erosion control are totally inadequate." Indeed, one can predict that days are limited during which Thailand can rely merely on expanded acreage for increased grain production. It will be necessary to depend on increasing rice and coarse grain yields per unit area. However, to achieve a yield take off on eroded land will not be easy while resource investment will be costly. Decisive and swift government action is called for to develop an erosion and runoff control program for the Northeast region.

The problem is primarily a soil and water management one, where sound soil management is at the same time conservation farming for sustained economic productivity.

The analyses provided in the Wood et al report, pages III 6-7 and continued in section V on Social implications is certainly pertinent to the erosion problem. Moreover, it suggests the need for improved technology which is socio-economically acceptable.

The well established Soil Conservation Service strategy for the USA, developed in section IV of the Wood Report as an effective program for Northeast Thailand, may deserve further scrutiny. But to be acceptable in Thailand erosion control measures must be site specific and that will require considerable on-farm testing and with much farmer participation.

4. Farming Systems Research Institute

This activity will provide expatriate technical assistance to help the FSRI of DOA to implement the plan described earlier under "strategy".

The team of crop and livestock expatriates will be located at a center in the Northeast, preferably at the same center at which the soil and water activity is sited. It will work most intensively at the host center but will plan regular consultations with other FSRI teams assigned to centers in the Northeast. The team will also participate in the national network.

The major job is to devise ways to make farming systems ideas operational. That must be a joint effort, with USAID providing expatriate talent.

The process will involve the following functions, all involving DOAE personnel to the extent feasible.

a. Development of a format for a rapid survey of farmers. This will be needed in unfamiliar areas. As the team continues to work in an area other types of activities will replace the rapid survey and provide better information.

b. Identification of farmer problems, needs, and production opportunities that can be matched with technology available through DOA.

c. Identification of improved technologies that farmers are using that appear to be useful.

d. The designing of what would seem to be the technology best suited to farming systems of the area.

e. The design and implementation of verification trials to find the "best technology". This could involve good farmer technology. This testing should be carried out in cooperation with farmers.

f. Analysis of the results of the verification trials.

g. Participation in the anaysis of all research of the center using insights generated in the farming systems work.

h. Participation in the planning of the total research program of the center to help insure that farmer needs and farming systems problems are appropriately reflected.

i. In all of the on-farm work, in the design of technology packages, and in verification trials, extension needs to be fully involved. It is the team's responsibility to develop procedures that achieve this involvement.

5. Contract Research

The purpose of the national contract research component is to provide DOA with a research capability beyond its own resources, especially until its capability has been considerably improved. The universities would be a major source of this talent, but other Thai organizations also have resources.

The USAID could provide funds for these contracts, but no special personnel are needed. Technical assistance personnel from other activities could participate.

Some modification of the following procedure could be followed.

a. DOA should determine the areas in which it most needs research, such as minor element deficiencies, soil toxicities, azolla production problems, rainfall probability patterns, farm management, or direct seeding of rice.

b. Projects submitted on prescribed formats should be selected on the basis of agreed criteria by technical committees established by DOA.

c. Selected projects would be implemented by scientists from a given department, section, university or agency with funds provided in accordance with a memo of understanding and per government procedures.

d. At quarterly intervals the research projects would be monitored both technically and financially on prescribed formats and accepted procedures with recommended action given each project leader by an appropriate DOA official.

e. Annual progress reports would be evaluated by a DOA appointed team to provide recommendations for modification, continuance or termination each project.

B. Implementation

1. Administrative Arrangements for Implementing Agencies

In general, the activities are designed to fit into the proposed new organization of DOA with as little disruption as possible. We anticipate no special arrangements. Technical assistance personnel will need office space and English-competent secretaries.

2. Technical Assistance Needed

The major contribution that USAID can make will be technical assistance. Needs are summarized in tabular form, and following this tabulation are terms of reference for each.

Description	Person Months
Center director development and support	
Research management advisor and team leader (E)	60
Administration specialist	36
Experiment station development specialist	36
Training specialist	24
Short-term consultants	24
Library and Information Service	
Library consultant (short-term) (E)	18
Research information consultant (short-term)	18
Soil and Water Management Research	
Dryland soil management and conservation specialist (E)	60
Soil fertility (chemistry) specialist (E)	36
On-farm water management specialist	36
Short term consultants	24
Farming Systems Research	
Agronomist (E)	48
Farm management economist (E)	36
Short term consultants	24
	480

Some of these specialists are more important than others. Six of the specialties are marked with an (E). These are considered essential for the success of the component.

Technical assistance can be greatly reduced by eliminating those positions not conidered essential. Some further economies could be made by procuring library expertise through a series of short-term consultancies, preferably by the same person or same two persons.

If still further economies are needed, two persons could fill the three positions dealing with soil and agronomy in the soil and water management and farming systems research programs.

Short-term consultants can compensate to a certain extent for the technical assistance consultants.

Other savings could be made by using Thailand consultant firms. The UNDP Program in Development Training and Communications Planning reports excellent results using a combination of expatriate and Thai talent. This would be exceptionally useful in the training of the center directors and even the institute directors.

Terms of Reference for Expatriate Specialists

a. Research management advisor and team leader will have responsibility for overall supervision of other consultant personnel. He will report to the Director General of DOA. He will be specifically responsible for the project activities in training of center directors and for follow up and assistance to them. He will work closely with the institute directors and will provide them management assistance as needed, either by himself or through resources at his disposal. He will also help strengthen relationships with international agricultural research centers

and donor agencies, advise on budget management control, work to strengthen linkage between research and extension programs and improve the communication and training competence of the research system network.

b. The administration specialist will have the major responsibility for providing logistic support to the expatriate consultants, including help with housing and overseas procurement. A second major responsibility will be to consult with and assist DOA managers in problems of management, especially those dealing with logistics, procurement, and contacts with donor agencies.

c. The experiment station development specialist will assist in improving the agricultural research centers including land leveling, field layout, irrigation, and drainage. He will assist in setting up farm machinery repair and maintenance facilities, including training and procurement. He will do training as needed to make his work more effective.

d. The training specialist will assist the in-country and foreign training programs. Planning short course/internship training schedules, workshops and seminars and assisting extension develop technically competent subject matter specialists. The specialist will need a broad knowledge of curriculum and methods of instruction at both university and international centers in order to tailor training to improve soil and water management research as well as farming system research performance. He will be particularly concerned with training of the center directors, using the limited time they can spare as efficiently and effectively as feasible.

