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File 493-0272

A.I.D. Project No. 493-0272

A.I.D. Loan No. 493-T-020

THAILAND

EVALUATION REPORT

FOR

LAM NAM OON INTEGRATED RURAL DEVELOPMENT PROJECT

EXECUTIVE SUMMARY

AND

MAJOR CONCLUSIONS AND RECOMMENDATIONS

Dated: August 17, 1981

EVALUATION TEAM COMPOSITION

Evaluation Team

William Schoux	-	Team Leader
Robert Muscat	-	Economist
Preeda Chantagul	-	Agricultural Economist
Sara Schwartz	-	Agricultural Economist
William Cox	-	Irrigation Agronomist
Charles Stevens	-	Engineer
Chakrit Noranitiphadungkarn	-	Management Specialist

Royal Thai Government Evaluation Working Group

Mr. Prasit Ujjin	-	Office of Fiscal Policy/MOF, Chairman
Ms. Phthra Chor Sorapongs	-	Budget Analyst/BOB, Deputy Chairman
Mr. Chayan Ekarohit	-	Office of Fiscal Policy/MOF
Mr. Chaiwat Prechawit	-	Civil Engineer/RID
Mr. Sombong Pattamavichaiporn	-	Evaluation Technician/DTEC
Ms. Angkana Chirabhummintara	-	Planning & Policy Analyst/MOAC
Ms. Kruerwal Sthitirat	-	Planning & Policy Analyst/MOAC
Mr. Sutthipan Pongsupha	-	Subject Matter Specialist/DOAE
Mr. Banterng Masang	-	Economist/OAE
Ms. Punnee Sribuntao	-	Agriculturist/DPW

BASIC PROGRAM IDENTIFICATION DATA

1. Country: Thailand

2. Bilateral Project Titles: Lam Nam Oon Integrated Rural Development Project

3. Bilateral Project Number: A.I.D. Project No. 493-0272
A.I.D. Loan No. 493-T-020

4. Program Implementation:

   a. First Project Agreement: FY 78
   b. Final Obligation: Ongoing
   c. Final Input Delivery: Ongoing

5. Program Funding:

   a. A.I.D. bilateral funding Loan $4.5 Million (FY 78-83)
   Grant 0.1 Million (FY 77-83)

   b. Other major donors: None

   c. Host Country Counteroart Funds: $39.2 Million

6. Mode of Implementation:

   a. Project Loan Agreement between USAID/Thailand and Ministry of Finance

   b. Project Grant Agreement between USAID/Thailand and Department of Technical and Economic Cooperation.

7. Previous Evaluations and Reviews: None

8. Responsible Mission Officials:

   a. Mission Directors: Charles L. Gladson 1977-78, and Donald D. Cohen 1978 - present.

   b. Responsible Project Officers: John C. Champagne August 1977 - June 1979 and Frank L. Gillespie November 1979 - March 1980; November 1980 - present.

9. Host Country Exchange Rates:

   a. Name of Currency: Baht

   b. Exchange Rate at Time of Project: Baht 20.00 = US$1.00.

Lam Nam Oon Executive Summary

The Lam Nam Oon Integrated Rural Development Project (the Project) was designed to meet a number of objectives beyond the provision of on-farm irrigation and increased agricultural production. In addition to research, extension, inputs and marketing activities designed to support the agricultural production objectives, the Project includes community development, health and family planning, and adult education services designed to meet social objectives. The overall project objectives were set in broad terms referring to the improvement of the quality of life of the families residing in the project area.

While many problems exist, there have been positive results from the Project. The evaluation team found that the integrated approach to project implementation has worked quite well in some respects. Various departments of the Royal Thai Government (RTG) cooperate to a degree not found in their informal activities outside the project area. The incentive of the price support program for groundnuts has resulted in the production of this crop by over 2,000 farmers during its first year of operation in Lam Nam Oon. The majority of the farmers who had access to reliable irrigation did cultivate at least part of their land during the past dry season.

The Project is, however, beset by a number of major problems, the most critical of which may be categorized as economic and physical, with both categories influenced by managerial difficulties. The fundamental economic problem is that the Project will not be able to produce sufficient return on the investment to cover the cost. When the cost of constructing the dam and the main and secondary canals are taken into account, economic indicators of project viability are discouraging. When the assumptions regarding future costs are varied, the Project, in all cases, achieves benefit/cost ratios of less than one, negative net present values and internal rates of return of less than 3 percent. When the US$50 million sunk cost is excluded from these calculations, the economic indicators improve, but reveal promising results only if it is assumed that lower cost methods of on-farm water development than have been used to date will be employed in the future.

There are two crucial problems related to the physical development of the irrigation system. First, the concrete-lined canals and related structures have deteriorated to such an extent that if operations and maintenance of the

system does not improve, the system will be unable to deliver at the necessary levels to an expanded number of farmers. The deterioration of canal linings, erosion of side slopes and other problems of the physical structures are the result of faulty design, inadequate construction, and lack of adequate resources for proper routine maintenance, or failure to utilize the resources effectively. Second, a large-scale land clearing and leveling technique is being employed which is at once both extremely costly (130,000 Baht for an average-sized farm of 20 rai, i.e. Dollars 6,500 per five acres) and potentially damaging to the thin topsoils of the area. Alternative techniques are available which could resolve both the cost and topsoil problems, but the RTG continues to plan further use of the land leveling technique, although not for the entire project area.

The above economic and physical problems are largely the result of managerial problems. Perhaps the best evidence for this is the fact that all RTG senior officials interviewed acknowledged that they had been generally aware of the major problems for some time. Indeed, earlier reviews of the Project by both outsiders and RTG personnel had identified most of these problems. Moreover, the senior officials apparently agreed with various recommended actions to correct the identified failings (e.g. cessation of the inappropriate land-clearing technique). Nevertheless, the problems have not yet been adequately addressed despite the fact that the Lam Nam Oon Project is not the only large-scale irrigation project in the Northeast, and the others reportedly suffer many of the same problems and are considered to be in a worse state.

Managerial problems are evident in many aspects of the Project. Although the main irrigation system and the on-farm irrigation works are the responsibility of a single RTG entity, the Royal Irrigation Department (RID), both horizontal and vertical coordination are poor. The Project Team at the site must deal with many RID offices in Bangkok. The on-farm irrigation works are the responsibility of a design team based in Bangkok, not at the site. The expensive, soil-damaging land-leveling technique is used, not because it is suited to the project area (or other areas in the Northeast), but because it was successful in the central plains. RID cannot provide management assistance to help project personnel to organize water users' associations or enlist the farmers' participation in construction or maintenance of on-farm irrigation systems. Although many of the Project's problems are common to all the major irrigation projects of the Northeast, no coordinated, systematic approach to them has been initiated. The provision of irrigation water to the farms and the managed use of that water for increased crop production are the essential elements

of the Project, yet it is precisely these two elements which suffer the most from insufficient management attention and action. Two major reasons for non-action on the part of senior managers are that (1) management information systems do not provide the type of information required in a consistent, timely manner; and (2) organizational and managerial arrangements established for the Project have either not been followed or have been ineffective.

The evaluation team makes a large number of recommendations designed to correct various problems or weaknesses of the Project. Some of these recommendations the team considers so fundamental to project success that if they, or similar recommendations are not implemented, there is serious question as to whether the Project should be continued.

Briefly summarized, the recommendations which fall in this category are:

(a) The operation and maintenance budget should be increased to finance the routine maintenance required to prevent further deterioration of the canal system. Management of the Project's O&M section should be strengthened and Project procedures for use of O&M funds reviewed. Funds should also be allocated to rehabilitate the system.

(b) The modified ditch and dike model developed for the Project (called the Lam Nam Oon Model) should be subjected to careful operations research for two or three years.

(c) During the testing of the Lam Nam Oon Model, further expansion of the irrigation system should be restricted to ditch and dike methods and the use of land leveling and consolidation methods (e.g. Chao Phraya Model) should be deferred.

(d) Applied research on dry and wet season crops suitable for project area soils should be expanded. Such research should include on-farm water management and use.

(e) Project management should be reorganized to provide for clearer lines of authority, more systematic information flow and closer management attention. This could include the assignment of one person to work within RID to assist the Project Director, and the formation of an inter-agency project implementation working group.

(f) The national coordinating committee should be reactivated to meet regularly to review project progress and to provide guidance to the operating units.

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Major Conclusions and Recommendations

The following report presents, in summary form, the critical aspects of the Lam Nam Oon IRD project which need to be addressed by both the RTG and USAID. While many problems exist, there have been positive results due to the project. The Evaluation Team found that the integrated approach to project implementation has worked quite well in some respects. Various departments of the RTG cooperate to a degree not found in their normal activities outside the project area. The incentive of the price support program for groundnuts has succeeded, in its first year of operation in Lam Nam Oon, in the production of this crop by over 2,000 farmers. The vast majority of the farmers who had access to reliable irrigation did cultivate at least part of their land during the past dry season.

The importance of these positive elements should not be minimized. However, major problems concerning the cost of the canal system and land development, the system's maintenance and rehabilitation, plans for on-farm development both in terms of water management and dry season cropping patterns, and RTG and USAID management need to be resolved. There are other issues which are discussed in the body of the report, but the foregoing are fundamental and discussed here to highlight their significance to effective project implementation.

A. Irrigation and Drainage System

The physical structures of the canal system have suffered extensive deterioration as a result of inadequate construction and a lack of maintenance. Concrete canal linings have broken up, earthen side slopes have eroded and division boxes drop water into unlined tertiary canals, causing erosion under the boxes and their foundations. Many of the water control and distribution boxes are inoperative due to not having had gates installed or gates being missing or broken. In addition, drainage of irrigated areas has proven to be inadequate, with large areas of farm land subject to ponding and thus unusable. Such flooded lands also create salinity problems under both wet season and dry season irrigation conditions. The results of this poor design/construction are canals which are unable to deliver their design capacity of water and a need for major investment in rehabilitation.

While some of these problems relate to improper design or construction, the major cause is an almost complete lack of

attention to maintenance. The O & M section of RID is responsible for operation and maintenance of virtually all the approximately 350 km. of irrigation canals and 100 km. of drainage canals constructed to date. The budget provided for the O & M work for the Project in 1981 is reported by RID to be 3.8 Million Baht (US$190,000).

RTG officials and the evaluation team agree that this amount is inadequate; but, it is not clear that an increased budget alone is enough to guarantee adequate maintenance of the system. The management of O&M funds needs to be reviewed and strengthened to ensure efficient use of allocated funds. Recommendations to correct these problems are:

1. A study should be made and a report prepared covering the work required and costs involved to rehabilitate the irrigation system, to eliminate side slope erosion and to improve the land drainage characteristics.

2. The Operation and Maintenance budget should be increased to a level sufficient to finance necessary routine operation and maintenance of the irrigation and drainage system. The management of the Project's O&M section should be strengthened and the Project procedures for use of O&M funds reviewed. Additional funds should be allocated to rehabilitate the system.

The on-farm development of irrigation systems is far behind schedule. The Project Paper shows a planned irrigated area of 102,000 rai by 1980. For the 1980/81 dry season, only 20,000 rai were irrigated, the primary reason being RID's inability to assure the delivery of sufficient water to a greater area.

It is argued by some project personnel that a larger area can be irrigated in the wet season than in the dry season, because farms with access to the irrigation system can be flooded to the point that water overflows the dike onto adjacent farms. While this, indeed, occurs, it cannot be considered controlled irrigation. Moreover, there are no reliable estimates of the area which received supplemental irrigation in the 1980 wet season. There is, however, no doubt that the irrigated area did not approach the target figure.

The development of on-farm system is being pursued through three different approaches. One (referred to as the Chao Phraya model) involves extensive land clearing and leveling by RID with heavy machinery, followed by realignment of farm boundaries and rebuilding of paddy dikes. To date, the model has been applied to three pilot areas totalling 6,600 rai. This model involves very high cost (6,500 Baht per rai) and significant damage to the thin, fragile topsoils found in the Northeast. The second (called Ditch and Dike) involves virtually no land leveling with RID's role limited to providing water to the farm turnout (via tertiary canals) and drainage for an area. The farmers are then expected to construct the channels which convey water from the turnout to the field. This model is relatively inexpensive (800 - 1,200 Baht per rai), does not damage the topsoil and involves the farmer in the project. Except for a small unsuccessful application of an earlier RID Ditch and Dike model in the early 1970's, the present Ditch and Dike model has not yet been applied in the project area. However, some 16,000 rai were cultivated in the 1980/81 dry season through the use of farm ditches constructed by farmers themselves. The third (Lam Nam Oon model) is essentially a variation on the Ditch and Dike methods. RID constructs irrigation and drainage canals, following natural contours (thus eliminating the need for land leveling), to the farm turnout. The major innovation of this model is the use of a proportional division box to regulate the flow of water rather than the constant head orifice used elsewhere in the irrigation system. Other aspects of the model are the same as those found in the Ditch and Dike model. The Lam Nam Oon model is presently being constructed in one pilot area of 2,600 rai, which should be ready for use in the 1981/82 dry season. Costs for this model are estimated to be 1,500 Baht per rai.

Because of the innovations incorporated in the Lam Nam Oon model and the hope that it will prove to be an acceptable alternative to the Chao Phraya model, it will need to be studied carefully. An operations research program has been designed to measure the model's performance with regard to hydraulics, agricultural yields, maintenance equipment, costs, etc. Assuming performance of the model is satisfactory, it, or a variation would be a vastly preferable alternative to the Chao Phraya model because of its lower cost, respect for the soils and involvement of the participating farmers. The Lam Nam Oon model can also be used independently or in conjunction with both the Ditch and Dike system and the Chao Phraya model.

Recommendations related to future land development include:

3. The Lam Nam Oon model should be subjected to 2-3 years of dry season experience, with careful operations research conducted.

4. During the above test period, expansion of the irrigation system should be restricted to Ditch and Dike methods. The use of land consolidation and leveling methods should be deferred.*

B. Economic Returns

According to the RTG Bureau of the Budget, the construction cost of the dam and irrigation system (excluding on-farm development) was estimated in 1967 at 268 million Baht (US$13.4 million). The current estimate is 1,100 million Baht (US$55 million), with over 1,000 million Baht (US$50 million) already invested, again excluding on-farm works. The Project Paper, in its economic analysis, ignored the capital investment in the dam and irrigation system and projected a benefit-cost ratio of 2.95 and an internal rate of return of 25.8%. These indicators were illusory, as the expected increase in agricultural production has not come about. Today, the economic indicators for the project, when the US$50 million are included, are truly dismal--a benefit-cost ratios of less than one, a negative net present worth and IRRs of less than 3%. To answer the economic question whether the Project should be continued, the Evaluation Team calculated these indicators excluding the sunk capital costs. Under this condition, the indicators are promising enough to conclude that the project should be completed.

The central issue for the Lam Nam Oon project is to determine the course of action which will provide maximum developmental impact at minimum additional cost, in terms of both funding and management inputs. A set of criteria for establishing priorities for new land development must

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* RTG evaluation working group has advised the USAID mission that funds for the development of 15,000 rai using the Chao Phraya model has already been budgeted for FY 1982. The representative from the Bureau of the Budget has recommended that these funds be used for Ditch and Dike development instead of the Chao Phraya model in the project area. However, the project field director has indicated that he is obligated to continue with the 3,000 rai of land consolidation which has been planned and budgeted for in FY 1982.

be developed. There is no question that the benefits to be produced by the project, for both the Thai economy and the individual farmers, cannot be achieved without the size of the irrigated area being increased and the cultivation of profitable dry season crops being expanded. These two objectives must be the focus of the project over the next few years. Increasing the irrigated area must be accomplished through methods which are lower cost than the Chao Phraya model. For this reason as well as concern for the soils, we have recommended deferral of further use of the Chao Phraya model. At the same time, expenditures on activities not directly related to the provision and use of water and the expansion of agricultural production need to be minimized. Despite the success of some elements of the integrated rural development approach of the project design, the paramount importance of water delivery and agricultural production dictates that the project be restructured and funds be reprogrammed to concentrate on a more limited number of project activities.

The Lam Nam Oon project is only one of several such irrigation projects being developed in Northeast Thailand. Capital costs for all the projects are considerable. In Lam Nam Oon the on-farm development work costs 130,000 Baht or US$6,500 for an average 20 rai (5 acre) farm. Operation and maintenance costs are also rather high, although the funding for adequate maintenance has not been provided (this leads to rapid deterioration of the system which is, in fact, a hidden capital cost). The fact that the several irrigation projects will serve only a very small portion of the arable land in the Northeast is a cause for concern to the RTG because of the huge investments required.

Although the Evaluation Team did not visit other projects, we were informed by RTG officials that all suffer a number of common problems. Examples include high per farm costs, damage to soils, inability to organize water user associations and insufficient information on on-farm water management and use. To address these common problems in the most efficient and cost effective manner, the RTG needs to approach them in a coordinated manner rather than treat each project separately.

Recommendations directed to these economic and managerial issues include:

5. The project design should be narrowed to comprise only the irrigation system, on-farm water management and use, and agricultural production. Cooperating agencies should utilize remaining project funds to address only these objectives. The consultant contract should be revised to correspond to the new emphasis.

6. A coordinating mechanism should be established to link the major irrigation projects now being developed in the Northeast. This mechanism would address the technical, operational, research and training problems common to the projects.

Agricultural Production

The soils of LNO are very poor for intensive agricultural production, especially in the dry season. The soils contain little organic matter; the continued use of soil amendments can create chemical toxicity problems; and improper water management and drainage practices will increase soil salinity. The top soil is thin (2 to 3 inches) and fragile.

Glutinous rice is the primary wet season crop. It is used for home consunption and has little market value. With high yielding varieties of seed and proper water management, enough glutinous rice could be produced to meet local needs on fewer rai. A proportion of rai now being planted to glutinous rice could be converted to non-glutinous rice for sale in the market.

Currently, the principal dry season crops are groundnuts, non-glutinous rice, pumpkins, and a variety of vegetables and fruits. Recent agronomic research indicates that these crops, with the addition of melons, sugar-cane, and chili, are the most suitable for the LNO soils.

The Department of Agriculture is now conducting research on diversified cropping patterns. However, more research is needed to develop improved varieties specifically adapted to the poor LNO soils. Agronomic practices which preserve and enhance the fertility of the soil, such as cultivating forage crops and green manure need to be developed. Current applied research regarding these practices should be enhanced and intensified in the project area.

The evaluation team recommends that:

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7. Research on dry and wet season crops suitable for LNO soils should be expanded. Non-glutinous rice, glutinous rice, and alternative dry season crops should be tested more intensively for their response to fertilizers, soil amendments and green manure. Agronomic practices which encourage both diversified cropping patterns and soil conservation need to be further developed and disseminated to the farmers.

Improved agricultural inputs and techniques will not be effective unless the farmers practice appropriate water management. The lack of on-farm delivery ditches and absence of irrigation water management skills result in inefficient use of irrigation water. Over-irrigation occurs when traditional wet season irrigation methods (i.e. flooding) are applied to dry season crops. As a result, the crops are damaged and yields reduced.

Land consolidation and leveling have damaged the top soil, exposing the infertile subsoils where the land was cut. Despite heavy cutting and filling, field observations indicate that many fields in those areas are still not level enough to efficiently apply water management techniques.

In areas where the land is level, a reliable source of irrigaton water is required for effective water management. Water courses must deliver water in the right amounts at the proper intervals to each farm boundary. Farmers will learn to apply irrigation water efficiently only if they are given on-farm technical assistance.

Currently, there is little expertise in water management in Thailand. Therefore, the evaluation team recommends that:

8. Agricultural personnel be trained to transfer irrigation water management technology to the field. Comprehensive courses for these agriculturalists must be taught and extension materials dealing with on-farm water management directed to the farmers should be developed.

Management and Organization

The Project was designed with a rather extensive administrative apparatus, intended to facilitate Project Implementation. This includes a National Coordinating Committee to provide overall policy guidance, to approve annual work plans and to decide major issues of budget, personnel

levels delegation of authority, etc. There is also a Provincial Coordinating committee, intended to provide closer, more frequent management review and guidance. The National Committee has only met once and the Provincial Committee meets only occasionally.

Day-to-day implementation is the responsibility of the Project Field Director at the site, who is supervised by the overall Project Director in Bangkok. The Field Director is supported by a Team composed of representatives of the participating agencies. This team meets monthly to coordinate activities and its members are those RTG officials with direct responsibility for actual on-site implementation of the various integrated activities of the project. This Project Team can be credited with some noteworthy successes, despite the limited progress in the major elements of the project - i.e., the irrigation system and the agricultural production activities.

(a) First, there are numerous instances of closer coordination of functional acitivities, and more extensive coordination is being developed than normally takes place between district or province officials and activities.

(b) Second, the integrated approach has resulted in greater adaptation of activities to a single program objective (i.e., the production objectives of the Project), than normally takes place. The evaluation team got a glimpse of what has probably been the major challenge and accomplishment of the IRD coordinating committee - the administration of the production support programs. Much coordinating committee time was devoted to dealing with the several occassions when the program looked as if it might unravel at both the LNO and Bangkok ends. At times the committee leadership had to cross bureaucratic lines, using the direct reporting line that had been established under the Ministry of Agriculture. The final steps in the support buying program for groundnuts were being carried out during the visit of the evaluation team, with the coordinating committee leadership playing a general program management role beyond the formal job responsibilities of their respective departmental positions. There seems little doubt that the production promotion program this past dry season would not have succeeded were it not for the existence and determination of the IRD committee. The importance of this achievement for the future impact on the entire project cannot be overstated.

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(c) Third, lessons are being learned from the beginnings of integrated planning and operations that may prove useful in the other Northeast irrigation projects, and in other areas and projects generally that call for joint working of different RTG agencies. The successes of the LNO Project Team have been achieved despite the strong traditions of separation, and of vertical rather than horizontal communication among RTG ministries and departments.

(d) Fourth, there is a high degree of motivation and desire for joint programming among the Team Leaders, including those from agencies not getting special budgets under the loan and counterpart provision.

Unfortunately, these successes have largely been realized at the local level with little carry-over to the national level. Moreover, they have occurred primarily in functional areas which have not had much impact on the fundamental elements of the project (i.e., the irrigation system and agricultural production). The major problems of the project may be viewed as having arisen in large part because of a break-down of the management and organization systems.

The Evaluation Team conducted extensive interviews of managers in many agencies at the project, province and national levels. We conclude that the project suffers from insufficient oversight by management in both the RTG and the USAID. There are numerous examples to support this conclusion.

(a) The use of the Chao Phraya model of land preparation continues, despite the fact that all senior RTG officials concerned with the project believe it to be inappropriate and excessively costly.

(b) Although the irrigation and drainage works are the responsibility of a single RTG entity (RID), both horizontal and vertical coordination are poor. The project team at the site must deal with a multiplicity of RID offices in Bangkok. The on-farm irrigation works are designed by a team based in Bangkok, not at the site. RID project personnel at the site believed the planned total irrigated areas was 63,000 rai while Bangkok managers stated it was 106,000.

(c) Delays of up to six months have occurred in processing financial documents for reimbursement simply because standard procedures have not been adopted and because there is not a designated official in each participating agency to relate to the project.

(d) Many of the problems of the project are common to all the major irrigation projects of the Northeast. Nevertheless, no coordinated, systematic approach to them has been initiated.

Recommendations related to these managerial and organizational issues include:

9. Project management should be reorganized to provide for clearer lines of authority, more systematic information flow and closer management attention. This could include the assignment of one person to work within RID to assist the Project Director and the formation of a Project Implementation working group composed of designated representatives of participating agencies to facilitate action within an agency and coordination among agencies.

10. The National Coordinating Committee should be reactivated to meet regularly to review project progress, set implementation targets and provide overall guidance to the operating units.

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FOR

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RURAL DEVELOPMENT PROJECT

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Annex 1 - Project Outputs

Annex 2 - People Interviewed by Evaluation Team

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The Project is, however, beset by a number of major problems, the most critical of which may be categorized as economic and physical, with both categories influenced by managerial difficulties. The fundamental economic problem is that the Project will not be able to produce sufficient return on the investment to cover the cost. When the cost of constructing the dam and the main and secondary canals are taken into account, economic indicators of project viability are discouraging. When the assumptions regarding future costs are varied, the Project, in all cases, achieves benefit/cost ratios of less than one, negative net present values and internal rates of return of less than 3 percent. When the US$50 million sunk cost is excluded from these calculations, the economic indicators improve, but reveal promising results only if it is assumed that lower cost methods of on-farm water development than have been used to date will be employed in the future.

There are two crucial problems related to the physical development of the irrigation system. First, the concrete-lined canals and related structures have deteriorated to such an extent that if operations and maintenance of the

system does not improve, the system will be unable to deliver at the necessary levels to an expanded number of farmers. The deterioration of canal linings, erosion of side slopes and other problems of the physical structures are the result of faulty design, inadequate construction, and lack of adequate resources for proper routine maintenance, or failure to utilize the resources effectively. Second, a large-scale land clearing and leveling technique is being employed which is at once both extremely costly (130,000 Baht for an average-sized farm of 20 rai, i.e. Dollars 6,500 per five acres) and potentially damaging to the thin topsoils of the area. Alternative techniques are available which could resolve both the cost and topsoil problems, but the RTG continues to plan further use of the land leveling technique, although not for the entire project area.

The above economic and physical problems are largely the result of managerial problems. Perhaps the best evidence for this is the fact that all RTG senior officials interviewed acknowledged that they had been generally aware of the major problems for some time. Indeed, earlier reviews of the Project by both outsiders and RTG personnel had identified most of these problems. Moreover, the senior officials apparently agreed with various recommended actions to correct the identified failings (e.g. cessation of the inappropriate land-clearing technique). Nevertheless, the problems have not yet been adequately addressed despite the fact that the Lam Nam Oon Project is not the only large-scale irrigation project in the Northeast, and the others reportedly suffer many of the same problems and are considered to be in a worse state.

Managerial problems are evident in many aspects of the Project. Although the main irrigation system and the on-farm irrigation works are the responsibility of a single RTG entity, the Royal Irrigation Department (RID), both horizontal and vertical coordination are poor. The Project Team at the site must deal with many RID offices in Bangkok. The on-farm irrigation works are the responsibility of a design team based in Bangkok, not at the site. The expensive, soil-damaging land-leveling technique is used, not because it is suited to the project area (or other areas in the Northeast), but because it was successful in the central plains. RID cannot provide management assistance to help project personnel to organize water users' associations or enlist the farmers' participation in construction or maintenance of on-farm irrigation systems. Although many of the Project's problems are common to all the major irrigation projects of the Northeast, no coordinated, systematic approach to them has been initiated. The provision of irrigation water to the farms and the managed use of that water for increased crop production are the essential elements

of the Project, yet it is precisely these two elements which suffer the most from insufficient management attention and action. Two major reasons for non-action on the part of senior managers are that (1) management information systems do not provide the type of information required in a consistent, timely manner; and (2) organizational and managerial arrangements established for the Project have either not been followed or have been ineffective.

The evaluation team makes a large number of recommendations designed to correct various problems or weaknesses of the Project. Some of these recommendations the team considers so fundamental to project success that if they, or similar recommendations are not implemented, there is serious question as to whether the Project should be continued.

Briefly summarized, the recommendations which fall in this category are:

(a) The operation and maintenance budget should be increased to finance the routine maintenance required to prevent further deterioration of the canal system. Management of the Project's O&M section should be strengthened and Project procedures for use of O&M funds reviewed. Funds should also be allocated to rehabilitate the system.

(b) The modified ditch and dike model developed for the Project (called the Lam Nam Oon Model) should be subjected to careful operations research for two or three years.

(c) During the testing of the Lam Nam Oon Model, further expansion of the irrigation system should be restricted to ditch and dike methods and the use of land leveling and consolidation methods (e.g. Chao Phraya Model) should be deferred.

(d) Applied research on dry and wet season crops suitable for project area soils should be expanded. Such research should include on-farm water management and use.

(e) Project management should be reorganized to provide for clearer lines of authority, more systematic information flow and closer management attention. This could include the assignment of one person to work within RID to assist the Project Director, and the formation of an inter-agency project implementation working group.

(f) The national coordinating committee should be reactivated to meet regularly to review project progress and to provide guidance to the operating units.

Major Conclusions and Recommendations

The following report presents, in summary form, the critical aspects of the Lam Nam Oon IRD project which need to be addressed by both the RTG and USAID. While many problems exist, there have been positive results due to the project. The Evaluation Team found that the integrated approach to project implementation has worked quite well in some respects. Various departments of the RTG cooperate to a degree not found in their normal activities outside the project area. The incentive of the price support program for groundnuts has succeeded, in its first year of operation in Lam Nam Oon, in the production of this crop by over 2,000 farmers. The vast majority of the farmers who had access to reliable irrigation did cultivate at least part of their land during the past dry season.

The importance of these positive elements should not be minimized. However, major problems concerning the cost of the canal system and land development, the system's maintenance and rehabilitation, plans for on-farm development both in terms of water management and dry season cropping patterns, and RTG and USAID management need to be resolved. There are other issues which are discussed in the body of the report, but the foregoing are fundamental and discussed here to highlight their significance to effective project implementation.

A. Irrigation and Drainage System

The physical structures of the canal system have suffered extensive deterioration as a result of inadequate construction and a lack of maintenance. Concrete canal linings have broken up, earthen side slopes have eroded and division boxes drop water into unlined tertiary canals, causing erosion under the boxes and their foundations. Many of the water control and distribution boxes are inoperative due to not having had gates installed or gates being missing or broken. In addition, drainage of irrigated areas has proven to be inadequate, with large areas of farm land subject to ponding and thus unusable. Such flooded lands also create salinity problems under both wet season and dry season irrigation conditions. The results of this poor design/construction are canals which are unable to deliver their design capacity of water and a need for major investment in rehabilitation.

While some of these problems relate to improper design or construction, the major cause is an almost complete lack of

attention to maintenance. The O & M section of RID is responsible for operation and maintenance of virtually all the approximately 350 km. of irrigation canals and 100 km. of drainage canals constructed to date. The budget provided for the O & M work for the Project in 1981 is reported by RID to be 3.8 Million Baht (US$190,000).

RTG officials and the evaluation team agree that this amount is inadequate; but, it is not clear that an increased budget alone is enough to guarantee adequate maintenance of the system. The management of O&M funds needs to be reviewed and strengthened to ensure efficient use of allocated funds. Recommendations to correct these problems are:

1. A study should be made and a report prepared covering the work required and costs involved to rehabilitate the irrigation system, to eliminate side slope erosion and to improve the land drainage characteristics.

2. The Operation and Maintenance budget should be increased to a level sufficient to finance necessary routine operation and maintenance of the irrigation and drainage system. The management of the Project's O&M section should be strengthened and the Project procedures for use of O&M funds reviewed. Additional funds should be allocated to rehabilitate the system.

The on-farm development of irrigation systems is far behind schedule. The Project Paper shows a planned irrigated area of 102,000 rai by 1980. For the 1980/81 dry season, only 20,000 rai were irrigated, the primary reason being RID's inability to assure the delivery of sufficient water to a greater area.

It is argued by some project personnel that a larger area can be irrigated in the wet season than in the dry season, because farms with access to the irrigation system can be flooded to the point that water overflows the dike onto adjacent farms. While this, indeed, occurs, it cannot be considered controlled irrigation. Moreover, there are no reliable estimates of the area which received supplemental irrigation in the 1980 wet season. There is, however, no doubt that the irrigated area did not approach the target figure.

The development of on-farm system is being pursued through three different approaches. One (referred to as the Chao Phraya model) involves extensive land clearing and leveling by RID with heavy machinery, followed by realignment of farm boundaries and rebuilding of paddy dikes. To date, the model has been applied to three pilot areas totalling 6,600 rai. This model involves very high cost (6,500 Baht per rai) and significant damage to the thin, fragile topsoils found in the Northeast. The second (called Ditch and Dike) involves virtually no land leveling with RID's role limited to providing water to the farm turnout (via tertiary canals) and drainage for an area. The farmers are then expected to construct the channels which convey water from the turnout to the field. This model is relatively inexpensive (800 - 1,200 Baht per rai), does not damage the topsoil and involves the farmer in the project. Except for a small unsuccessful application of an earlier RID Ditch and Dike model in the early 1970's, the present Ditch and Dike model has not yet been applied in the project area. However, some 16,000 rai were cultivated in the 1980/81 dry season through the use of farm ditches constructed by farmers themselves. The third (Lam Nam Oon model) is essentially a variation on the Ditch and Dike methods. RID constructs irrigation and drainage canals, following natural contours (thus eliminating the need for land leveling), to the farm turnout. The major innovation of this model is the use of a proportional division box to regulate the flow of water rather than the constant head orifice used elsewhere in the irrigation system. Other aspects of the model are the same as those found in the Ditch and Dike model. The Lam Nam Oon model is presently being constructed in one pilot area of 2,600 rai, which should be ready for use in the 1981/82 dry season. Costs for this model are estimated to be 1,500 Baht per rai.

Because of the innovations incorporated in the Lam Nam Oon model and the hope that it will prove to be an acceptable alternative to the Chao Phraya model, it will need to be studied carefully. An operations research program has been designed to measure the model's performance with regard to hydraulics, agricultural yields, maintenance equipment, costs, etc. Assuming performance of the model is satisfactory, it, or a variation would be a vastly preferable alternative to the Chao Phraya model because of its lower cost, respect for the soils and involvement of the participating farmers. The Lam Nam Oon model can also be used independently or in conjunction with both the Ditch and Dike system and the Chao Phraya model.

Recommendations related to future land development include:

3. The Lam Nam Oon model should be subjected to 2-3 years of dry season experience, with careful operations research conducted.