The work of this specialist will need to be coordinated with the training activities of other donors who are programming substantial degree training for Thai scientists.

e. The library specialist will be expected to play the major role in designing a library system for the DOA. This will include not only procurement of books but the development of a reference service that will serve the entire DOA system. This also will involve procurement of the equipment needed for an efficient reference service. The advisor must design a service that provides a flow of information to scientists throughout the system.

f. The research information specialist will be responsible for helping design the service that publishes and reports the research results of the DOA. DOA serves several audiences, each with its own needs. These audiences and their needs need to be reflected.

g. The dryland soil management and conservation specialist should be experienced in moisture deficiency, salinity, and erosion problems, which are major constraints to production. He will develop research that integrates crop needs with available moisture both from rainfall and from seasonal soil moisture flux. Salinity management problems and runoff and erosion problems should be diagnosed and analyzed as a basis for a multi-disciplinary effort to solve dryland farming problems. Attention must be given to moisture interactions and fallow-mulch-tillage techniques that would improve use of soil profile moisture storage. Contours, ditching, and terrace studies to control runoff also need attention. He will be responsible to work with extension and others to diffuse the technology developed.

h. The on-farm water management specialist will assist in the design and field testing of various water lifting devices, efficient water conveyance systems and the assessment of various water measurement and control structures for small scale irrigation distribution. He will work closely with the farming system specialists and soil scientists in conducting on-farm irrigation studies and with extension in conveying new technologies to farmers.

i. The soil fertility-chemistry specialist will assist in planning, organizing, and implementing on-farm research in soil fertility including major and micro-nutrient studies on benchmark soils for major crops or systems. Characterization of salinity, it's management in the field as well as fertilizer trials and soil-plant testing will involve this soil scientist. He will also advise in the equipping and operating of analytical laboratories and assist in training field and laboratory technicians as needed, including repairs and procurements. He will help to package improved soil fertility/management practices and their transfer to extension and/or farmers.

j. Short term consultants will address problems in the chemistry, physics, and biology of soil as they are identified. It cannot be predicted what they will be.

k. The farming systems agronomist will work intensively at one center in the Northeast but he will spend considerable time with the FSRI teams at the other centers in the region. It will be his responsibility to help the FSRI team activate the plan discussed earlier. That will involve an interaction with the farmer, the design of technology packages, and the testing of those packages. He will need a solid experience in working with farmers, an appreciation of their knowledge and wisdom, and a willingness to work with them.

Although his work will be concentrated in the Northeast he will also participate in the national farming systems network.

l. The farm management economist will have much the same overall responsibility as the agronomist, except that he will deal with economics, i.e. prices, costs, labor, competition for resources and farm income. Since the DOA capacity in economics is much less than in agronomy, he may also find it necessary to provide training. Like the agronomist he will be based

at one center where he will do more field work than anywhere else. He will visit other centers in the Northeast regularly and will participate as needed in the national farming systems network.

3. Training Needed

The training needs of DOA are great and this project has provision for a modest amount of M.S. and Ph.D. training. This modest provision is due to the fact that the Australians are funding 30 Ph.D. candidates and 140 M.S. degree students. DAO is doubtful that they can find candidates for more extensive training.

It is recommended that the project provid^ for six Ph.D. and fifteen M.S. fellowships during the project life. Opportunity for pur .ng advanced degrees within the project would have a threefold purpose namely: (1) to upgrade manpower competence in subjects vital to the project focus; (2) to provide additional motivation among participating scientists; and (3) to encourage strengthening linkages between the university and MOAC. Preference would be given to thesis research for advanced degrees being done in Northeast Thailand on problems relevant to this region. An item in the budget (U.S.$750,000) has been allocated for M.S./Ph.D fellowships.

At least three types of short term training will be highly useful.

a. One of these is study tours to an international agricultural research center, a U.S. experiment station, or a well-run experiment station in another country to study research management. These should be of three months duration at one station, not a junket. The study tours could almost be a type of apprentice training rather than a tour.

We recommend that two persons from each center take this training. Depending on needs and station development, one group of ten could take these tours each year for the next five years. That would provide institute directors and others in the system a chance for the training.

b. Center directors should also have one seminar per year of at least one week's duration on research management. Short-term consultants should be brought in for this seminar. It may turn out that more management seminars will be needed.

c. Another short-term training course needed is in farm management. At least one agronomist per center needs some training in farm management. DOA need not wait for M.S. graduates. An expatriate in one month of intensive training could give the equivalent of a three hour credit course in farm management. Whether a university would accept the credit is not known. One such course a year for two years for ten agronomists each could be of significant help. An alternative would be to give all FSRI team members training in farm management with emphasis on rapid survey techniques and in other areas more specific to farming systems research. This would involve up to 60 persons--one course a year for 12 persons for five years.

The technical assistance personnel in their own programs will find themselves involved in training of various kinds. That is accounted for within their programs. There need to be annual workshops for DOA professional categories that cut across centers. For example, FSRI workshops would involve all FSRI workers and should be used for in-service training.

4. Procurement Plan

This project gives heavy emphasis to the procurement of consultants and trainers.

Table V-1 shows a reasonable schedule for deploying the consultants. Table V-2 indicates the year in which commodities and services will be procured and their estimated costs. In Table V-3 is presented the request of DOA for equipment for the information service. The total has been reduced in the budget, since we see little need for certain video equipment. A short-term consultant should be advise on these needs.