4. During the above test period, expansion of the irrigation system should be restricted to Ditch and Dike methods. The use of land consolidation and leveling methods should be deferred.*

B. Economic Returns

According to the RTG Bureau of the Budget, the construction cost of the dam and irrigation system (excluding on-farm development) was estimated in 1967 at 268 million Baht (US$13.4 million). The current estimate is 1,100 million Baht (US$55 million), with over 1,000 million Baht (US$50 million) already invested, again excluding on-farm works. The Project Paper, in its economic analysis, ignored the capital investment in the dam and irrigation system and projected a benefit-cost ratio of 2.95 and an internal rate of return of 25.8%. These indicators were illusory, as the expected increase in agricultural production has not come about. Today, the economic indicators for the project, when the US$50 million are included, are truly dismal--a benefit-cost ratios of less than one, a negative net present worth and IRRs of less than 3%. To answer the economic question whether the Project should be continued, the Evaluation Team calculated these indicators excluding the sunk capital costs. Under this condition, the indicators are promising enough to conclude that the project should be completed.

The central issue for the Lam Nam Oon project is to determine the course of action which will provide maximum developmental impact at minimum additional cost, in terms of both funding and management inputs. A set of criteria for establishing priorities for new land development must

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* RTG evaluation working group has advised the USAID mission that funds for the development of 15,000 rai using the Chao Phraya model has already been budgeted for FY 1982. The representative from the Bureau of the Budget has recommended that these funds be used for Ditch and Dike development instead of the Chao Phraya model in the project area. However, the project field director has indicated that he is obligated to continue with the 3,000 rai of land consolidation which has been planned and budgeted for in FY 1982.

be developed. There is no question that the benefits to be produced by the project, for both the Thai economy and the individual farmers, cannot be achieved without the size of the irrigated area being increased and the cultivation of profitable dry season crops being expanded. These two objectives must be the focus of the project over the next few years. Increasing the irrigated area must be accomplished through methods which are lower cost than the Chao Phraya model. For this reason as well as concern for the soils, we have recommended deferral of further use of the Chao Phraya model. At the same time, expenditures on activities not directly related to the provision and use of water and the expansion of agricultural production need to be minimized. Despite the success of some elements of the integrated rural development approach of the project design, the paramount importance of water delivery and agricultural production dictates that the project be restructured and funds be reprogrammed to concentrate on a more limited number of project activities.

The Lam Nam Oon project is only one of several such irrigation projects being developed in Northeast Thailand. Capital costs for all the projects are considerable. In Lam Nam Oon the on-farm development work costs 130,000 Baht or US$6,500 for an average 20 rai (5 acre) farm. Operation and maintenance costs are also rather high, although the funding for adequate maintenance has not been provided (this leads to rapid deterioration of the system which is, in fact, a hidden capital cost). The fact that the several irrigation projects will serve only a very small portion of the arable land in the Northeast is a cause for concern to the RTG because of the huge investments required.

Although the Evaluation Team did not visit other projects, we were informed by RTG officials that all suffer a number of common problems. Examples include high per farm costs, damage to soils, inability to organize water user associations and insufficient information on on-farm water management and use. To address these common problems in the most efficient and cost effective manner, the RTG needs to approach them in a coordinated manner rather than treat each project separately.

Recommendations directed to these economic and managerial issues include:

5. The project design should be narrowed to comprise only the irrigation system, on-farm water management and use, and agricultural production. Cooperating agencies should utilize remaining project funds to address only these objectives. The consultant contract should be revised to correspond to the new emphasis.

6. A coordinating mechanism should be established to link the major irrigation projects now being developed in the Northeast. This mechanism would address the technical, operational, research and training problems common to the projects.

Agricultural Production

The soils of LNO are very poor for intensive agricultural production, especially in the dry season. The soils contain little organic matter; the continued use of soil amendments can create chemical toxicity problems; and improper water management and drainage practices will increase soil salinity. The top soil is thin (2 to 3 inches) and fragile.

Glutinous rice is the primary wet season crop. It is used for home consunption and has little market value. With high yielding varieties of seed and proper water management, enough glutinous rice could be produced to meet local needs on fewer rai. A proportion of rai now being planted to glutinous rice could be converted to non-glutinous rice for sale in the market.

Currently, the principal dry season crops are groundnuts, non-glutinous rice, pumpkins, and a variety of vegetables and fruits. Recent agronomic research indicates that these crops, with the addition of melons, sugar-cane, and chili, are the most suitable for the LNO soils.

The Department of Agriculture is now conducting research on diversified cropping patterns. However, more research is needed to develop improved varieties specifically adapted to the poor LNO soils. Agronomic practices which preserve and enhance the fertility of the soil, such as cultivating forage crops and green manure need to be developed. Current applied research regarding these practices should be enhanced and intensified in the project area.

The evaluation team recommends that:

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7. Research on dry and wet season crops suitable for LNO soils should be expanded. Non-glutinous rice, glutinous rice, and alternative dry season crops should be tested more intensively for their response to fertilizers, soil amendments and green manure. Agronomic practices which encourage both diversified cropping patterns and soil conservation need to be further developed and disseminated to the farmers.

Improved agricultural inputs and techniques will not be effective unless the farmers practice appropriate water management. The lack of on-farm delivery ditches and absence of irrigation water management skills result in inefficient use of irrigation water. Over-irrigation occurs when traditional wet season irrigation methods (i.e. flooding) are applied to dry season crops. As a result, the crops are damaged and yields reduced.

Land consolidation and leveling have damaged the top soil, exposing the infertile subsoils where the land was cut. Despite heavy cutting and filling, field observations indicate that many fields in those areas are still not level enough to efficiently apply water management techniques.

In areas where the land is level, a reliable source of irrigaton water is required for effective water management. Water courses must deliver water in the right amounts at the proper intervals to each farm boundary. Farmers will learn to apply irrigation water efficiently only if they are given on-farm technical assistance.

Currently, there is little expertise in water management in Thailand. Therefore, the evaluation team recommends that:

8. Agricultural personnel be trained to transfer irrigation water management technology to the field. Comprehensive courses for these agriculturalists must be taught and extension materials dealing with on-farm water management directed to the farmers should be developed.

Management and Organization

The Project was designed with a rather extensive administrative apparatus, intended to facilitate Project Implementation. This includes a National Coordinating Committee to provide overall policy guidance, to approve annual work plans and to decide major issues of budget, personnel

levels delegation of authority, etc. There is also a Provincial Coordinating committee, intended to provide closer, more frequent management review and guidance. The National Committee has only met once and the Provincial Committee meets only occasionally.

Day-to-day implementation is the responsibility of the Project Field Director at the site, who is supervised by the overall Project Director in Bangkok. The Field Director is supported by a Team composed of representatives of the participating agencies. This team meets monthly to coordinate activities and its members are those RTG officials with direct responsibility for actual on-site implementation of the various integrated activities of the project. This Project Team can be credited with some noteworthy successes, despite the limited progress in the major elements of the project - i.e., the irrigation system and the agricultural production activities.

(a) First, there are numerous instances of closer coordination of functional acitivities, and more extensive coordination is being developed than normally takes place between district or province officials and activities.

(b) Second, the integrated approach has resulted in greater adaptation of activities to a single program objective (i.e., the production objectives of the Project), than normally takes place. The evaluation team got a glimpse of what has probably been the major challenge and accomplishment of the IRD coordinating committee - the administration of the production support programs. Much coordinating committee time was devoted to dealing with the several occassions when the program looked as if it might unravel at both the LNO and Bangkok ends. At times the committee leadership had to cross bureaucratic lines, using the direct reporting line that had been established under the Ministry of Agriculture. The final steps in the support buying program for groundnuts were being carried out during the visit of the evaluation team, with the coordinating committee leadership playing a general program management role beyond the formal job responsibilities of their respective departmental positions. There seems little doubt that the production promotion program this past dry season would not have succeeded were it not for the existence and determination of the IRD committee. The importance of this achievement for the future impact on the entire project cannot be overstated.

(c) Third, lessons are being learned from the beginnings of integrated planning and operations that may prove useful in the other Northeast irrigation projects, and in other areas and projects generally that call for joint working of different RTG agencies. The successes of the LNO Project Team have been achieved despite the strong traditions of separation, and of vertical rather than horizontal communication among RTG ministries and departments.

(d) Fourth, there is a high degree of motivation and desire for joint programming among the Team Leaders, including those from agencies not getting special budgets under the loan and counterpart provision.

Unfortunately, these successes have largely been realized at the local level with little carry-over to the national level. Moreover, they have occurred primarily in functional areas which have not had much impact on the fundamental elements of the project (i.e., the irrigation system and agricultural production). The major problems of the project may be viewed as having arisen in large part because of a break-down of the management and organization systems.

The Evaluation Team conducted extensive interviews of managers in many agencies at the project, province and national levels. We conclude that the project suffers from insufficient oversight by management in both the RTG and the USAID. There are numerous examples to support this conclusion.

(a) The use of the Chao Phraya model of land preparation continues, despite the fact that all senior RTG officials concerned with the project believe it to be inappropriate and excessively costly.

(b) Although the irrigation and drainage works are the responsibility of a single RTG entity (RID), both horizontal and vertical coordination are poor. The project team at the site must deal with a multiplicity of RID offices in Bangkok. The on-farm irrigation works are designed by a team based in Bangkok, not at the site. RID project personnel at the site believed the planned total irrigated areas was 63,000 rai while Bangkok managers stated it was 106,000.

(c) Delays of up to six months have occurred in processing financial documents for reimbursement simply because standard procedures have not been adopted and because there is not a designated official in each participating agency to relate to the project.

(d) Many of the problems of the project are common to all the major irrigation projects of the Northeast. Nevertheless, no coordinated, systematic approach to them has been initiated.

Recommendations related to these managerial and organizational issues include:

9. Project management should be reorganized to provide for clearer lines of authority, more systematic information flow and closer management attention. This could include the assignment of one person to work within RID to assist the Project Director and the formation of a Project Implementation working group composed of designated representatives of participating agencies to facilitate action within an agency and coordination among agencies.

10. The National Coordinating Committee should be reactivated to meet regularly to review project progress, set implementation targets and provide overall guidance to the operating units.

The Thai Context

Thailand, a nation of over 45 million, remains essentially rural and agricultural in character. The metropolis of Bangkok - a burgeoning, modern city of 5 million - remains the main exception, but an important one given its central political and economic power and its demand on natural resources. The agricultural strength of Thailand, centered especially in the fertile delta-like, Central Plains north of Bangkok, has been historically prodigious, and has been the principal engine of growth in Thai development. Thailand is and has been one of the leading rice exporters of the world. Under its constitutional monarchical system, social, economic, and political power has been centralized, governed by "elite" groups operating under approximate rules of consensus and laissez faire capitalism.

Agriculture is the most important sector of economic activity in Thailand, and will remain so over the Fifth Plan period and for years to come. Agriculture's share of GDP has fallen significantly over the last twenty years, but still contributes 26% of total GDP. More importantly, agriculture provides employment for two-thirds of the Thai labor force and accounts for 60-70% of total exports. Until recently, the fundamental capability of Thai agriculture to finance growth and development, especially through exports and taxation, was taken for granted.

During the past 20 years, Thai agricultural production has maintained an annual growth rate of 5%, primarily attributable to expansion of land under cultivation. Most Thai land suitable for agriculture is now in use; the option of extensification of agriculture (which at least in recent history has been at the expense of much of Thailand's natural resource endowment, such as forests) was virtually exhausted by 1980. Therefore, Thailand will have to intensify productivity on existing agricultural acreage through large-scale and efficient investment in order to achieve growth rates anywhere close to the Fifth Plan target of 4.7% for agriculture. This transition from extensive to intensive agri- culture will not be easy. Current yields on several major crops, including rice, are among the lowest in Asia and fertilizer usage significantly lags behind other Asian countries. To assist the small farmer in this transition appropriate research, technology diffusion, multi-purpose credit, modern inputs and marketing systems must be made available. This is of particular relevance in Thailand as the majority of farmers will not participate in irrigation projects. Such basic services tend to reduce the farmer's risk level and thus facilitate acceptance of new technology and the diversification to more renumerative cropping activities.

In common with many developing countries, the Thai Government has pursued a cheap urban food policy, with emphasis on stable, moderate rice prices. The main measure for implementing the policy has been through export taxes on rice (i.e. export duties, premiums and rice reserves). The combined effect of these taxes amounted to a 25% tax on paddy at the farm level in 1980, despite progressive reductions from prior years.

It is generally agreed that such taxes have a disincentive effect on farm production. Since 1974, increases in farm paddy prices have lagged substantially behind the pace of inflation as measured by either the CPI or WPI. Since overall paddy yields have been falling, it would seem that per farm household real incomes from this cereal (and certainly on a per unit planted basis) have also been falling since 1974.

Without incentive pricing, agricultural investment has lagged and the enormous output (and export) potential of Thai agriculture has not been realized.

A second serious problem arises from the variation among regions in agricultural resource endowments, past government investments, and associated productivity in agriculture. The Central Plains, with more fertile soil and more abundant water supplies, is by far the most agriculturally productive and progressive area in Thailand. It has also enjoyed a higher level of public sector investment, particularly in irrigation, and supporting services than other regions, although productivity and output even in this region clearly lags well behind potential. Large sections of the Northeast and North, particularly those that have no access to irrigation, are confined to subsistence farming. Roughly one-half of the 14 million Thai currently considered to be living in "absolute poverty" are rainfed farmers of Northeast Thailand.

The North-Eastern Context

The Northeast grows about one-third of the nation's rice, more than any other region. Rice occupied about 3.5 million hectares of the 8.0 million hectares of available farm land. Yields are low, averaging about 1.4 ton/hectare; virtually all the rice is rainfed and production is subject to wide year-to-year fluctuations. Kenaf became an important crop in the 1960's and in recent years there has been a rapid expansion of cassava cultivation. Both crops, which are now among Thailand's major exports, are grown on upland areas unsuited for rice and are important sources of cash income for the region's farmers.

Storage dams are essential to irrigation in the Northeast. During the dry season, the flow in all except the lower reaches of the larger rivers virtually ceases. In the wet season, river flows follow a similar pattern to rainfall with sharp recessions in flow coinciding with drought periods. Runoff per square km is much lower than in the Northern and Southern regions, and the potential for year-round irrigation is limited to about 30,000 hectares, or less than 10 percent of the toal paddy area. At present, about 30,000 hectares benefit in some degree from wet season irrigation and about 6,000 hectares are irrigated in the dry season. Throughout the Northeast the deep groundwater is highly saline. Shallow aquifers with fresh groundwater are tapped throughout the region for domestic water supply, but yields are too low for irrigation.

Existing Irrigation Projects in the Northeast

Reservoirs. RID began a major program of dam and canal construction in the 1960's. At the present time there are six large projects designed to irrigate about 160,000 hectares. The area receiving reliable and timely irrigation is far less than the potential of the existing projects because of technical deficiencies in the canal systems. Construction of distribution systems was not coordinated with main canals, and in some places main canals are falling into disrepair because they are not being operated, and consequently, are not being maintained.

Tanks. Over the past 20 years, RID has constructed about 200 small reservoirs or tanks in the Northeast with capacities varying from 40 Mcm to less than 0.1 Mcm. The area receiving reliable irrigation from these tanks is probably less than 10,000 hectares in the dry season. The potential for further tank projects in the Northeast is quite limited because terrain and hydrology are not conducive to small-scale irrigation from reservoirs. The flat terrain results in broad and shallow reservoirs and inundation of cultivated areas is large in relation to areas benefited by irrigation. Also, a significant part of the water stored is lost through evaporation.

Low-Lift Pumps. Several projects to exploit the potential for pump irrigation in the Northeast are also being undertaken. The National Energy Administration (NEA) has a particularly successful program for pumping water from rivers in the Northeast and since 1968 has expanded their coverage to about 40,000 hectares, almost 15 percent of the total existing potential. Plans call for more than doubling this total during the next three years.

Policies for Irrigation Development

In most countries, policies have evolved through three states. First, focus is given to the capture and conveyance of water; secondly, more concern is given to plant-water-soil relationships and water utilization; and thirdly, focus is usually given last to the on-farm improvements. In keeping with stage one, the Royal Thai Irrigation Department (RID) has been involved heavily in the design and construction of works to capture and deliver water to command areas. Manpower training and policy formulation has been heavily influenced by this emphasis.

The earlier focus is now in question as the Government is concerned more with water distribution at the farm level in order to increase agricultural production. More attention now is needed on soils, crops, and basic agronomic elements to be incorporated in design, construction and operation of the system.

The special conditions in the Northeast are such that policy decision making is influenced by concerns for rural development and there is general awareness that future projects must be justified in terms of agricultural growth, equity in income distribution, employment generation, and infrastructure to provide small farmers with higher levels of living. The Prime Minister declared that 1979 would be the year to begin to focus on the farmer.

The droughts in the Northeast over the past few years have influenced irrigation policy, as have social and political considerations. Official policy is now concerned with decentralization of decision making in the provinces and integrated approaches utilizing the resources and expertise of a large number of agencies in a coordinated concerted effort. The Ministry of Agriculture and Cooperatives, in which most of these agencies are located, has declared that all future irrigation projects will be integrated, and intensive efforts will be made to coordinate all the departments.

The major international agencies involved, such as the World Bank, Asian Development Bank, and USAID have also had an influence on present policy in Thailand; as they have realized the importance of intensive irrigation improvement to provide the end users with water control and devices for improved agricultural production.

The LNO Context

While the production impact of the irrigation project has been very limited thus far, the LNO area has participated in the general growth of the Northeast over the past twenty years. The expansion of the transportation system; electrification of the villages; increases in the (upland) production of cassava, maize and other export crops; employment and income generation from the spread of government services and investment programs; growth of processing industries - have all contributed to the development of the LNO area. The growth is reflected in the quality of houses, electrification of over half the houses, the increasing ownership of consumer durables (e.g. 8% of households owned TV sets, nearly 25% have sewing machines), and the higher levels of educational attainment of the children compared with their parents.

In many respects the socio-economic conditions in LNO compare favorably with rural areas in other developing countries. There are virtually no landless laborers, very few tenants or share croppers, and the size distribution of land holdings is not skewed. Indebtedness is low, and institutional credit is available and used. Most of the population has been on the same holdings for at least a generation, but there is substantial mobility, especially of the young adults, and especially in the dry season. There appear to be no serious endemic health problems, although drinking water contamination may be widespread. The population is growing. Average family size has been estimated by different surveys as between 6 and 7.85 persons, with the number of living children per mother is 4.6, if not higher. Figures on numbers of women practicing family planning were unclear, but indicated a range of 10-15%.

Wet season glutinous rice is the principal crop, and is grown largely for own consumption. Small amounts of other crops, including vegetables and fruit, are also grown for own consumption and for sale. The population of the area thus depends on outside employment, remittances and injections from government to sustain some considerable portion of its income.

The LNO irrigation project seeks to raise the income of the LNO population, thereby decreasing dependence on aid from the government.

Irrigation and Drainage System

The data and information contained in this section are based upon a review of the available reports, field visits, and reviews and discussions with administrative and operating staff at the LNO project. Discussions were also held with USAID and RID management and administrative personnel in Bangkok. The information obtained has not always been consistent and has varied among the sources. Some of this inconsistency may well have been the result of a language barrier and the difficulty in discussing and exchanging views through an interpreter, particularly at the project site. However, RTG staff from the Bureau of the Budget who worked with the Evaluation Team at the LNO site, reported that they also encountered inconsistencies in their review of the LNO project budget and expenditures.

One notable example that has significant consequences for the project feasibility and ultimate goals was the number of rai to be irrigated, particularly during the dry season. At the project site, the dry season irrigable area was reported most frequently to be 63,000 rai (25,200 acres) versus the 105,630 rai (42,200 acres) which the Engineering Consultants Inc. (ECI) cited in their basic design. The chief of the design section in Bangkok confirmed the 105,630 rai figure to be the design objective. However, even at this Bangkok headquarters office, which was using 1974 ECI data, an inconsistency was noted. These 1974 data show the design total wet-season irrigable area as 204,280 rai (81,700 acres). The 1977 ECI reports that 185,800 rai (79,320 acres) are irrigable in the wet season.

Similar inconsistencies were encountered when the team attempted to determine the length of main and secondary concrete-lined canals constructed to date. All sources agreed that construction of these canals was completed. However, the length of such work varied among sources, as illustrated in the following tabulation:

	ECI Design Data kms	Project Manager kms	Other Personel kms	Reported by BKK Design Section kms
Left System	102	101		101
Main canal	27	28		28
Secondary canal	75	73		73
Right System	290	160		253
Main canals	45	45		45
Secondary canals	245	115		208
Total	392	261	345	354

However, since on-farm delivery systems taking off these main and secondary canals are still in a relatively early stage of development (some 20,000 rai irrigated in 1980/81 of a potential dry season irrigable area of 105,630 rai), such inconsistencies should have only limited influence on the findings of a review of the system at this time.

The Lam Nam Oon project design includes a 30-meter high earthen dam, creating a 520-million cubic-meter lake (128,400 acre feet) of which 475-million cubic meters (117,300 acre feet) are usable for irrigation, and about 350 kms of concrete-lined main and secondary distribution canals. The dam was plugged and reservoir storage started in July 1973. The construction of the main and secondary canal systems are scheduled to be completed in 1981.

The Bureau of the Budget breakdown of expenditures to date amounts to US$51.5 million which includes costs of the canals, dam, right-of-way, administration, consultants, and equipment. Some of these expenditures are related to the upstream Nikhom Nam Oon relocation project (directed to farmers from the flooded reservoir area who were relocated upstream.) These expenditures are difficult to differentiate. This cost breakdown is summarized as follows, and it is presented together with the 1973 ECI estimate for the Lam Nam Oon work.

	Bureau of Budget Cost Breakdown (Lam Nam Oon + Nikhom Nam Oon Project) US$ Million	1973 ECI Cost Breakdown (Lam Nam Oon Project) US$ Million
1. General Work (Surveys, buildings)	2.00	1.55
2. Dam (incl. canal outlet works)	7.43	7.39
3. Irrigation and Drainage System (primary, seconda and on-farm syste)	29.30	13.76
4. Nikhom Nam Oon Project	2.61	not part of LNO.
5. Administration	1.13	0.83
6. Consultants	0.61	0.73
7. Equipment	4.10	4.25
8. Right-of-way	3.30	3.50
9. Roads	1.00	Incl. in item 3
10. Miscellaneous	0.02	Contingency 0.09
Total	51.50	32.10

The major difference between the two cost estimates is reflected in item 3, Irrigation and Drainage System. Higher costs than originally projected were incurred. Current costs are presented in Section 2.

1. Irrigation System

a. General layout. The irrigation system comprises two main canals, a system of secondary canals, on-farm earthen distribution canals, and an earthen channel and drainage system. Water is delivered to the service area by the main and secondary canal systems. When the on-farm canal delivery and distribution systems are completed, current design demonstrates

that the right main canal system will service an irrigable area of 123,069 rai and the left system an area of 62,731 rai, or a total irrigable project area of 185,800 rai out of a gross project area of 266,000 rai. These 185,000 rai could be served with supplementary irrigation water during the wet-season months of May through September.

During the dry season, October through April, design reservoir operation studies show that the reduced quantities of water available (less reservoir inflow,higher evaporation losses, less rainfall) would limit the irrigation coverage to 105,630 rai, given the predicted cropping patterns. At the present stage of development, about 20,000 rai are being irrigated during the dry season.

The water delivery system includes four recently completed low-lift pump stations, with average lifts of about 5 meters. The project design predicts that about 38 percent of the total irrigation demand will be pumped. Three pump stations are located in the left canal system, one along the 28-km main canal at kilometer 16, two along left system secondary canals, and one on a secondary canal off the right system.

b. Canals and drainage. The water delivery system comprises two independent systems of main and secondary canals, one system on each side of the Lam Nam Oon. Water is discharged to each of the main canals through gate and regulator structures constructed in the dam embankment.

Land classification data, selected cropping patterns of areas to receive irrigation water, and duty of water (irrigation water requirements) were used in the design of canal capacities. Main and secondary canals, trapezoidal in cross-section, are lined with unreinforced concrete and have varying cross-section areas commensurate with respective design capacities and gradients.

Under the recent pilot area development (land consolidation and leveling), in Areas 1, 3, and 3A, tertiary canals have been constructed to convey water to the on-farm delivery points. Under the earlier (1972, 1973 and 1974) National Extensive Ditch Program (Ditch and Dike), a series of tertiary canals were constructed by providing extensions to the farm turnouts from the primary/secondary canals to selected division points. Farmer groups, using ditch and dike methods can continue the system to on-farm division points.

Approximately 100 kms of a projected total of 280 kms of drainage ditches and canals have been installed in the irrigated areas for which on-farm water supply and distribution systems have been provided. Where practicable, existing drainage courses and channels have been followed in providing land drainage relief.

c. Access roads Laterite surfaced roads have been provided alongside the primary, secondary and selected stretches of the tertiary canal systems to provide access and egress for farm materials and crops. The roadway width designs vary from 3 to 4 meters along the smaller tertiary canals to a maximum of 10 meters along the main canals. About 198 kms have been constructed of which 33 kms, located at the heads of the left and right main canals, are asphalt surfaced.

d. Operation and maintenance. According to project personnel at the site, a varied grouping of 137 persons comprise the staff of the Operation and Maintenance Department (O & M). As the sections of the primary/secondary canal and drainage systems are constructed, the completed sections are turned over to the O & M for operation and for maintenance. With primary/secondary canal systems now complete, the O & M has assumed the responsibility for the concrete lined primary/secondary system and the constructed sections of the land drainage network.

As various sections within the project area are developed (e.g. Pilot Areas 1, 3, 3A), additional maintenance responsibilities are added. These include the tertiary canal systems (together with the paralleling access roads) which convey the irrigation water supply from the primary/secondary basic canal system to the on-farm distribution gate/pipe. The access roads which parallel the basic primary and secondary canal systems, however, are maintained by the sub-regional office of the RID Road Construction and Maintenance Department for Irrigation Projects, located in Phang Khon, 10 km east of LNO. This division is organized to perform road work on several projects and operates independently of the O & M office of LNO.

2. Pilot Areas

Two basic pilot systems have been developed. One pilot system is patterned after the central plains Chao Phraya project model. The other system is reported to be a new approach for LNO. It was prepared by the Berger consulting team and represents a modified RID ditch and dike model which is applicable to the LNO project. The systems will be observed

in order to compare construction costs, operational results on water delivery, water management and use, land management, cropping and yields, and land drainage characteristics.

a. Chao Phraya model. This model encompassess land consolidation, extensive land leveling and clearing (tree removal), and a tertiary unlined canal system to the on-farm delivery point with a parallel access road network. Limited water control is provided through concrete division boxes, all with the same standard equal-area openings (40 cm x 50 cm) provided with guided slots for inserting a wooden or metalic barrier stop control. The on-farm diversion is by means of an uncontrolled 8-inch pipe inserted through the canal level as it passes the farm property. It is reportedly placed at a level to provide a 10 cm head over the top of the pipe when the tertiary canal is running full.

This model has been applied on Pilot Areas 1, 3 and 3A, a total of 6,600 rai. Pilot Area 1 (900 rai) was completed in 1976; Area 3 (3,000 rai) which is subdivided into 3 sections was constructed during the years 1977-80; and, Area 3A (2,700 rai) is to be completed in 1981. The 1981/82 land development plan proposes that 5,000 rai adjacent to Area 3A be developed using the Chao Phraya Model. In addition, there are plans to re-enter and improve Area 1 since neither farmers nor RID have been maintaining the tertiary conveyance system to the on-farm delivery points.

Development costs for this model have averaged 6,000 baht per rai (US$750 per acre), and costs for the next increment of work are projected at 6,500 baht per rai (US$810 per acre). Considering that the average farm size is about 20 rai, this projected cost results in an average investment by RID of 130,000 baht (US$6,500) per farm. Seven per cent of the farmer's land is required for canals, drainage ditches and roads. The farmers do not object to the loss because they perceive that they will receive enough benefits to make up for the lost land.

b. Lam Nam Oon model. This model minimizes the degree of land preparations. It requires no land consolidation and involves only limited land leveling and limited, selective land clearing (trees are left wherever practicable). The layout of the unlined tertiary and quaternary canals, drainage, and road systems with a reported 2% farmland loss are adapted to the topography, avoiding the extensive land clearing and leveling operations of the Chao Phraya model. Water control is provided by means of concrete division boxes whose sizes of outlet openings are proportioned to the number of rai to be irrigated below the outlet. A further degree of water control is

exercised through a rectangular multiple section hinged flap gate which regulates the quantity of water passing through the proportional opening by the number of sections of flaps in the open and/or shut position. The on-farm diversion is through an uncontrolled 8-inch pipe inserted through the canal level as it passes the farm property. The number of such diversions per tertiary/quaternary canal are limited. This lowers losses by evaporation and seepage, minimizes competition and encourages sharing in water use, particularly during the dry season. Generally, it represents a modified ditch and dike development operation, a practice that has been followed since the mid-seventies at other RID projects. The basic differences of the LNO model are the shorter canals and the proportional division boxes.

This model is now being installed in Pilot Area 2, an area of 2,600 rai. A 2 to 3 year testing period has been suggested by the consultants to observe operational results. However, after the first year of operation, the LNO model, according to the LNO RID project field director, will probably be installed in the project (if it is successful and is accepted by the farmers) in the 1982 ditch and dike program on 15,000 rai in an area east of Pilot Area 3A.

Development costs for this model are expected to average 1,000 to 1,200 baht per rai. On the basis of an average 20 rai farm unit, the development cost per farm unit will be 24,000 baht (US$1,200).

3. Consultants

The firm of Louis Berger International, Inc. is providing consultant services, financed under the AID loan, for assistance and advice to the RID in overall project management. The contracted cost for these services is US$1,028,249 and 3,039,000 baht or the sum of US$ 1,180,199 to provide 139 man-months of services until the termination date March, 1983.

a. Scope of services. The scope of work provides for advisory type services and enumerates a multitude of consultant assistance and advisory duties. No definitive responsibilities other than the preparation of a monthly report, using data provided by the concerned agencies, for submission to the USAID are required. These duties include advice to the RID regarding preparation and development of work programs and documentation for construction by contract and by force account; completion, development and implementation of operation and maintenance procedures; preparation and completion of topographic maps;

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supervision and management of construction contracts and activities; procurement of materials and equipment; implementation of project cost and management control and information systems; and, coordination of operational research in the three pilot areas.

In addition, similar advisory type service is to be provided other departments to develop functioning agricultural extension and research programs and to coordinate community development activities.

b. Performance. The effectiveness of the Berger team, serving basically in an advisory role with no delineated project activity responsibility, is limited. The three-man expatriate team working at the Lam Nam Oon site conveys the impression that it is an independent working group. Communication between the team and the RID and LNO administrative and operating staff is limited. The scope of services of the Berger contract basically outlines an advisory role to provide selected assistance in planning, construction, scheduling, maintenance, procurement and on-farm testing operations. Performance and effectiveness in this type of advisory role requires a close inter-relationship between consultants and project manager. There must be mutual understanding and trust. Both seem to be lacking in this particular consultant/client association. An advisory role requires a high degree of inter-personal skills and sensitivity. Consultants who have prior experience in Thailand and speak Thai could be more effective in this capacity.

The above mentioned problems could be the result of a vague scope of work which does not identify any meaningful project responsibility. The consultants were contracted by the Ministry of Agriculture in accordance with USAID loan conditions. However, it is the RID who must implement the project. Most of the RID work has been financed from the RTG budget and is not matched by funds from the USAID loan.

In order to document their participation in project activities, the Berger consultants prepared a series of 6 to 8 documents (in English), dealing with project planning, development and operations. One of these, Guidelines for Tertiary Irrigation System Development, is the basis for the LNO model on-farm canal and drainage system development in Pilot Area 2. Another, Lam Nam Oon Preliminary Water Space and Integrated Rural Development Planning, (Project Note #2), provides guidelines for establishing priorities for selecting areas for on-farm development. There has not yet been a government response to the consultant's Project Note #2. Since the RID

recognizes that land consolidation and leveling are inappropriate in the Northeast (and very expensive), the LNO field staff was directed to implement the LNO model in Pilot Area 2.

c. Proposed changes. At this stage of development, the consultant should emphasize water conveyance and on-farm water distribution. Without reliable irrigation water, farmers will be unwilling or unable to take advantage of the other components of the project. Therefore, those aspects of the consultant services which do not deal with guaranteed water delivery and on-farm distribution can be deferred and, perhaps, even eliminated. The consultant has presented a revised staffing structure for approval of the RID and USAID. The USAID is deferring its comments awaiting the results of this evaluation.

4. Maintenance Equipment

During the preparation of the PP in early 1977, the RID and USAID agreed to a list of operation and maintenance equipment to be procured with loan funds. This list was reviewed and updated in January 1980, and it includes the basic equipment needed to perform the routine operations and maintenance of the main and secondary canals, the on-farm tertiary and quaternary canal networks, the land drainage channels, and the on-farm tertiary and quaternary canal networks, and the on-farm access road system. The estimated cost projected in the PP for this procurement was US$2,186,500 of which US$547,000 would be provided by the RTG. US$1,639,500 would be financed with project loan funds.

a. Project paper equipment listing. The following tabulation shows this updated January, 1980 list of operation and maintenance equipment needs. The total cost of this equipment is US$1,693,125 which includes an allowance of 25% of the basic cost for spare parts procurement.