Table V-1. Technical Assistance Implementation Schedule by Specialist Category

Specialists/Consultants	Year I	Year II	Year III	Year IV	Year V
1. Research Center Development					
o Research Management Advisor & Project Leader	←	—	—	—	→
o Administration Specialist	←	—	→		
o Experiment Station Development Specialist		←	—	→	
o Training Specialist	←	—	→		
o Short Term Consultants			←	—	→
2. Library and Information Service					
o Library Specialist	←	—	—	→	
o Research Information Specialist		←	—	→	
3. Soil and Water Management Research					
o Dryland Management and Conservationist	←	—	—	—	→
o Soil Fertility Specialist	←	—	—	→	
o On-Farm Water Specialist			←	—	→
o Short Term Consultants		←	→	←	→
4. Farming System Research					
o Agronomist	←	—	—	—	→
o Farm Management Production Economist	←	—	—	—	→
o Plant Protection Specialist		←	—	—	→
o Short Term Consultant			←	→	←

Table V-2. Total and Annual Budget by Category and Year
(US$000)

Category	YEAR 1	2	3	4	5	Total
1. Specialists						
Salary 1/	525	750	900	600	225	3,000
Furniture	25	25	-	-	-	50
Equipment/Supplies	25	100	50	25	-	200
Travel	25	75	50	50	-	200
Contingency	50	50	25	25	25	175
Sub-total						(3,625)
2. Contract Research						
Operational	50	50	50	50	50	250
Equipment/Supplies	50	250	300	150	-	750
Sub-total						(1,000)
3. Library/Information						
Central Library	75	-	25	-	-	100
Library Centers	25	25	25	25	-	100
Library Equipment	50	-	-	-	-	50
Information Equipment	150	100	-	-	-	250
Sub-total						(500)
4. Soil and Water Management						
Equipment/Supplies	25	50	100	50	25	250
Vehicles (5)	45	30	-	-	-	75
Operational Cost	25	50	75	75	25	250
Construction 2/	50	250	200	-	-	500
Miscellaneous	50	50	50	50	50	250
Sub-total						(1,325)
5. Farming Systems						
Equipment	25	50	100	50	25	250
Vehicles (5)	45	30	-	-	-	75
Operational Cost	25	50	75	75	25	250
Construction 2/	50	25	25	-	-	100
Miscellaneous	50	50	50	50	50	250
Sub-total						(925)
6. Training						
In Country 3/	25	25	25	25	25	125
Third Country 4/	-	150	150	-	150	450
U.S.A. 5/	230	-	-	230	-	460
M.S., Ph.D.	150	150	150	150	150	750
Sub-total						(1,785)
TOTAL	1,845	2,385	2,425	1,680	825	9,160

1/ Consultant salary @$75,000 per year.

2/ Minor construction and modification.

3/ In-country training estimated $15,000 per month long course and $1,500 per 3-day workshop.

4/ Third country training includes cost of special course for center directors.

5/ U.S. training includes cost of special course for center directors.

Table V-3. Preliminary Request for DOA Information Service Equipment

(Price in Baht)

1.	High speed single color press	1,200,000
2.	Plating screen 30" x 40"	500,000
3.	Paper cutter 45"	1,200,000
4.	Film dryer 24" x 36"	160,000
5.	Movie camera, equipped	300,000
6.	Camera, equipped	70,000
7.	Film magnifying projector	200,000
8.	Slide duplicator	12,000
9.	Film editing and scanning	40,000
10.	16 mm movie projector	80,000
11.	Slide projector, multivision	80,000
12.	Photograph dryer	15,000
13.	Overhead projector	10,000
14.	Video tape, equipped	600,000
15.	Tape recorder	5,000
16.	Amplifier, equipped	80,000
17.	Copying machine, plain paper	250,000
18.	Typewriter, electric (2)	60,000
19.	Vehicle, sedan (2)	400,000
	Total	5,262,000

5. Implementation Schedule

Several factors may influence the implementation plan. One of these is the rate at which stations take on the functions of centers. If that proceeds slowly, work with the directors may also proceed at the same pace. If it is more rapid, then the implementation of study tours for the directors could be speeded up.

Another factor that could influence implementation is the time other donor assistance phases out. Other donors are providing manpower development expertise. The training person could start after the other donor personnel leave.

For the most part, however, implementation should begin rather early (see Table V-1). All problems are clearly evident, and the address to them is clear. The actions are simple and straightforward.

6. Monitoring and Evaluation

This component of the project should present no particular problem either in evaluation or monitoring.

Monitoring responsibility should be assumed by the project leader for all activities and the director of the institute in which other activities are housed. Monitoring should be constant for two reasons. One is to assist in the implementation of the activity. Some of these are unconventional activities, at least on a broad scale and can be expected to experience implementation problems. It may also happen that implementation problems will not arise, but that the activity will not achieve all that is expected of it. For example, an FSRI team may develop a logical set of procedures, but may tend to neglect the understanding of the farmer or the link with extension. Simply accomplishing all of the duties is not enough.

They must be accomplished with the collaboration of extension and in full contact with and understanding of the farmer. It is the responsibility of monitoring to see that the spirit as well as the letter is accomplished.

The second responsibility of the monitors is to see that the benefits of each activity are shared throughout the system. If things are learned or developed by the FSRI team, monitors should hold themselves responsible that others in the system know about it. Or as the library develops, monitors need to be sure it is known about throughout the system and is appropriately utilized.

There should probably be two evaluations, one at the end of two years, and the other at the end of the fourth year.

Each component will need its own set of evaluation criteria.

The library and information service will be the easiest. Most of their products are visible and can be counted. Some data may be available on impact, but for the most part evaluation will have to be on the basis of utilization and of products produced and distributed. This will include reference services.

Contract research will need to be evaluated on the basis of how decisions were made on research to be contracted, methods for awarding contracts, and extent to which the research produced matched the research requested. Within the time of this project it is not realistic to expect great gains from the contract research.