OPERATION AND MAINTENANCE EQUIPMENT LIST/COST

(Updated List of January 1980)

	Description	No.	Unit Cost (US)	Amount (US)
1/	Front-end 1.5 cu yd (with multi purpose bucket, rubber tire, 100 HP	3	$ 47,500	$ 142,500
1/	Backhoe Attachments for Loader	3	8,100	24,300
1/	Trailing Ditcher for Loader	3	1,900	5,700
1/	Land Plane	3	2,500	7,500
4/	Backhoe (5/8 cu yd 100 HP)	1	55,000	55,000
2/	Dump Truck, 5-6 Ton (Diesel Engine)	6	21,000	126,000
3/	Motorized Grader, 60-70 HP	3	38,500	115,500
4/	Motorized Grader, 125 HP	1	81,000	81,000
4/	Excavator, dragline 0.75 cu yd	1	220,000	220,000
4/	Generator, mobile diesel (25 kva)	1	11,000	11,000
4/	Truck, water tank (1,500 gal)	3	38,000	114,000
4/	Truck, fuel (1,500 gal)	1	38,000	38,000
3/	Truck, Flat-bed (5-6 ton), (Diesel engine)	1	21,000	21,000

4/	Vibrator, Concrete, gas stow	4	2,000	8,000
4/	Tractor, Crawler w/blade, 140 HP	2	90,000	180,000
3/	Farm Tractor w/mower	3	10,000	30,000
4/	Crane, wheeled, 5 ton	1	70,000	70,000
	50 Ton Lowbed, Semi Trailer, with Tractor 54,000 lb GVW	1	105,000	105,000
	Sub-total			$1,354,500
	Spare Parts 25% 5/			338,625
	TOTAL			$1,693,125

1/ From Table 7 Annex 1 World Bank Appraisal Report on Northeast Thailand Improvement Project, July/73.

2/ Two units per Operating Unit plus 2 for general project use.

3/ One unit per Operating Unit.

4/ Overall project use.

5/ Essential that a FE fund be provided for this otherwise efficiency will be severely affected.

b. Proposed equipment needs. To date, none of this equipment has been procured. The evaluation team reviewed this list and revised it based on the project's current needs for operations and maintenance equipment. The present and projected stage of development and the deteriorated condition of the irrigation and drainage system were taken into consideration. To assist the evaluation team, USAID provided the services of Niel A. Dimick, USAID/Cairo, Agricultural Engineer, who after consulting with RID staff at the project site, prepared the following listing of maintenance equipment. This list shows the number and types of units proposed to equip a mechanical equipment pool needed to respond to routine operational and maintenance requirements. The team suggests a

minor change to the Dimick list which it considered more applicable: that is, the substitution of 3 dump trucks for 3 flatbed trucks, a change which USAID may wish to review and pursue further with the RID.

The on-farm irrigation system development work has fallen behind schedule. Therefore, the projected lengths of operating systems (canal/drainage) to be maintained has been reduced. Thus, the evaluation team suggests this equipment should be under two separate purchases, immediate and future, as shown in the listing. This two-step purchase arrangement also will provide the benefit of the actual experience/record with the first-stage equipment purchase, thereby permitting modifications where needed. The second-stage of the procurement process should be completed two years following the first purchase.

The following list identifies the number and types of equipment proposed by the evaluation team. The estimates of cost are based on 1981 and the list basically includes the equipment required to perform routine maintenance (canal, drainage ditch and side-slope clearing) and some minor reconstruction work. Any extensive reconstruction and rehabilitation work requiring heavy construction equipment, such as, drag lines, large bull dozers, graders (e.g. realigning and clearing land drainage courses and extensive reconstruction and repair to rehabilitate the canal system) should be contracted. This eliminates the need for the heavy construction-type units (drag line, low-bed trailer and graders) included in the earlier list at an estimated saving of US$651,900, including spares, when compared with the earlier January, 1980 list. This type of heavy equipment would be used only intermittently and would place an extraordinary burden on the O & M budget with its logistic and manpower needs. Although graders are needed for main road maintenance, this function is the responsibility of the RID Road Construction and Maintenance Department at LNO. The O & M engineer at LNO stated that this would be the first RID irrigation project with a pool of maintenance equipment of this type and scope. It is expected that other internationally financed project, such as Nam Pong and Nong Wai, under German and Japanese support, will soon follow with similar types of maintenance equipment pools.

Proposed Equipment Procurement
(June 1981 US Dollars)

Item No.	Immediate No.	Immediate Cost	Future No.	Future Cost	Total No.	Total Cost
1. Pick-up truck (1)	2-	$24,000	2-	$24,000	4-	$48,000
2. Trucks (2)						
(a) Dump	2-	50,000	1-	25,000	3-	75,000
(b) Flatbed	1-	25,000			1-	25,000
3. Motor Cycles (3)	9-	6,600	13-	9,500	22-	16,100
4. Truck w/crane and hydraulic Vaughan type (muc) pump	1-	150,000			1-	150,000
5. Industrial tractors (Ford 6,600 or equal) with loader, backhoe and Vaughan type pump (4)	2-	100,000	1-	50,000	3-	150,000
6. Heavy duty goose neck trailer matched to 2. (b)	1-	20,000			1-	20,000
7. Tractor with mowers (4)	1-	20,000	2-	40,000	3-	60,000
8. Work site drainage pumps (4)	1-	4,000	2-	8,000	3-	12,000
9. D-4 type crawler w/dozer and ditcher	1-	40,000			1-	40,000
10. Fuel/service truck	1-	40,000			1-	40,000
11. Service trailers (5)	1-	10,000	2-	20,000	3-	30,000

Footnotes:

(1) One for each operation unit and one for main office.
(2) One dump truck for each operation unit; the flatbed truck for general use.
(3) One for each zoneman, 125 cc off-road type.
(4) One for each operation unit.

12. Hand Tool sets (6)	2-	2,500	2-	2,500	4-	5,000
13. Concrete mixers (4)	1-	5,000	2-	10,000	3-	15,000
14. Concrete vibrators (1)	4-	3,000			4-	3,000
15. Water tanks (7)	1-	2,000	2-	4,000	3-	6,000
16. Communication System (8)	Lot	42,000	Lot	28,000		70,000
17. Portable compacting machines (4)	3-	3,000			3-	3,000
18. Tar-pitch asphalt kettle trailer units (4)	1-	2,000	2-	4,000	3-	6,000
19. Compressor w/accessories	1-	20,000	2-	4,000	3-	6,000
20. Portable generator welders (4)	3-	5,000			3-	5,000
21. Generator - 25 KVA			1-	11,000	1-	11,000
22. Workshop equipment (9)	Lot	10,000				10,000
Sub-total		$584,000		$236,000		$820,000
Spares - 25%		$146,000		$ 59,000		$205,000
Total		$730,100		$295,000		$1,025,100

(5) Could be made locally, descriptive literature will be forwarded. Snoco company in the United States makes such a service trailer.
(6) More comprehensive list will be forwarded.
(7) Locally fabricated units to be carried on trucks as work requires.
(8) See attached skematic; basic system serves both operations and maintenance and administration.
(9) Budget of $10,000 based on retention by O & M of existing buildings and shop equipment now used by Construction Department.

5. Field/Site Observations

A two-week field and site review was conducted by the visiting team. The team observed the stage of development, operation and maintenance practices, the condition of the canal and drainage system, planning and development procedures, and water control and delivery performance. In conducting these on-site reviews, field trips were made over selected portions of the system to observe conditions in the pilot areas, ditch and dike fields, and along parts of the main and secondary canal and drainage system. Assisting and participating were administrative, design, construction, operating and maintenance members of the LNO staff, and the three expatriate members of the Berger consultant team. Many technical discussions had to be conducted via an interpreter. This was particularly difficult because the interpreter was not familiar with technical terminology. As a result, responses to particular points in discussion were often vague. The Berger consultant team, occupying adjacent office space, was extremely helpful in providing project data and information from its files. They also briefed the team on the project background and on their experience at the LNO site. The LNO staff were equally cooperative.

a. Condition of conveyance roads, and drainage systems. At the time of the visit, the last sections of the main and secondary canal system at its lower eastern end and had just been completed (early 1981). This work was performed under contract. Construction work in Pilot Area 3A, being performed by force account, was also nearing completion, projected for June/July. The initial work on Pilot Area 2, also under force account, was underway. However, with the rainy season approaching, it was reported that Area 2 would probably not be completed until the next dry season, beginning in October.

The older main and secondary canal system (between dam and Area 3 on both left and right sides) is in a deteriorating state and in need of extensive repair and rehabilitation. Near the head of the right main canal, an earth slide behind the concrete on the right side had dropped a 50-foot section of lining and other debris into the canal. Apparently this condition has existed for more than two years. Silt deposits were noted throughout, estimated at 0.5 to 1.0 meter deep, with vegetation growth in many of the silted areas.

Washouts were appearing behind the concrete lining, the result of piping action whereby surface water, for lack of appropriate drainage, infiltrated the earthen embankment behind and at the top of the lining, worked its way to the bottom of

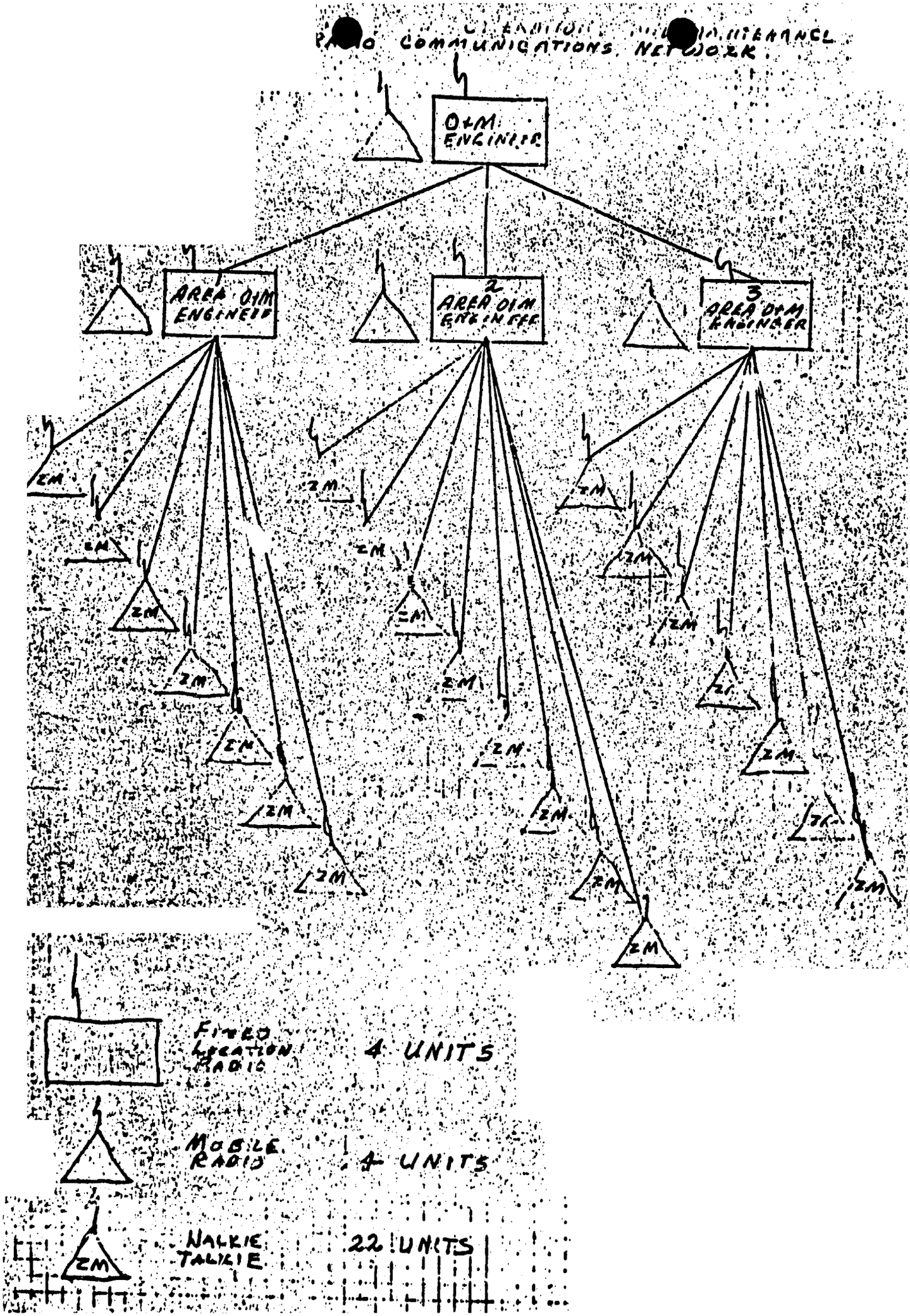
the canal, and the hydrostatic pressure created had broken holes in the concrete. The construction drawings show a weephole in the lower middle of every concrete slab to relieve such a situation. The unreinforced concrete slabs, about 2 inches thick, which make up the lining, have been placed in lengths of 2 to 3 meters. Although at first examination, weep holes were not evident, a second inspection near the head of the right canal, where the water level had receded, disclosed some 1-1/2 inch pipe weep holes near the bottom of the slide lining opposite the point of such damage as noted above. Apparently, the gravel filters behind the weep holes have been plugged and appear not to be functioning.

Such holes were evident throughout many sections of the canal, in most cases appearing at the bottom of the side lining and at other locations nearer the center and top of the lining. No doubt, at some locations, this concrete break-out problem may be the result of poor concrete construction (some spalling and crumbling was noted) but more frequently, it could be attributed to a lack of hydrostatic relief behind the lining. Fast drawdown of the water level in the canal, a reportedly frequent occurence, leaves a hydrostatic pressure build-up behind the lining and contributes to this potentially destructive situation.

Longitudinal cracking near the center of the lining was noted throughout, another result of hydrostatic pressure build-up behind the lining. At some locations, bulging at the cracking would indicate that the hydrostatic pressure exerted may be pushing the lining out of place.

Along lined sections with barren, earthen side slope above and with no berm (the drawings indicated a berm but it was apparently not constructed - possibly a cost saving measure), considerable erosion was noted with silt in the bottom and side of the canal. As much as 1/3 to 1/2 of the cross-sectional area was blocked by silt at some locations. Where side slope vegetation growth had taken place, erosion was not so evident. The Berger team told the evaluation team this condition has existed since the team's arrival and no corrective action has been taken except under crisis conditions (extreme water flow reduction and/or stoppage).

Main canal check structures lack the control gates for which space had been provided. Similarly, many of the farm turnouts lacked the planned gate controls. Also, the connection from the main/secondary canal turnout to the limit of the right of way, generally a short lined section of canal, was, in many cases, destroyed where it crossed the borrow area alongside the road.


RADIO COMMUNICATIONS NETWORK
O+M ENGINEER
AREA O+M ENGINEER
2 AREA O+M ENGINEER
3 AREA O+M ENGINEER
ZM
FIXED LOCATION RADIO
4 UNITS
MOBILE RADIO
4 UNITS
WALKIE TALKIE
22 UNITS

Some lining repair work was observed in progress. Damaged sections of concrete lining were being removed and replaced with new work. Inspection of a recently repaired lining showed it was again deteriorating, cracking up and falling apart.

The roads appeared to be in relatively good to excellent condition. Along the majority of the routes, except for a few soft spots in low areas where surface drainage appeared to pond and present a problem, riding surfaces appeared to be in good condition. At a few other locations bordering borrow pits from which the materials for the construction embankments for the roadway and canal had been obtained, erosion which was cutting back and endangering the roadway embankment was noted. However, fill and rehabilitation work to repair and remedy this condition was observed in progress. At another location, piles of laterite surfacing material had been deposited to prepare for roadway resurfacing. The surface of the roadway appeared in fairly good condition, and the need for resurfacing at this time could be questioned, particularly considering the relatively light amount of traffic. In view of the deteriorating condition of canals, the priority of expenditures for questionably needed road maintenance versus funding for more urgent canal repairs should be a factor for consideration in future budget allocations for these services.

Considerable drainage problems and ponding were observed throughout the arable areas of the system. This occured in areas scheduled to be developed with on-farm conveyance and delivery systems and in other areas with on-farm delivery canals and drainage networks in place. In the case of the areas developed under the intensive program (land consolidation and leveling), two problems were apparent. In the one situation, the land leveling (reportedly accomplished under somewhat unsupervised procedures, utilizing heavy construction equipment without the benefit of control surveys and grade stakes to identify amounts of cuts and fills) resulted in uneven finished grades with high and low spots which tended to create ponding conditions without outlets for drainage.

In the other situation, land drainage was apparently discharged to existing drainage and stream channels without downstream reviews to assure that these channels passing through developed farm areas had the capacity to receive and carry off the drainage flows, particularly in conjunction with the intense monsoon rainfalls. The team observed flooding and ponding on developed farm areas after a heavy rain.