There is a good reason to expect at least at the end of four years that some definite improved technology will have been produced by the FSRI team to which expatriate advisors are assigned. It may not be in widespread use on farms, but it should definitely have an important place in extension programs of the area. The actual product will be one criterion for evaluation. A second criterion will need to be the style of operation with particular reference to how it involves farmers and collaborates with extension. AID/W has a contract with the University of Florida on farming systems research and extension. A team from that project supplemented by some Thai personnel experienced in farming systems research should do the evaluation of this component.

Soil and water research aims specifically at the development of improved management technologies. To a certain extent it will use a farming systems approach, but it will discipline itself to keep to soil and water management. Some improved technologies can be expected by the end of year four. At the first evaluation a more general set of criteria will be needed. This evaluation should be conducted by a group of applied researchers, perhaps only two, one in soil research and one in water.

C. Technical Feasibility

Three areas of activities are proposed in the research component. Two of them are standard. One is the library and information service, without which an adequate research system is simply not possible. This paper only identifies the need and recommends that resources be provided for technical assistance and materials to work with. There is no question about the feasibility. Both are essential and feasible.

The soil management research component is critical. DOA needs a soil management capacity. This project will accelerate its coming. We emphasize soil management because all other research and all development projects depend on better technologies for managing the soils of the Northeast. This component would operate only in that area. Other components will have nationwide impacts. Since standard methodologies are anticipated there should be no problem of feasibility.

The RTG policy of helping the Northeast as a depressed area is likely to be of limited success until improved soil and water management technologies are available. Data from AIT and from the Department of meteorology and consultants to the NERAD project all support the judgment that a better technology is feasible.

Given the current state of the art, almost all farming systems methodology and organization is in a sense experimental. Of all the alternatives the team could generate, this one seemed to have both a good chance of working and a significant impact. It is derived from experience around the world which has been analyzed and reported. The proposed scheme follows a model being used in the Philippines.

D. Social Soundness Analysis

We take the "social soundness" of any activity to mean its compatibility with the goals of society.

Those goals can be numerous. With respect to efforts to increase agricultural production they may include the objectives of (1) making the best use of agricultural resources--especially land, water and the rural labor supply; (2) increasing the domestically produced food supply for the population; (3) improving the income distribution among agricultural producers or between farmers and other cohorts of the population; (4) compatibility between measures to increase agricultural production and social values such as widespread participation in a program (instead of dependent on various bureaucracies to provide selected services in a one-sided manner) and perhaps others.

We submit that it is important not to choose among those many goals but to recognize the desirability of all of them and to recognize that there are frequently conflicts among them; pursuit of any one of those goals frequently involves the necessity of being less than satisfied with the effect the selected activity has on one or another goals.

Moreover, in assessing social soundness it is important to take both short-term and long-term effects into account. For example, an agricultural research project may have very little impact in the beginning but a very great impact over the longer term. Similarly, a project may show very little return if the prerequisites for its success are not already in place but a much greater return where those prerequisites are present.

We assess the research and extension activities being recommended in this Report to rank high with respect to social soundness, albeit for different reasons, and despite the fact that some of them would rank low in the short run.

Agricultural research ranks high in that it is essential to developing the improved technologies by which agricultural production can be increased. It is also important in getting all land into its most effective use (a matter of high importance on the rainfed farms of the Northeast and one which our recommendations attach directly in emphasizing attention to soil and water management research.

Agricultural extension can contribute substantially to increasing farm production wherever the five essentials for agricultural development are present but not elsewhere. It is for that reason that we emphasize confining extension to those places where the prerequisites for increasing agricultural production are present.

Moreover, social soundness depends not only on what is done but how. Our recommendations regarding involving farmers in selecting projects for research and in conducting Local Verification Trials can substantially increase farmer participation in agricultural development but that involvement depends, in practice, on how those activities are organized and operated.

It has been contended by some critics in recent years (1) that advanced academic training is elitist benefiting a few officials but not farmers, (2) that research benefits primarily the bigger, wealthiest farmers but not the "poorest of the poor" and (3) that concentrating extension activities in areas for which improved farm practices already are available also helps primarily the farmers who are better off now.

We reject those arguments. It is true that advanced academic training immediately benefits only those who receive the fellowships, but there is no other way to build up research programs to develop the technologies that all farmers, rich and poor, desperately need in order to increase production. Furthermore, empirical studies have indicated that most research results are as pertinent to the problems of small poor farmers as to those of larger farmers, and as for concentrating extnesion activities where technologies to increase production are already available we do not recommend that other areas be neglected. Instead, we argue that substantial research efforts be undertaken there to find improved technologies, after which (when it has a chance to be productive) extension activities can be added.

E. Financial Feasibility

1. Agricultural Research Institutions and Expenditures

There are several government agencies and educational institutions in Thailand, as shown in Table V-4, that engage in agricultural research. Private organizations doing agricultural research are not included in the table. Generally speaking, they play a very small role in this activity. Some private companies do undertake verification trials on their products before promoting sales. Others have contributed financial support for research to governmental agencies and educational institutions. The public sector, however, plays the major role in agricultural research in Thailand.

The proliferation of research agencies in the public sector is not necessarily bad in itself if research activities are properly coordinated to serve the needs of farmers. However, an effective coordinating mechanism is still lacking. Further, research undertaken by some of these agencies, particularly educational institutions, are often not relevant to the farmer's problems (physical, social and economic). Provided that an effective coordinating mechanism could be developed, they could become a part of the total research and extension network which could effectively serve the needs of Thai farmers.

When the expenditures for research are considered, it can be seen from Table V-5 that the Ministry of Agriculture and Cooperatives and the Universities are the principal agencies conducting agricultural research. In 1981, the expenditures for agricultural research of the Ministry of Agriculture and Cooperatives and of the universities accounted for 89.6 percent and 7.4 percent of the total agricultural research expenditures respectively. Altogether, the other agencies spent only 3 percent of the total agricultural research expenditures.