In the undeveloped farm areas, the severe ponding appears to result from the system of distribution of uncontrolled supplemental irrigation waters which flowed over the land from one enclosed farm unit (bunded areas) to the next without any provisions for drainage. Drainage occurs at the last farm unit of the chain, which may or may not be located alongside a natural drainage channel. Under this condition, intense monsoon rains, some of which were experienced during the team visit, create huge lakes, inundating large areas because of the lack of defined drainage channels through the farms and because of the runoff restrictions created by the bunded farm units. It could take several days to weeks for the farm units to drain, creating conditions which could induce water logging and increased salinity in the soils.

The Berger consultants have recommended that no further land drainage work (nearly 100 kms completed of a projected 280 kms total) be undertaken until a drainage survey of the project area has been conducted and analyzed. This study should review the drainage characteristics of the project area; consider projected irrigation return flow patterns and projected storm water runoff flow patterns, both in conjunction with capacities of drainage channels to carry off and discharge the combined return and peak storm water flows with a minimum flooding and ponding in the project area. The study should also summarize and present the indicated measures, together with costs and priorities for implementation. The scope and types of modifications to improve the area drainage characteristics should be provided in order to meet the land drainage needs of the project area in the least damaging and most cost effective manner.

b. Operation and Maintenance. The Operations and Maintenance Department reports to the Ubon Regional Office, which is responsible for the entire main and secondary canal and drainage systems and the tertiary systems and roads within the developed areas. The LNO O & M department reported that it had a 1981 repairs budget of 3.8 million Baht (US$190,000), to perform routine operations and maintenance of the canal system. An even larger sum would be needed annually to rehabilitate the system.Priorities for maintenance work are determined by the seriousness of the problem. Occasional added funding may be made available for urgently needed repairs of unforeseen disruptive damages to canal operation. The LNO O & M Department is also responsible for the maintenance of the relatively small development (27 km of canals and pump station) of the upstream Nikom Nam Oon project.

The O & M operates a relatively small equipment pool, all units over 10 years old except for a new pick-up truck, as follows:

1 - dump truck
1 - land rover
1 - pick-up truck
3 - concrete mixers
3 - motor cycles
8 - wheel barrows with hand tools

The motor cycles are used by four zone men for water control purposes. On this basis, one zone man is responsible for overseeing the irrigation of 40,000 rai in the wet season (O & M reports 160,000 rai are provided with supplemental irrigation water in the wet season).

The repair shops and buildings of the construction department are located beside the O & M office at the LNO administrative center. The O & M people expect that these buildings, together with the machine and repair facilities, constructed and equipped for the construction of the dam, will be retained by the O & M following the construction of the on-farm develoment facilities, projected for completion in 1985. In addition, the O & M proposes to construct three project area maintenance centers (estimated at 300,000 Baht each - US$15,000), but O & M's budget for these facilities has not been approved yet. The centers are to be located at the mid-zones of the west, center and east portions of the project area.

People have given the evaluation team a variety of estimates concerning budget needs for maintenance. These estimates have varied from as much as 70 Baht per rai for fully developed areas to as low as 30 Baht per rai. RID has a country-wide average unit allowance of 42 Baht per rai determined by the Bureau of Budget, based on examinations and evaluations of RID budget requests.

RID officials, both at the site and in Bangkok, indicated that they are fully aware of the deteriorating conditions of the canal system. The O & M people maintain that they are addressing the problem. They consider that all critical potentially disrupting situations have been confronted and remedied. They told the team that the lower portion of the main and secondary system, only recently completed, is still under contractor guarantee and will require little or no maintenance. This rationale was also given for the relatively low LNO maintenance budget allocation.

Nevertheless, one order of magnitude type of estimate, prepared by the Berger consultants, indicates that a funding level of 40.0 million Baht (US$2.0 million) per year over a three to four years period is needed to fully rehabilitate the damaged conveyance system. This estimate is reportedly based on a very general reconnaissance and is subject to confirmation by a more detailed field review and survey to identify the scope, type, location, and magnitude of the rehabilitation work needed. A detailed cost estimate and implementation schedule showing the priority for accomplishment and the method for construction, whether by force account or by contract, should also be developed.

The RID told the team that this type of review had been done in preparation for a budget request presented last year. RID was requesting funds to repair damages following heavy flooding. The team was unable to examine these data; therefore it is not known whether or not it contains the necessary analysis of the problems and the estimates of costs, materials and personnel required to repair them.

5.0 million Baht (US$250,000) have been requested for 1982 operations. The maintenance people are not sure that this amount will be made available because, within RID, the major budgeting emphasis is on new construction. Even during the operating year, it is reported that shifting and transfer of funding takes place to meet new project construction funding needs, to the detriment not only of the LNO maintenance budget but also to the detriment of older LNO on-farm project construction and development. The Bureau of the Budget reports that the LNO project has never expended more than 40% of its approved annual budget allocations because of the above mentioned transfers. The LNO project director reports, however, that, although this may have happened in the past, during 1981, the project fully utilized its allocated construction and administration budget of 45.0 million Baht (US$2.25 million).

A law proposing that farmers pay an on-farm maintenance fee of 20 Baht per rai is in the process of being issued. The law has received Cabinet approval and now awaits enactment by Parliament. Under the Ditch and Dike Act, RID is responsible for maintenance of the canals to the farm turnout, after which the farmer takes over. Experience has indicated that the majority of farmers are not able to meet this on-farm irrigation maintenance responsibility. To assure that the on-farm maintenance is performed, a modest fee will be collected for this purpose by the Water Users Association, which will also administer the use of these funds and the maintenance work. Farmers will be contracted to do the

necessary work. It is recognized that this type of program will only be accepted and succeed in areas where the water supply be guaranteed. Thus, once the law is enacted, the identification of a pilot area in which to initiate this maintenance and operation fee charge will be subject to careful study and selection.

The maintenance of the access roads paralleling the main and secondary canals is performed by the RID Road Construction and Maintenance Department. This group does not maintain the road network along the tertiary canals within the on-farm development areas. This is the responsibility of the O & M operation. The LNO area road office, located in Phang Khon and reporting to the Korat Regional Office, is also responsible for road work in the Lan Pao and Nam Phong irrigation projects and other small irrigation developments spread over eight northeast provinces.

At the present time, all the main/secondary road network (198 kms) of the LNO project has been constructed and turned over to the RID Road Construction & Maintenance office for maintenance. This road network includes 69 kms along the left and right main canals of which 33 kms at heads of these canals are asphalt surfaced (double-surface treatment) and 36 kms are laterite surfaced. The 129 kms along the secondary canal system are laterite surfaced.

Budget allocations for road maintenance appear to be quite ample. The road engineer told the team that his 1981 budget was for 2.7 million Baht (US$135,000). 1.4 million Baht (20,300 Baht (US$1,000) per km) was for main canal roads and 1.3 million Baht (10,100 Baht (US$500) per km) was for secondary canal roads. These are repair work allocations and do not include salaries. He maintains a permanent staff of 40 direct hire employees, mainly equipment operators, and hires labor (47 Baht per day) at the job sites.

The equipment pool includes many pieces of basic construction equipment. This group also performs road construction work. It is now building roads at the Lam Pao project. The equipment pool may be temporarily supplemented, on a loan basis, through requests to its Korat Regional Office, a procedure which may take up to one month to fulfill. This projected equipment loan request needs to be identified at the time of the annual budget submission so that the use of the equipment pool may be programmed. The borrowed equipment is retained until the work for which it was requested is completed. In the same way, this sub-regional office may temporarily loan its equipment to other road offices.

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The equipment pool at the time of the field visit is s follows:

3 - Bulldozers (TD20's)
4 - Scrapers (Euclid 6/8 yds)
4 - Graders
3 - Pneumatic compactors
2 - Farm tractors
3 - Water trucks
1 - Metal roller
7 - Dump trucks (6 cm)
5 - Pick-ups (2 on loan)
2 - Two-ton Flatbed trucks
1 - Front end loader (on loan)
1 - Asphalt spreader.

c. Planning and Development. Recent planning and development appears basically to have been concentrated in the on-farm intensive developments of Pilot Areas 1, 2 and 3. Earlier planning also included some development below the dam (reportedly 50 to 60,000 rai) by ditch and dike methods (1972, 1973, 1974 - National Extensive Ditch Program).

Under the intensive program of Pilot Areas 1 and 3, land consolidation and reparcelling were followed by land clearing, tree removal and land leveling. The tertiary canal system with its division boxes and land drainage network were then installed.

For 1982, the LNO administration is proposing construction of an additional 5,000 rai intensive land consolidation area adjacent to and east of Pilot Area 3-A. This area may be reduced to 3,000 rai*. For 1982, the LNO staff proposes that 15,000 rai in the area east of Pilot Area 3-A be developed using modified ditch and dike procedures. The LNO model will be used, if the results of the evaluation and testing program now underway in Pilot Area 2 confirm the planning, design critieria, and the expectations for this model.

* Information submitted to USAID after the evaluation team's departure indicates that funds for 15,000 rai of land consolidation have been allocated for FY 82. RID officials have stated their willingness to reallocate these funds for other methods of land development. However they feel obligated to proceed with the planned 3,000 rai of land consolidation in FY 82.

There is one problem regarding the land to be used for the ditch and dike and LNO model canal system. Under land consolidation, the 7% land loss for roads and canals is shared by all the farmers. Under ditch and dike and the LNO development models, the area loss (2 to 3%) is borne by the farmer on whose property the roads and canals are constructed. Thus, farmers find road construction less acceptable under ditch and dike construction practices.

d. Water Control and Delivery. Two methods of water control are exercised in the operation of the canal system. The first is through the use of constant head orifices controlled by two gates at the farm turnouts. The second is through canal check gates and structures which control water levels for regulating flows into farm turnouts and through secondary and tertiary canal systems. There are 725 farm turnouts in the system. The canal system has many gates missing, apparently removed after installations, indicating a general lack of water control capability.

Four of the projected 22 zonemen are on the O & M staff now. They try to exercise some form of control of the on-farm water deliveries. The zonemen, working with farmer groups in the developed pilot areas, are able to implement and exercise some degree of control over the planned systems of water deliveries, division, and on-farm conveyance. However, in other areas, farm turnouts from the main and secondary canals are turned on by the farmers. The water is allowed to run freely, first filling borrow pits alongside the canals and then inundating bunded areas, with water flowing from one farm unit to the next. As discussed earlier, this results in water waste. Water logging and increased soil salinity may also occur.

Under the proposed LNO development plan, the 22 projected zonemen were to have been organized under the O & M Department to work with 725 Chak operators (1 per farm turnout). The Chak operators were to have been members of local Water Users Associations. They were to control the on-farm irrigation water distribution. Implementation of on-farm irrigation development has been delayed; therefore, irrigation water delivery could not be guaranteed. This is one reason why the local water users associations have not yet been organized. In some cases, farmers have formed informal groups. These groups arrange some form of equitable distribution of the irrigation waters. The members usually come from the same village or the same family.

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The system has been designed to provide supplemental irrigation during the wet season to 185,800 rai and to 105,630 rai during the dry season. It is reported that about 20,000 rai are now irrigated during the dry season and as much as 50,000 to 60,000 rai receive supplemental irrigation, principally by land flooding, during the wet season. As a result, the quantity of water supply has not yet become a critical problem since the system only operates at a fraction of its design potential. It is quite possible, however, that given the deteriorated condition of the canal system, increased irrigation water demands above the present level may result in water shortages. Silt and side slope erosion deposits reduce canal cross-sectional areas and restrict the capacity of the canal conveyance system. This potential problem may reduce benefits accrued in the pilot area developments. This problem needs to be examined and remedied. In Pilot Area 1, O & M reports that, even at the present stage of development (land consolidation, land clearing and leveling, on-farm delivery, etc.), firm delivery of irrigation water in the dry season cannot be guaranteed.

6. Summary and Conclusions

The previous sections of the irrigation and drainage system evaluation have presented the findings of the evaluation team's examination and review of the planning, design, construction, operation and maintenance features of the LNO project. This section provides a general compilation of these findings, together with a summary of conclusions.

a. Project Administration. The project field director acts as the project coordinator. His authority appears to be limited to the construction operations of the irrigation and drainage system. His control over the personnel and budget of the other RID departments assigned to the LNO project is minimal. The operation and maintenance department reports to its regional office at Ubon. The roads construction and maintenance department reports to another regional office at Korat. Other government agencies, such as the Department of Agriculture, extension services and community development, also require their field staff in LNO to report to their regional offices in Sakon Nakhon.

The RID should reorganize the LNO project field administration structure to give the project field director full and complete control for the integration of all activities to include: planning and development; design and construction; operation and maintenance; pilot area research and review; water control, delivery and use; agricultural

extension, research, and training; and, community and farmer/water user organization development. The LNO field administration should determine and establish the project needs, exercise control and supervise all staffing, equipment and materials procurement and use, and annual budgetary funding requests and disbursements. Quarterly reporting of project activities and monthly reporting on disbursements should be submitted. Bangkok headquarters control, following annual budget reviews and approvals, should be limied essentially to policy guidance and monitoring.

b. Planning and Development. Excessive costs of the Chao Phraya land development model, together with budgetary restrictions, have affected the schedule of the system's development. Completion of the main/secondary canal and drainage systems has been delayed. On-farm development will require another four to five years to implement. Standard criteria need to be used to set priorities for the next areas to be developed. The Berger proposal for identifying development area rank orders of priority, outlined in its Project Notes No. 2, presents a basis for consideration in the development and establishment of such criteria.

Prior to any further on-farm development, the RID needs to examine, review and establish a policy and develop guidelines regarding the use of the Chao Phraya, LNO, and ditch and dike models (and any modifications of this model). RID should defer the use of the costly land consolidation and land leveling procedures in future on-farm development until the LNO model has been tested adequately. Land drainage characteristics likewise need to be examined, reviewed and solutions developed to minimize flooding and ponding problems both within the project area and downstream from the project site.

c. Operation and Maintenance. This feature of the project appears to have been neglected. The deteriorating condition of the canal and drainage systems and the relatively small O & M budget demonstrate that O & M requires more resources. The RID claims that it is aware of the problem and that the canal system has already been surveyed for damages. These data need to be updated, costs re-evaluated and a priority and time schedule for implementation established.

The O & M department requires increased staff and a larger budget before the maintenance equipment can be used effectively. A report should be prepared showing the canal system maintenance plan and budget, the work program to

rehabilitate, and repair the conveyance facilities, and a description of shop and repair facilities to be provided to maintain the equipment.

A full report would include:

(i) A proposal describing the O & M organizational structure and staffing pattern.

(ii) A report which includes the proposed schedules, plans, layouts, costs and sites for the construction of the three LNO O & M field offices.

(iii) A review of current rehabilitation and cleaning requirements to restore and repair the main and secondary canal systems, together with a plan, schedule and cost for its accomplishment, identifying, by stations, the type and cost of work to be performed and whether by contract and/or by force account;

(iv) The scope of work, schedule and method for accomplishment, and initiation of a drainage study to review and correct land drainage deficiencies both on-farm and along the receiving downstream natural drainage courses;

(v) A proposal for shop and repair facilities, identifying the site, layout, and shop equipment to be provided for the maintenance and repair of the mechanical equipment and vehicles to be procured;

(vi) The annual budget, by fiscal years and by line items, to fulfill and accomplish the foregoing O & M items (i) through (v).

d. Water Control and Delivery. Rehabilitation of the canal and drainage systems will allow the system to function as designed. Water control measures (constant head orifice gates and check structures) will again be operable, and on-farm delivery systems will be able to supply a variable demand for irrigation water in accordance with cropping pattern needs.

Simple depth measuring devices (fixed gauges to record depths and/or losses of head through calibrated openings and along sections of canal) need to be installed at the heads of the two main canals, at all farm turnouts, and at selected division boxes. These recordings, to be accomplished by daily visual guage readings, will provide a fairly complete

measurement of water delivery and distribution. Following farm delivery, however, the farmer needs on-farm technical assistance to use the irrigation water effectively and productively . Irrigation agronomists should be retained to help develop cropping patterns and on-farm delivery system layouts for the various farm units within the developed areas.

e. Village and Farmer Participation. Plans call for groups of water users associations to provide 725 chak operators to control and distribute on-farm supplies. They will work under the guidance of the zonemen and assist farmers in on-farm water use, distribution, drainage and canal maintenance. Farmers are hesitant to participate and accept responsibility for work performed by the RID (conveyance and delivery system to on-farm turnout), even though it would be to their benefit. In general, farmers expect the RID to take care of the canals. This attitude is reflected in a general lack of maintenance of the on-farm irrigation conveyance and distribution systems, for which the farmers are responsible.

f. Consultant Contract. RID agrees that it should continue with the Berger contract for selected services in LNO project design, implementation and operation. This will require some changes in the personnel to be provided under the contract.

At this stage of project development, the consultants should emphasize water delivery and on-farm water distribution. The present test program of observing operational results within the developed pilot areas needs to be continued. Appropriate revisions, should be incorporated into the design of new work and the rehabilitation of existing installations. This can be accomplished, initially, with the project leader and irrigation engineer currently at the LNO site.

Assistance will be needed to accomplish the on-farm water allocation and distribution, which in turn are dependent upon water supply, soils, topography, crop selection and farm layout patterns. The evaluation team suggests that a combination irrigation/agronomist specialist should be added to the team. This specialist should be recruited immediately. Thai language capability should be a criterion for his selection.

Recommendations

1. A study should be made and a report prepared covering the work required and costs involved to rehabilitate the irrigation system, to eliminate side slope erosion and to improve the land drainage characteristics.

2. The Operation and Maintenance budget should be increased substantially to a level sufficient to finance necessary routine operation and maintenance of the irrigation and drainage system. The management of the Project's O & M section should be strengthened and the Project procedures for use of O & M funds reviewed. Additional funds should be allocated to rehabilitate the system.

3. The Lam Nam Oon model should be subjected to 2-3 years of dry season experience, with careful operations research conducted.

4. During the above test period, expansion of the irrigation system should be restricted to Ditch and Dike methods and the use of land consolidation and leveling methods should be deferred.

Economic Prospects and Problems

I. Economic Returns

Based on costs and yields measured on test plots and on experimental on-farm plots under supervision of the DOA, we have made a simple recalculation of project costs and benefits, to compare with original project expectations. Given the wide ranges of some of the key variables, and the extent of agronomic and water delivery uncertainties, the benefit-cost arithmetic of this project must be seen as even more "illustrative" than is normally the case.

An examination of the LNO project in 1976 concluded that the rate of return would be too low to justify the investment from a strictly economic point of view. When the Project Paper was written, it was believed that the expected results of the project had improved sufficiently (based largely on a finding of nearby limestone that could be applied to off-set soil acidity), to raise the rate of return to a marginally acceptable IRR of 10.3%. However, limestone is not being applied because it appears to have adverse effects on the soil chemistry after a few seasons. The PP did not take account of the lost production from cultivated lands that were flooded as the reservoir rose.

The dry season production benefits projected in the PP appear, in hindsight, to be at the upper end of a very wide and uncertain range of possible outcomes. One inter-related set of variables involves the area that might be cultivated, the water that might be available and the manner in which it is delivered and managed, and the crops chosen by farmers. A second set of variables involves the labor-time available in the project area, the available alternative dry season income opportunities, and, again, the crop areas and choices farmers will make in the light of the labor and opportunity costs involved. The evaluation team examines these variables at several places in this report, although it obviously did not have the time to explore them in the same depth as other studies performed in the area prior to this evaluation.*

* Work Days: A Daily Record Keeping Study of Irrigated and Rainfed Farmers in Northeast Thailand. Technical Report (Draft) UNDP/FAOTHA/74/015. Fritz Von Fleckenstein, April, 1980; "A Socio-logical Benchmark Survey of Lam Nam Oon Farm Household," George W. Hill, Louis Berger International Inc., April, 1980; "Markets and Lam Nam Oon," Jose Vegara and M. Casares, Louis Berger Technical Note No. 4, January, 1981

One of the variables that might reduce the extent of project benefits is labor supply. A study (under the LBI contract) of the labor availability and the labor time required to carry out the cropping plan on which the PP benefits were calculated, concluded that the PP plan was infeasible because it required more labor than is available, especially when taking account of the dry season income opportunities already absorbing family labor time.* The cropping plan proposed instead is based on a rather drastic change in crop mix (mostly non-glutinous rice, sugar-cane and kenaf). Another uncertainty is the size of the irrigable area; a third arises from the uncertainties over the system's delivery capacity and the water distribution and management problems that are not yet being addressed. The calculations, based on an oversimplified two-crop dry season, are meant only to show the range of potential outcomes from the minimum results obtained to date to the full design capacity assumed in the Project Paper.

On-Farm Economics

Introduction

The costs and benefits of this project will be discussed on two levels. The micro level will focus on the individual farmer. The macro level will deal with over-all project benefits to the LNO area as compared to the cost of the irrigation system and accompanying land development.

Dry season irrigation and the added protection of a wet season source of water during a drought can provide the farmer with a substantial increase in income. However, he must be assured of a regular water supply before he will risk the production expense in the dry season. Presently, the basic irrigation system and on-farm canal network delivers water to approximately 20,000 rai. The maximum potential under full development will range from 63,000 to 106,000 rai. This analysis will compare the private benefits from irrigation versus the public costs of constructing and maintaining the system.

While economic benefits to the farmer can be increased by supplemental irrigation during the normal wet season growing period, income is increased significantly only if the farmer decides to produce a second crop during the dry season period. That decision is based on the availability of water, the costs of production and the market price of crops grown.

* Vegara and Casares, Op. cit.

Current Practices

Glutinous rice is the primary wet-season crop both for farmers who have access to irrigation and for those who depend on rainfed cultivation. Dry season cropping takes place only in the irrigated sections of the project. Non-glutinous rice and peanuts are the most important dry season crops in the LNO area. Other crops such as vegetables, kenaf, chili and fruit are grown for both sale and home consumption. However, dry season cultivation of these crops varies from year to year depending on market demand.1/ Since 60% of the irrigated rai are planted in either groundnuts (45%) or rice (15%),2/ these crops are used to demonstrate the benefits of irrigation vs. non-irrigation.

Wet Season Production

Glutinous rice is grown for home consumption. By converting to a high yielding variety (HYV) seed, a farmer can reduce the number of rai planted in glutionous rice needed to sustain his family.3/ He could then use the rai formerly planted in glutinous rice to grow non-glutinous rice (or another cash crop) for sale.4/

1/ "Integrated Rural Development in the Nam Oon Irrigation Project Area, Sakon Nakhon Province - Accomplishments of 2 Years - 1979-1980." Department of Agriculture, Field Operations Team, April, 1981, p. 20.

2/ "Dry Season Cropping Promotion Project Yields and Planted Area Survey - 1980/81." Lam Nam Oon Project Staff. Mimeo.

3/ Presently only 25% of the farmers in the LNO area use HYV seed. ("Tambon Socio-logical Benchmark Survey - Lam Nam Oon Households", George W. Hill, Center for Rural Development, Louis Berger International Inc., p. 28). No disaggregated data exist for the number of users in the irrigated area vs the number of farmers in the rainfed area. Therefore, it is assumed that the same proportion of farmers on the irrigated farms use HYV seed as do the farmers who plant rice on non-irrigated land.

4/ It is assumed here that due to the increase in yield from HYV seed, farmers in the irrigated area would grow non-glutinous rice on 30% of his rai. Farmers on non-irrigated farms could devote 50% of their rai to non-glutinous rice and 50% to glutinous rice.

It is assumed that the production cost of producing rice from HYV seed is the same as local seed. However, more inputs are used in irrigated areas than on rainfed farms, leading to higher production costs.*

Supplementary irrigation in the wet season increases rice yields,5/ leading to a higher net income for all farmers in irrigated areas, approximately 30% higher than those in the non-irrigated area (Baht 558/rai in irrigated areas vs. Baht 430/rai in rainfed areas - See Table A). A higher on-farm income is earned by those farmers who grow dry season crops.

Table - A

Wet Season Production6/

	Yield kg/rai Glutionus Rice (Local Seed)	Yield kg/rai Glutinous Rice (HYV Seed)	Yield kg/rai Non-Gluti Rice	Net Income Baht/ kg/rai	% Net Income
Rainfed	209.6	422.9	265.8	430**	
Irrigated	365.1	474.1	265.8	558	+29.8

Price: Glutinous Rice 3 Baht/kg
Non-glutinous Rice 3 Baht/kg.

Variable Cost: Glutinous rice irrigated Baht 519.3/rai
Glutinous rice non-irrigated Baht 185.8/rai
Non-glutinous rice Baht 405/rai.

* Department of Agriculture, Field Operations Team, Op. Cit., p. 22.

5/ Yield from local seed increases by 70%; yield from HYV seed increases by 12%. (Department of Agriculture, Field Operations Team, Op. Cit., p. 21).

6/ Department of Agriculture, Field Operations Team. Op. Cit., p. 21-22.

** Work and Days: A Daily Record Keeping Study of Irrigated and Rainfed Farmers in Northeast Thailand. Technical Report (Draft), UNDP/FAO - THA/74/015. Fritz Von Fleckenstein, April, 1980, p. 90.

Dry Season Production

The most significant benefit goes to those who are able to grow dry season crops. As stated above, sixty percent of the rai cultivated in the dry season in the Lam Nam Oon area are planted in non-glutinous rice or groundnuts. To simplify, this analysis assumes that farmers will grow only these two crops.

It also assumes that 25% of the rai will be planted in non-glutinous rice and 75% of the rai will be planted in groundnuts.7/ Variable costs for producing groundnuts are much higher than for producing non-glutinous rice, but the return is nearly twice as high (Baht 622.2/rai for groundnuts vs. Baht 339.2/rai for non-glutinous rice. See Table - B). The total net return to the farmer is Baht 551.5/rai in the dry season, almost equal to the net return/rai earned by the farmer in the irrigated area during the wet season.8/ (See Table C).

Table - B9/

Dry Season Production

	Yield kg/rai	Net Income/rai
Non-glutinous Rice	265.8	339.2
Groundnuts	212.9	622.2
Price:	Non-glutinous rice	Baht 3/kg
	Groundnuts	Baht 8/kg
Variable Costs:	Non-glutinous rice	Baht 405/rai
	Groundnuts	Baht 1,081/rai

7/ In 1981, of the 12,000 rai cultivated in the dry season, 25% was planted in non-glutinous rice and 75% was planted in groundnuts (LNO Project Staff, Op. Cit.)

8/ Since individual farmers tend to cultivate less rai in the dry season than in the wet season (Von Fleckenstein, Op. Cit., p. 90), it would be incorrect to assume that farmers in the irrigated sections of LNO double their incomes if they cultivate crops in the dry season. One can only say that the return is increased on those rai which are planted in the dry season.

9/ Department of Agriculture, Field Operations Team. Op. Cit., p. 22.

Table - C

Total Production

	Wet Season[10/] Net Income Baht/rai	Dry Season[11/] Net Income Baht/rai	Total Net Income Baht/rai	% Increase in Net Income Baht/rai
Rainfed	430	-	430	
Irrigated	558	551.5	1,109.5	158

Benefits of Irrigation

Irrigation leads to higher yields of glutinous rice in the wet season, and the opportunity to grow a second crop in the dry season. As shown in the preceding tables, the return/rai for each rai irrigated and double-cropped is more than twice that of the return/rai for areas in the rainfed area.

According to the project field director, in 1981, 20,000 rai were cultivated in the dry season and irrigated in the past wet season*, leading to an increase of approximately Baht 13.6 million in the LNO area (See Table - D). If the irrigation system reaches its goal of delivering water to its planned full capacity in the dry season, income in the LNO area will be increased by up to Baht 72 million per year.

10/ Von Fleckenstein, Op. Cit., p. 90. Weighted yields and return to HYV and local seeds used.

11/ Department of Agriculture, Field Operations Team, Op. Cit., p. 22. Weighted yields and returns to non-glutinous rice and groundnuts used.

* It has been reported that 60,000 rai were irrigated during the last wet season, but this figure included those areas which were flooded as well as those areas irrigated with controlled irrigation water.

Table - D

Net Income in LNO Area[12/]
(in Baht)

	Irrigated	Rainfed	-
Net Y/rai	1,109.45	430	679.5
Net Y/1,000 rai	22,189,000	8,600,000	13,589,000
Net Y/63,000 rai	69,895,350	27,090,000	42,808,500
Net Y/106,000 rai	117,607,000	45,580,000	72,027,000

Irrigation System Costs

To date, about $50 million [13/] has been invested in the Lam Nam Oon project. This includes the cost of the reservoir construction, irrigation canals, and all land development. Further investment in land development to complete the project and in canal rehabilitation will be required in the next 3 to 5 years. Funds for routine operation and maintenance must be provided throughout the life of the project.

Conflicting data indicate that the potential dry season irrigation capacity of the irrigation system ranges between 63,000 and 106,000 rai. Cost projections for both the upper and lower ranges will be presented here.

Capital Cost

The $50 million already invested in the construction and development of the irrigation system is considered as a sunk cost. There is a range of alternatives for further investment in land development. The cost of further development depends on whether land consolidation and leveling continues on a large scale or whether the Lam Nam Oon or ditch and dike method is employed.

12/ Based on weighted yields of glutinous and non-glutinous rice and groundnuts, using yields, production costs, and market prices presented in preceding text and tables.

13/ Bureau of the Budget.

By 1982, twenty-nine thousand rai 14/ are scheduled to have been developed. This includes 5,000 rai under Land Consolidation and 15,000 rai of ditch and dike to be developed in 1982 at a cost of 50.5 million Baht (US$2.5 million)15/. Assuming the planned total irrigated area of 106,000 rai, another 77,000 rai will remain to be developed after 1982. It will cost up to Baht 500 million at current prices ($25 million) if these 77,000 addition rai are consolidated and leveled to meet the 106,000 rai goal and Baht 220 million ($11 million) to meet the 63,000 rai projection, more than five times the cost of using the ditch and dike method (See Table E).

Table - E

Future Capital Cost16/
($ 000)

	63,000 rai goal	106,000 rai goal
Land Leveling	11,050	25,025
Ditch and Dike	2,040	4,620

The advantages and disadvantages of the two alternatives are discussed in the section, Irrigation and Drainage System.

Rehabilitation, Operation and Maintenance

The cost of rehabilitation of the canal system is estimated at 6 to 10 million dollars, or $2 million/year for the next three to five years.17/

14/ Project Field Director, Lam Nam Oon.

15/ Based on US$325/rai for land consolidation and leveling and US$60/rai for ditch and dike as estimated by RID engineers.

16/ Assumes US$325/rai for land leveling and consolidation, US$60/rai for ditch and dike as estimated by RID engineers.

17/ Louis Berger International Inc. estimate.

The LNO operation and maintenance staff have estimated that Baht 70/rai (US$ 3.50) are needed to operate and maintain the irrigation system adequately.18/ At 63,000 rai, this would require an O & M budget of approximately $250,000/year; approximately $370,000/year for 106,000 rai.

The total cost of the system (including the $50 million already invested) at its completion can range from approximately $69 million dollars to approximately $83 million depending on the number of rai intended to be irrigated and the method chosen to develop the land.

Net Project Benefits

In the previous sections, the costs of the irrigation system and the private benefits received by the farmers in the project area have been discussed. The costs and benefits will now be compared and conclusions regarding the economic viability of the project reached.

The costs and benefits, net present worth and internal rates of return (IRR) were calculated for two alternative methods of completing the project. The first assumes that the goal for dry season irrigation is 63,000 rai to be reached by the end of 1983; the second assumes that the goal is 106,000 rai to be completed in 1985. To simplify the analysis, it is assumed that after 1982, all remaining rai to be developed for dry season irrigation will be prepared using only one method, i.e. land consolidation and leveling, or the ditch and dike method. No combination of land development techniques after 1982 has been considered in the analysis. (In the absence of a long range plan, any combination assumed now would be purely academic.)

If the sunk costs of $50 million are included, the returns to the project are extremely low, even lower than the marginal IRR of 10.3% calculated in the LNO Project Paper. The lowest IRR for the 63,000 rai goal, 1.5%, occurred when it was assumed that the area would be developed using land consolidation and leveling. However, the IRR did not increase very much (to 2.4%) when the less expensive method, i.e. ditch and dike, was considered. The net present values in both cases were negative and the benefit - cost ratios were less than one.

18/ Lam Nam Oon Operation and Maintenance Engineer's estimate. The RTG Bureau of the Budget reports that it budgets for O&M at a standard Baht 42/rai for all irrigation projects.

If the 106,000 irrigated rai goal is used the situation improves to some extent, but not enough to have justified the investment in this project on an economic basis. The IRR ranges from 3.2 to 4.5%. Even if the project reached its initial goal of irrigating 106,000 rai in the dry season, the present value would still be negative and the cost-benefit ratios less than one. In other words, the economic return would still be extraordinarily sparse.

However, the $50 million has already been invested. The decision must be made on how best to minimize the loss and obtain the most benefit. Therefore, the IRR was calculated for land development alone, excluding all sunk construction costs for the reservoir and irrigation and drainage system. The investment return still remains marginal if land consolidation and leveling continues over the remaining rai (13.1% to reach 63,000 rai and 13.6% to reach 106,000 rai). However, the IRR indicates that further investment would yield favorable returns if the ditch and dike method were to be employed over the remaining rai. It ranges as high as 31.8% for ditch and dike over 34,000 rai to 44.7% using the ditch and dike method over 77,000 rai. All net present values are positive and the benefit-cost ratio for all land development including land consolidation and leveling is greater than one. Therefore, the continuation of land development, preferably at the low cost ditch and dike method can be justified as long as project planners are willing to write off all previous investments.