The reason why the research activities of some of the educatonal institutions are not relevant to farmer's needs, can be inferred from these research expenditures. For example, there are at present 10 agricultural colleges under the Institute of Technology and Vocational Education offering bachelor degrees in agriculture. But altogether they spent only 5.1 million Baht on research, or about half a million Baht for each college. As a consequence, their research activities are mainly for educational purposes and are not meaningful in terms of serving farmer needs.

2. Agricultural Research Expenditures Relative to the Value of Agricultural Production

The total agricultural research expenditure in 1981 represented only 0.28 percent of the value of agricultural GDP. The expenditure on crop research was only 0.25 percent of the value of the crops produced (Table V-6). The research expenditures of the DOA were 0.23 percent of the total farm value of crops worked on by the DOA (Table V-7). Furthermore, the expenditures for research on corn and sorghum in 1981 were only 0.17 percent of the total farm value of those crops (Table V-8), and that for rice was about 0.06 percent of the value of the crop.

It should be noted here that although these research expenditures were derived and estimated from several sources which certainly might be subject to some error, these agricultural research expenditures in relation to the value of agricultural production are in line with other previous estimates. They have a clear policy implication for Thailand. They clearly reveal that Thailand is still underinvesting in agricultural research. Even if the total research expenditure of the DOA were twice that in 1981, the share of agricultural research expenditure to the value of agricultural GDP would increase only from 0.28 percent to 0.42 percent which would still be below the 0.50 percent recommended by the World Food Conference and also far below the 1 to 2 percent that most of the developed countries are spending for their agricultural research.

Research is a long-term investment. It takes time to produce results. It also takes time to sustain such results. Under-investment in agricultural research will not only slow down the process of creating and sustaining the growth of agricultural technology but also slow down the growth rate of the agricultural sector of the country. As a consequence, Thailand is not enjoying the full benefit of possible agricultural developments.

3 Benefit and Impact of Agricultural Research

Although there is no study on the impact of agricultural research in Thailand, various studies in other countries, with few exceptions, show very clearly that the returns realized on investment in agricultural research are very high, ranging from 20 percent to well over 40 percent per year. There is no doubt but that investment in agricultural research has contributed to the growth of agricultural production in Thailand. In the case of rice, even before the introduction of the high yielding varieties during the 1951-53 to 1962-64 period, the increase in rice production was due to a 13 percent increase in area and a 15 percent increase in yield (Silcock, T.H., the Economic Development of Thai Agriculture, 1970). Although the yield per rai of rice has varied from year to year, since 1960 the long term (10 year) average has remained relatively stable (Table V-9). The variation of rice yields from year to year is believed to be due to the variation in climatological factors and changing economic factors. It should be noted, however, that during the last 5 years, the national average yield of rice has decreased.

For maize production, the yield per rai has improved since 1960. The long-term (10 year) average indicated that the yield in the last two decades increased quite substantially. Although the planted area of maize has also increased substantially during the same period, there is no doubt but that the yield increase has also contributed to the growth of maize

production (Table V-10). It is also clear that this result is due mainly to major efforts going into the improvement of maize varieties since the early 1960's.

It would be very interesting to look at the total expenditures on the corn and sorghum research of the joint corn and sorghum research program of KU and DOA and compare it with the farm value of corn and sorghum of the recent year. The joint program was initiated in 1968, but the university started work earlier. Unfortunately, the expenditures for the earlier years are not available. At any rate, the expenditures for this early period is believed not to exceed 2.5 million Baht. Thus, the total expenditures on corn and sorghum research since the inception of the joint corn and sorghum research program up to 1982 would amount to 144.7 million Baht which represented only 2.25 percent of the farm value of corn and sorghum in 1980/81 crop year. This would certainly imply that it pays handsomely to invest in research. To put it differently, Thailand would not have realized the growth of corn production as she enjoys now if there were no concentrated effort on corn and sorghum research.

Donors such as USAID and the Rockefeller Foundation also contributed heavily. If their contributions were equal to RTG expenditures, it would still have taken only five percent of one year's corn crop to pay the total cost of the research program since the beginning. Thailand was the center for the Asian Maize Network which found a genetic solution to the downy mildew problem.

On the other hand, sorghum does not seem to have received the impact which corn has shown, although it has received attention. The planted area of sorghum has increased but the average yield per rai has declined (Table V-11). Yield declines are difficult to understand, especially in view of rapid acreage expansion.

Table V-4. Agencies Engaging in Agricultural Research in Thailand

1. Ministry of Agriculture and Cooperatives (MOAC)
   a. Department of Agriculture (DOA)
   b. Department of Land Development (DLD)
   c. Department of Livestock Development (DOLD)
   d. Department of Fisheries (DOF)
   e. Royal Forest Department (RFD)
   f. Royal Irrigation Department (RID)
   g. Office of Agricultural Economics (OAE)
   h. Office of Under-Secretary (OUS)

2. Bureau of Universities (BOU)
   a. Kasetsart University (KU)
   b. Chiang Mai University (CMU)
   c. Khon Kaen University (KKU)
   d. Prince of Songkhla University (PSU)
   e. King Mongkut Institute of Technology (KMIT)
   f. Mae Joe Institute of Agricultural Technology (MJIAT)

3. Ministry of Education (MOE)
   - Institute of Technology and Vocational Education (ITVE)

4. Ministry of Finance (MOF)
   - Tobacco Monopoly of Thailand (TMT)

5. Ministry of Industry (MOI)
   - Sugarcane and Sugar Institute (SST)

6. Ministry of Science, Technology and Energy (MSTE)
   - Thailand Istitute of Science and Technological Research (TISTR)

Table V-5. Expenditure for Crop Research and Total Agricultural Research by Agency and Funding Source, 1981*
(Million Baht)

Agency	Funding Source		Total	Expenditure for Crop Research
	RTG	Loan & Donation		
1. Ministry of Agriculture and Cooperatives				
DOA	247.5	32.9	280.4	273.3
DLD	40.0	-	40.0	31.2
DOLD	23.6	-	23.6	-
DOF	80.4	-	80.4	-
RFD	50.2	-	50.2	-
RID	-	-	-	-
OAE	10.0	-	-	9.5
OUS	6.0	6.3	12.3	12.3
2. Bureau of Universities				
KU	26.0	2.4	28.4	15.4
CMU	2.7	2.5	5.2	4.7
KKU	2.5	2.0	4.5	4.0
PSU	1.0	-	1.0	1.0
KMIT	1.0	-	1.0	1.0
MJIAT	1.0	-	1.0	1.0
3. Ministry of Education				
ITVE	5.1	-	5.1	4.5
4. Ministry of Finance				
TMT	3.0	-	3.0	3.0
5. Ministry of Industry				
SST	2.5	-	2.5	2.5
6. Ministry of Science, Technology and Energy				
TISTR	5.7	-	5.7	5.0
Total	508.2	46.1	554.3	358.4

Source: Budget Bureau Documents

*Estimated net total budget allocated to the research agencies because these research agencies do not perform only research functions but are involved in other activities as well. For example, DOA also performs regulatory and servicing functions beside research. Time does not permit to check the accuracy of these estimates.

Table V-6. Research Expenditures for Corn and Sorghum Program by Cooperative Research Agencies (Baht)

Year	KU	DOA	Total
1970	1,418,000	3,170,600	4,588,600
1971	863,200	2,893,300	3,756,500
1972	2,090,200	3,925,000	6,015,200
1973	2,119,400	5,888,000	8,007,400
1974	2,353,300	5,812,200	8,165,500
1975	3,096,300	7,082,800	10,179,100
1976	3,302,900	8,545,100	11,848,000
1977	3,582,100	9,243,700	12,825,800
1978	4,847,600	9,648,300	14,495,900
1979	4,190,500	9,909,100	14,099,600
1980	4,134,700	9,253,300	13,388,000
1981	4,876,600	11,956,900	16,833,500
1982	4,285,100	10,671,910	14,957,010

Sources: KU and Corn and Sorghum Branch, Farm Crops Division, DOA

Table V-7. Value of Crops Affected by DOA in 1980/81 Crop Year
(Million Baht)

Item	Value Produced	Value Exported*
Rice	46,459.7	19,817.6**
Maize	7,284.9	7,300.1
Sorghum	530.9	660.5
Cassava	12,405.0	14,880.6**
Mungbeans	1,527.1	612.0
Castor beans	207.5	137.0**
Peanuts	1,030.4	61.1
Soybeans	578.1	27.9
Kenaf	919.2	144.0
Cotton	1,848.9	441.2**
Sesame	339.0	1.0**
Sugarcane	9,053.3	21,624.5**
Kapok	327.7	255.2
Vegetables	6,707.6	213.6**
Fruits	22,723.3	2,419.1**
Rubber	7,433.7	12,937.6**
Total	119,376.3	81,533.0

Source: Office of Agricultural Economics

* 1980 export

** Processed products included

Table V-8. Estimated Gross National Product from Agriculture, 1981

Item	Value (Million Baht)
1. Crops	148,562
2. Livestock	24,712
3. Fisheries	11,637
4. Forestry	10,043
Total	194,954

Source: Bank of Thailand Monthly Bulletin, August 1982.

Table V-9. Average Yield of Rice Per Rai 1940-1979

Period	Yield (kgs)*
1940 - 1949	189
1950 - 1959	225
1960 - 1969	261
1970 - 1979	267

*When four-year averages are used, yields decline through the 70's.

Source: Agriculture Statistics of Thailand various issues.

Table V-10. Planted Area and Average Yield of Corn
1950 - 1980

Year	Planted Area (1,000 rai)	Yield (kg/rai)	Production (1,000 tons)
1950	226	119	26.9
1951	259	161	41.7
1952	281	159	44.8
1953	298	171	51.1
1954	331	188	62.3
1955	347	195	67.5
1956	514	223	114.8
1957	606	226	136.8
1958	792	235	186.3
1959	1,249	254	317.2
1960	1,785	305	543.9
1961	1,916	312	598.3
1962	2,050	325	665.4
1963	2,612	328	857.7
1964	3,449	271	935.1
1965	3,605	283	1,021.3
1966	4,084	275	1,122.4
1967	4,651	262	1,217.4
1968	4,763	279	1,331.0
1969	4,503	380	1,713.5
1970	5,180	374	1,938.2
1971	6,368	361	2,300.0
1972	6,231	211	1,315.0
1973	7,712	326	2,339.0
1974	7,749	323	2,500.0
1975	8,200	349	2,863.2
1976	8,029	333	2,675.2
1977	7,534	223	1,676.5
1978	8,661	322	2,790.6
1979	9,529	300	2,863.2
1980	8,960	335	2,997.9

Source: Agricultural Statistics of Thailand, various issues.

Table V-11. Planted Area and Average Yield of Sorghum

Year	Planted Area (1,000 rai)	Yield (kg/rai)	Production (1,000 tons)
1970	254	270	68.5
1971	523	278	145.5
1972	359	283	101.6
1973	555	252	139.7
1974	1,263	198	250.1
1975	1,226	188	230.9
1976	892	166	148.4
1977	1,062	118	125.9
1978	1,098	197	215.8
1979	1,182	169	199.4
1980	1,546	153	237.0

Source: Agricultural Statistics of Thailand, 1982.

Table V-12. Seed Produced and Distributed by the Seed Centers DOAE, 1981

Crops	Amount of Seed (kgs)
Rice	1,318,166
Maize	865,749
Sorghum	36,211
Mungbeans	54,243
Soybeans	262,394
Peanuts	81,085
Cotton	136,719

Source: Seed Division, DOAE

Note: The private sector produced and distributed about 8,000 tons of maize seed to farmers in 1981. In addition, about 50 tons of hybrid seed of maize was also produced and distributed by the private sector in the same year.

Table V-13. Expected Area Planted Using Amount of Improved Seeds Distributed by DOAE and Private Sector

Crop	Area Planted (rai)	Incremental Production 1/ (ton)	2/ Value (1,000 Baht)
Rice	263,633	7,909	23,727
Maize	2,955,249	88,657	221,642
Sorghum	12,070	241	482
Mungbeans	18,081	181	905
Soybeans	43,732	656	3,280
Peanuts	4,054	81	486
Cotton	68,359	1,025	8,200
Total			258,722

1/ Assuming an increase of 10 percent of an average yield of 300 kgs/rai for rice; 300 kgs/rai for maize; 200 kgs/rai for sorghum; 100 kgs/rai for mungbeans; 150 kgs/rai for soybeans; 200 kgs/rai for peanuts; and 150 kgs/rai for cotton.

2/ At price of rice 3,000 Baht/ton; maize 2,500 Baht/ton; sorghum 2,000 Baht/ton; mungbeans 5,000 Baht/ton; soybeans 5,000 Baht/ton; peanuts 6,000 Baht/ton; and cotton 8,000 Baht/ton.

F. Log Frame

Goal: To increase agricultural productivity and farm income in the rainfed areas of Thailand with particular emphasis on the Northeast.

Measurement of Goal Achievement: There will be no noticeable impact on national data during the life of the project.

Assumptions: None.

Purpose: Purpose of this component of the project is to strengthen the Department of Agriculture's internal capacity to manage research and its linkage with farmers, extension workers and other researchers.

End of Project Status:

1. DOA will have a functioning library service and center researchers will have access to the work of other researchers both in Thailand and elsewhere. (This can be measured by publications in center libraries and by number of requests received by the reference service).

2. DOA will have a functioning information program and will be publishing annual reports and other reports as relevant.

3. Farming system research teams will be in operation in at least 10 research centers, and they will be cooperating with extension both in designing technology packages and conducting field trials. This is an indicator of farmer and extension linkage.

Assumptions:

1. That the DOA will have at least ten of its outlying research centers in full operation.

2. That other donors will accomplish their goals for training personnel.

No other assumptions are needed.

Outputs:

1. A library service, including a reference service to take advantage of agricultural library facilties in Thailand and other

2. [illegible]mation or publication service reporting research results.

3. [illegible]sons per center fairly well trained in research [illegible]ment.

4. [illegible] set of farming systems research procedures developed which are applicabe nationwide and which are being utilized in 10 centers as an integral part of their programs. These procedures will include linkage with extension.

5. Three improved methodologies for managing the problem soils of the Northeast which are economic and appropriate to a significant numbers of farmers.

6. Six Ph.D and 15 M.S. gradutes.

Output Indicators:

1. Reports of library utilization by researchers.

2. Number of publications written, number printed, and distribution of each.

3. Training reports

4. The number of teams operating and the number of verification trials placed on farmer fields will be objective indicators. Results of trials in relation to farmer practice will serve as an indicator of value. Field visits and interviews with farmers will indicate, but not measure, the value of research to agriculture. Interviews will also establish the quality of the research-extension linkage.

5. Research reports and reports of verification trials will be an indication of the output. It is possible that within the life of the project one or more soil management technologies will be in widespread use on farms, but it cannot be predicted.

Assumptions:

1. That the DOA will be able to have at least ten centers in operation by the end of the project.

2. That other donor training proceeds as scheduled. No other assumptions are needed.

Inputs:

1. 480 person-months of technical assistance

2. Library book and library equipment estimated at $245,000.

3. Printing equipment estimated at $250,000.

4. 200 person months of short-term training.

5. M.S. and Ph.D training estimated at $750,000.

Appendix A

Professional Personnel, Department of Agriculture
By Level of Training and Sub-Unit, 1982

Training Level	Total	Administration and Finance						Research							Technical Services								DG Office
		DDG Off	Sec.	Fin.	P/P	Per.	Reg.	DDG Off	Rice	F/C	Hort.	Rub.	Ser.	FS/ Tech.	DDG	B/W	B/Ch.	Ag. Eng.	Ag. Tox.	PP/M	E/Z	SS	
Ph.D	63	-	4	-	1	-	-	-	7	6	2	3	-	2	-	4	2	-	1	8	13	10	
M.S.	349	-	2	-	8	3	7	-	39	38	17	8	2	28	-	18	40	7	7	39	44	44	
B.S.	1,070	-	26	4	25	9	42	-	178	161	75	74	34	51	-	22	72	21	44	75	104	73	
Voc.	1,635	-	37	54	23	35	53	-	262	243	106	175	54	85	-	42	38	49	35	79	87	178	
Total	3,117	-	49	58	57	47	102	-	486	448	200	260	90	164	-	86	152	77	87	201	248	305	

Appendix B

Distribution of Budget, Department of Agriculture By Administrative Unit and Between Headquarters and Field, 1982

Administrative Unit	Budget			% Field Budget is of Total
	Total	Field	H.Q.	
DG Office	-	-	-	-
DDG Administration Office	-	-	-	-
Secretary Office	4,450,240	-	4,450,240	-
Finance Division	12,124,600	-	12,124,600	-
Program Planning Div.	17,293,920	5,185,400	12,108,520	30.0
Personnel Division	4,280,340	-	4,280,340	-
Agri. Regulatory Div.	15,310,160	-	15,310,160	-
DDG Research Institute Office	-	-	-	-
Rice Institute	107,848,610	85,114,320	22,734,290	78.9
Field Crops Institute	115,293,540	101,782,510	13,511,030	88.3
Horticulture Institute	86,697,990	76,072,710	10,625,280	87.7
Rubber Institute	68,886,140	61,452,540	7,433,600	89.2
Sericulture Institute	26,357,000	19,825,100	6,531,900	75.2
Farming System Research Institute	7,676,360	1,495,490	6,180,870	19.5
DDG Technical Service Office	-	-	-	-
Botany & Weed Science Div.	9,064,320	1,048,730	8,015,590	11.6
Agri. Chemistry Div.	16,321,450	-	16,321,450	-
Agri. Engineering Div.	32,161,070	8,674,200	23,486,870	27.0
Agri. Toxicology Div.	8,813,420	-	8,813,420	-
Plant Pathology and Microbiology Div.	21,839,180	7,104,150	14,735,030	32.5
Entomology & Zoology Div.	21,699,090	13,002,140	8,696,950	60.0
Soil Science Division	8,448,140	3,419,340	5,028,800	40.4
Total	584,565,570	384,176,630	200,388,940	
Percent	100.0	65.7	34.28	

Appendix C

Farming System Research and Development

Content and methodology are of equal importance in Farming System Research and Development. Farming system research integrates research and development of technology for transfer to and from the farmer. Farming system research is characterized by:

1. enterprises the household manages according to specific resources, goals, and preferences in response to physical, biological and socio-economic conditions.

2. being part of a larger system (such as a local community) and capable of division into sub-systems (such as cropping systems.)

3. farmer-problem orientation which requires an approach that complements existing research and development activities and is iterative, dynamic, and responsive.

The farming system process suggests:

- Selecting areas and rather similar groups of farmers as targets for development;

- Identifying and ranking problems and alternative opportunities;

- Planning, implementing, and monitoring experiments in conjunction with other research;

- Coordinating on-farm experiments and studies with commodity and disciplinary oriented research;

- Evaluating farmer acceptance and expanding improved technology transfer;

- Developing improvements in public policy and support services;

- Extension of results by multilocation testing and pilot production programs, through extension.

Appendix D

Preliminary Request for Support to
Agricultural Communication Division, DOAE
(Baht)

	Equipment	Amount	Budget
1. Central Office			12,793,000
Video Production	Outdoor type VTR camera (umatic)	1	130,000
	Studio VTR camera (Umatic)	2	700,000
	TBC	1	640,000
	Editing Set	1	53,000
	Editing system control	1	55,000
	Monitor and VTR for Viewing (Umatic)	1	400,000
	Telecine system and adapter	1	70,000
	Test chart	1	15,000
	AC Power Supply	1	10,000
	Sychro generator	1	150,000
	Jackboard for audio	1	20,000
Film Production	Zoomlens for 16 mm. camera	2	300,000
	Steenbeck editing set	1	500,000
	Nagra sound recorder for 16 mm. film	2	260,000
	4-door car with air conditioner	1	350,000

	Equipment	Amount	Budget
Publication	Phototype setting machine	1	1,300,000
	Photohead lining	1	280,000
	Book binding	1	1,200,000
	Process camera	1	800,000
	Offset printing machine one run two colors numbering paperating 15 + 18"	1	950,000
	Paper cutting machine 46"	1	900,000
Exhibition and Contest	Refractometer	20	80,000
	Microbus with air-conditioner	1	330,000
	Truck (diesel 4 cycle)	1	100,000
	Exhibition hall and workshop with air-conditioner	1	3,000,000
	Rear and front sound slide projector	1	36,000
2. Regional Offices			10,956,000
Printing Unit	Offset printing machine	6	3,000,000
	Electro static offset plate maker	6	1,200,000
	IBM type writing machine	6	210,000
	Paper stitching machine	6	540,000
	Paper cutting machine	6	300,000
Video Production	VHS-VTR handy camera with camera	6	180,000
	Monitor and VTR for viewing (VHS)	6	300,000

	Equipment	Amount	Budget
Exhibition and and contest	Refractometer	60	240,000
	Rear and front sound slide projector	6	216,000
	Prototype of economic crops	750	3,200,000
	Exhibition kids	800	1,600,000
3. Fellowships			2,095,000
Academic Training for M.S. in Communication		2/ 2 yr.	600,000
Study Tour and Workshop in USA or Europe	Video and film production	4/ 3 mo.	340,000
	Film library	1/ 1 mo.	55,000
	Graphic arts	3/ 1 mo.	165,000
	Film festival	2/ 2 wks.	95,000
	Manage and Printing System	5	300,000
	State fair and exhibition	3/ 1 mo.	165,000
Study Tour and Workshop in Philippines, Korea	Printing technique	6	210,000
	Agricultural fair and exhibition	3/ 1 mo.	165,000

Appendix E

Preliminary Request for Training Equipment, DOAE

Item	Cost Estimate		
	Price Per Unit	No. of Unit	Total Cost
Central Office			
1. Complete set of VTR	450,000	1	450,000
2. Movie projector (16 mm)	35,000	1	35,000
3. Overhead projector	10,000	1	10,000
4. Slide projector with synchronized tape	30,000	2	60,000
5. Cassette tape recorder	4,000	2	8,000
6. Projection screen (70"x70")	3,500	2	7,000
7. Camera (55 mm.)	15,000	1	15,000
8. Electric and manual mimeograph with steel cabinet	30,000	2	60,000
9. Wireless microphone	800	5	4,000
10. Photo copier	120,000	1	120,000
11. Megaphone	4,000	3	12,000
12. Opaque projector	30,000	1	30,000
13. Typewriter	15,000	2	30,000
Total			Baht 841,000 $36,566

Item	Cost Estimate		
	Price Per Unit	No. of Unit	Total Cost
Regional Offices			
1. Complete set of VTR	450,000	6	2,700,000
2. Slide projector with synchronize tape	30,000	6	180,000
3. Overhead projector	10,000	12	120,000
4. Cassette tape recorder	4,000	12	48,000
5. Amplifier (100 watt)	9,000	6	108,000
6. Projection screen (70"x70")	3,500	12	42,000
7. Camera (55 mm.)	15,000	18	270,000
8. Electric and manual mimeograph with steel cabinet	30,000	6	180,000
9. Wireless microphone	800	30	24,000
10. Movie projector	35,000	6	210,000
11. Opaque projectro	30,000	6	180,000
12. Megaphone	4,000	24	96,000
13. Microphone with stand	1,750	24	42,000
14. Loud speaker	2,000	48	96,000
Total			Baht 4,296,000 $186,783
Grand Total	186,783 + 36,566 =		$223,349