II. Raising Project Benefits - Options and Constraints

Project benefits are seen to flow from a) higher glutinous rice yields in the wet season; b) a transfer of some glutinous rice area to non-glutinous rice grown for sale; and c) dry season, irrigated production of non-glutinous rice, groundnuts and/or other crops. The level of actual benefits will vary depending on the area irrigated (63,000 or 106,000 rai), the area actually cultivated and the cropping patterns actually selected by the farmers. The given volume of water available in the system for distribution on farm, the extent of the area cultivated in any dry season and the crops chosen are not independently determined factors. The amount of water per rai required for the different crops varies substantially. If non-glutinous rice proves to be viable and farmers choose to plant many rai of non-glutinous rice in the dry season, the irrigable area will be at the lowest end of the range that can receive water from the system. Other crops will require less water and, hence, increase the irrigable area.

Given the problems of management and control over the distribution of water through the system, this variation in the amount of area that might be cultivated may have an important impact on the distribution of project benefits among farmers. That is, if water distribution remains uncontrolled, the crop and area choices of the farmers nearest the canal turnouts will determine the volume of water available to the farmers further away. It is thus extremely important to develop a capacity to manage the system, whatever distribution method is used. Failure to manage the system properly would result in serious maldistribution of benefits among the project population, and create a basis for sharp inter-personal or inter-village conflict over water, where none now exists under a largely rainfed regime.

Labor Supply

The uncertainty that is normally attached to hypothetical cropping patterns used in irrigation appraisal and design is heightened in the case of Northeast Thailand irrigation projects by the thin base of agronomic research, and by a sharp divergence of view on the availability of labor time in the region. The Hill survey* of 364 households in LNO concludes that underemployed labor is available in the dry season. In the World Bank appraisal report (1978) on the Lam Pao and Lam Takhong projects, it is assumed that there is "severe" under-employment of much of the year, and that local labor shortages that might develop after the project is operational (during peak work periods in July, August and November) can easily be met by hiring the necessary labor from surrounding areas. (For the benefit-cost calculation that report uses a shadow rate of Baht 8 per man-day compared with an estimated range of Baht 10-25 per day for market wages.)

The RTG clearly puts high priority on job creation in its development plans, and operates a large-scale employment generation program in the Northeast during the dry season (January- May). The program has been operating in the LNO area, building small works in many villages. Amphoe officials reported that nearly 3,300 residents (about 75% were males) of the LNO area had gotten jobs under this program this past dry season. We did not get detailed figures, but it appeared as if the average number of days per participant was around ten. Participants were able to work a day here and a day there

* "A Sociological Benchmark Survey of Lam Nam Oon Farm Households", Dr. George W. Hill, Louis Berger International, April, 1980

if they preferred, with anyone free to join until a given project was completed. Nobody was turned away for lack of funds, even though the amounts allocated per tambon were fixed. Average earnings were said to be about Baht 44 a day, much higher than the IBRD estimate of the daily wage in the Lam Pao area in 1978, a little under the RID wage of Baht 47 for unskilled labor on the LNO project, and more than double the Baht 20 farmers told us they were paying for hiring daily labor from neighboring farm families. The program's flexibility enabled a farmer to earn a day's wage whenever he had a slack day.

That such slack days exist in the dry season was demonstrated. But given the small size of the program in relation to annual area income (on the order of 1.5%) or the resident annual labor supply (well under 1%), and the height of the daily earnings, it is also significant that no queueing or other indications of labor supply pressure against a limited number of convenient and competitively priced jobs was reported. This experience is consistent with the conclusions drawn in a recent study of rural employment in Thailand done by an IBRD consultant*, and by an extensive review performed under the Berger contract focussing on the Northeast and the LNO area.**

The macro level IBRD study concludes that under-employment does not exist in rural Thailand, while the contractor's study (Technical Note #4, by Vegara and Cesares) goes further in concluding that labor availability is a key constraint to dry season cropping. We believe, on balance, that severe unemployment and under-employment as is unequivocally evident in many other countries does not exist in the LNO area. In practice, this means that the returns to labor on and off the farm during the dry season are already sufficiently high that it cannot be taken for granted that mere provision of water will induce farmers to cultivate. The income the farmer can earn from such cultivation must exceed the income he is already earning from a variety of other activities.

Risk and Uncertainty

The difficulty of inducing farmers to switch to dry season cultivation may be greater than is implied by merely comparing net returns from cultivation with the options the farmers already have, for three reasons:

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* Von Fleckenstein, Op. Cit.
** Vegara, Op. Cit.

1) Irrigated agriculture requires new techniques most farmers are not familiar with. This increases the risk of low returns, especially if the information and extension service systems are not able to train the farmers adequately.

2) Dry season off-farm work pays immediate or regular cash wages. Cropping requires investment in fertilizer and pesticides, absorbs labor time, and produces, at the end of the process, a net return for these inputs that is uncertain at the start of the process and dependent on production results and market conditions.

3) Given the long gestation period of the LNO project, farmers are said to be skeptical, or at least uncertain, about the system's reliability for delivering water when needed.

In economic terms, these uncertainties and knowledge imperfections reduce the farmer's perception of the "expected value" of dry season cultivation. An objective calculation taking account of these risks may discount the net returns compared with the immediacy and greater certainty of the off-farm alternatives. It is ironic that in the wet season the same logic leads to the opposite conclusion: the high expected value of gaining a year's supply of the preferred glutinous rice dominates over alternatives that may offer higher income but not the virtually assured absence of risk to basic consumption. Therefore, we believe the RTG was correct in launching a price guarantee program for LNO in groundnuts this past dry season.

Recognizing the common marketing problems facing the four irrigation projects now being developed in the Northeast (LNO, Dom Noi, Lam Pao, Nong Wai), the RTG set up a special policy coordination committee in August, 1980 on Northeast Irrigated Agriculture Production Marketing. The committee was composed of senior officials at the ministry levels in Bangkok, with the same departments comprising coordinating and implementing committees at the Changwad and project levels. The Committee set up production plans for the 1980/81 dry season for each project. LNO was assigned the following:

Rice	8,800 rai
Groundnuts	9,500 rai
Green beans	200 rai
Yellow beans	50 rai
Others	6,500 rai
Total	25,050 rai

The actual production plan was based on the outcome of discussions between project staff and each individual farmer in an area of about 20,000 rai where the RID was prepared to guarantee to the farmers that the necessary water would be delivered. The actual crop distribution of the 1980/81 dry season just ending was closely estimated by project staff as follows:

Rice	3,965 rai
Groundnuts	9,078 rai
Pumpkins	2,663 rai
Melons	787 rai
Others	4,016 rai
Total	20,509 rai

Thanks to the efforts of several departments represented on the Integrated Rural Development coordinating committee, the program successfully implemented. With the RID assuring farmers in an area of about 20,000 rai that water would be delivered, and with that assurance accompanied by a package offer to deliver seed and other inputs, and to buy the groundnut production at Baht 8 a kilo, 2,200 farmers did cultivate the area. As the evaluation team was leaving LNO, the CDD was delivering to the villages the bags for packing the groundnuts; the funds for buying the production were in hand; the Farmers' Marketing Organization people were on site; and the buying had begun. The operation appeared a bit shaky at certain points, but vigorous efforts by several members of the LNO management team working as a group that had, occasionally, to cross divisional lines - contributed to apparent final success. Some possible obstacles did not turn out to be problems. For example, BAAC made a special effort to ensure availability of credit at the start of the production season.

It is interesting that farmers decided to put only about 9,000 rai out of the 20,000 into groundnuts, even though only groundnuts were being supported under the promotion program at LNO. (The reasons for this is one of many aspects of this first season's operations that should be studied fairly quickly.) Presumably they did so because of uncertainty over whether the support program would actually work as promised, and because of higher returns expected from cultivating melons and other crops that occupied the remaining 11,000 rai.

In summary, the full extent of irrigated area to which the project management was prepared to guarantee timely water delivery, was, in fact, cultivated. In order to overcome the factors discussed above, the RTG made three interventions (discussed below) that appear to have been critical: a marketing intervention -

1. The purchase guarantee at a guaranteed price, for the one crop that farm trials have so far demonstrated to have more than a marginal dry season net return; and two "service" interventions;

2. Delivery of the necessary inputs to the farmer;

3. Personal suasion by the project staff.

The evaluation team was not in a position to study the operations of the guarantee program or the dynamics of this dry season experience in any depth, or to learn of the results of the parallel support programs at the other three participating irrigation projects. The RTG should undertake such a study immediately a) to improve the effectiveness of future operations, b) to learn if the farmers are satisfied with the results or are disappointed and considering ignoring the availability of water next dry season.

III. Marketing

The marketing prospects and constraints facing LNO were examined in detail by Vegara and Cesares (Technical Note #4) under the Berger contract. The significance of the labor constraint in judging the feasibility of alternative cropping patterns is well stated in this report, and will need to be kept in mind by DOA staff working on crop research and integrated farm systems approaches for LNO. However, the Vegara report develops a cropping pattern of its own which appears to us, for all the attention given to labor requirements and opportunity costs, as too great a leap from existing circumstances. It will not serve as a very useful guide for policy in the near future. The pattern would involve the elimination of glutinous rice, and would comprise mainly non-glutinous rice, sugar cane, kenaf and groundnuts. The report does envisage an interim cropping pattern that is less of a departure from existing farmer experience, and that is more likely to evolve in practice if the RTG were to follow the broad policy approaches that the report recommends.

The Vegara report develops a picture of a Northeast marketing system, from the farm-gate to the local town merchants and shippers connected with the Bangkok market, that is essentially efficient and competitive. (At what seems unnecessarily great length, the report explains that the national and export markets of Thailand for potential LNO crops

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are very large in relation to the LNO area. Therefore, no price effects on those markets would constrain absorbtion of LNO products.) The change that the LNO project will introduce, will be the increased scale of commodities the local marketing system will have to absorb for distribution and/or processing. Since the wet season has been given over to glutinous rice, with its limited marketability, and the dry season has been limited to few areas with access to water, it is not surprising that the local market structure is thin, and that common opinion in the area tends to cite market weakness as a major constraint to expansion of irrigated agriculture. Few merchants are thought to be operating in the area, and the farmers are believed to have few alternative offers and to be subject to "cheating". The weight of evidence is against this picture, although Vegara does cite some survey sources showing that as many as one-quarter of farmers received only one offer to buy their produce.

In one respect, the project appears clearly to have reduced the extent of this problem. The network of roads that accompanies the project - especially in the pilot areas where leveling and chanelling entails more extensive penetration by roadways - seems universally welcomed by farmers and was reported to have resulted in merchants coming to the villages to buy produce. Before the roads penetrated the area, farmers said they had hauled their produce to nearby towns for sale.

This experience already repeats on a micro-scale the broad experience of the Northeast since surfaced highways and feeder roads began to penetrate the region in the late 1950s. In a mutually supportive interaction, rising demand (maize, kenaf and cassava were the major items) induced a supply response in wide areas, while the obviously high elasticity of supply induced rapid penetration by the marketing system seeking out a supply of these commodities. Demand and supply fed each other, the middlemen and mills acting as the facilitaters and promoters working on small margins.

There is no reason to think this scenario will not unfold at LNO; it seems to have begun already. The question is how the RTG and the project can help speed this process. Without physical delivery of the water, none of this will occur. And the RTG must also make a vital contribution in crop research and farmer training. On the marketing side, there are no reasons we can see, peculiar to the LNO area, why the marketing system will not respond and adjust to the requirements of handling produce on a much larger scale. The key requirement

is to raise the scale of output. It would be counter-productive at this stage to attempt to design full-blown solutions and put scarce policy and management attention into elaborate cropping patterns and newly created marketing institutional arrangements.

On the other hand, Vegara's insights, the experience of the past dry season, and our own observations, do lead us to some observations on what might be a good "transition" strategy, i.e. a program under which the RTG would help bring about the change from the present thin production/marketing situation, to the relatively large-scale dry season economy envisaged under the LNO project.

First, to ensure that farmers are faced with an attractive alternative to their present dry season income opportunities, the RTG should continue the guarantee program until the scale of the production and marketing systems reaches a point where the momentum will carry the whole system up to the full dry season potential. The turning point is not some level that can be determined in theory. It involves having a large enough proportion of the farmers having made sufficient returns to be willing to plant dry season crops each year. This will have a demonstration effect that will induce other farmers to do likewise. If the program is successful this season, it seems plausible that if water can be guaranteed and used for half the project area, say by 1983/4, the RTG could then safely phase out the guarantee program within two or three years, ending it in 1985/6.

Second, the experience of the last dry season demonstrates that farmers are willing to commit some labor to growing one crop on a portion of their holdings. By planting in the dry season, the farmer has given up the opportunity to work off the farm. Therefore, he may be willing to cultivate additional area in order to utilize all his labor-time. Whatever the reasons, the guaranteed groundnuts and rice occupied only 60% of the area cultivated. If this kind of relation continues, a partial area guarantee, in effect, would be sufficient to encourage full cultivation of the area irrigable. The RTG need not be drawn into a full-scale support program.

Third, the price support level should provide only a narrow margin of profit which is just sufficient to elicit farmer response. If this is feasible, and if the support can be limited to the one crop that (from field trials and market experience) will yield the <u>lowest</u> incentive return, the program might avoid creating a heavy dependence of farmers on the

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support buying. Using this method, farmers could be more easily weaned off the program as dry season production and confidence grows. By supporting the low profitability crop, while encouraging the production (through extension and CDD services, training, etc.) of the high-valued alternatives, the support program could become less interesting to the farmers, and the demand for the program would disappear.

Fourth, since dry season cultivation is limited to very few areas in the Northeast, LNO should have a location advantage for supplying its surrounding areas with perishable commodities. A few of the Thai members of the evaluation team spent a little time in Phang Khone town exploring local market conditions. They learned that several fruits and vegetables (e.g. papaya, red onions, mangosteen) had been trucked in from other Changwads as far away as Chonburi and Chantaburi. It would be sensible for the DOA research effort to emphasize these items in its search for viable production possibilities. Finally, as the water distribution system expands, and water is no longer in excess supply in the dry season as it is now in the limited areas getting water, crop selection will become increasingly important (as mentioned above) for its effect on the number of farmers able to cultivate. If rice is pushed as a dry season crop, it may entail both a maldistribution of project benefits (with more farmers further from the outlets not getting any water), and a constraint on the growth of the size of the market. There may be some loss of the economies of scale that such market growth could generate for a greater diversity of crops.

IV. Two Unanticipated Benefits

Fish Ponds

In the original project design, benefits were expected to accrue to farmers (mainly in the resettlement area) from fishing in the reservoir. The reservoir was to be stocked by the Fisheries Department. The benefits were not estimated or included in the benefit calculations in the Project Paper. While the Fisheries Department has been stocking the reservoir (roughly five million fingerlings), the number of farmers harvesting has been small. The fishermen are usually farmers living near the reservoir doing contract fishing for merchants. More substantial benefits appear likely to accrue from the unanticipated program for construction of on-farm fish ponds. These fish ponds can only be sustained where irrigation water is actually available since the water level in the ponds

needs topping up several months of the year. One hundred and ten ponds were reported to have been constructed. About 50 ponds can be built with the budget allocated to the Sakon Nakorn Fisheries Station by the Integrated Rural Development budget.

According to the Fisheries Station Director, a one-rai pond costs about Baht 15,000 - 20,000 to construct and can yield about Baht 15,000 worth of fish a year, or roughly six times the annual net income per rai earned on an experimental farm plot growing rice in the wet season and groundnuts in the dry season (in the 1979-80 seasons, revalued at present prices).

A comparison of returns to labor time would show fish pond cultivation much higher yielding than cultivating irrigated crops. We did not get information on the number of man-days required per year (probably unknown), but minimal care and harvesting time is required. One study* estimates the man-day earnings from irrigated glutinous rice (on the same soils as in LNO) at about Baht 30. Even if the return to labor for a one rai fish pond were as low as Baht 30 per day, the minimal labor time required to maintain the pond would make raising fish an attractive alternative to growing non-glutinous rice on that rai.

It is hardly surprising that the number of farmers requesting fish ponds is reported to be much greater than the Fisheries Department can supply at its present construction capacity. The demand is especially high since the Department charges "poor" farmers only Baht 1,800 (to cover fuel) and provides fingerlings for the first year free and at Baht 10 per hundred after that. Each farmer getting a pond must attend a training course. Village ponds are also being constructed or renovated, and some fishing is done in the borrow pits.

Fish are said to be the major source of animal protein in the Northeast. Marketing constraints will arise as production increases in the project area. The Fisheries Department recognizes the need for development of proper storage and handling services. These services could be provided by private merchants when the supply exceeds the local capacity to handle it. The team could not look into this matter any further. There are high relative returns said to be obtainable from ponds, and the farmers are interested in having ponds on their land (one woman interviewed had 4 ponds being fed with the

* Von Fleckenstein, Op. Cit, P. 90

animal waste from her flock of 2,000 ducks; she grew no crops). Therefore, it does not seem necessary to closely compare per rai or per man-day yields of ponds as aginst crop cultivation. (This is an economic question that should be on the list of things to be recurrently researched, as suggested below.)

The number of on-farm fish ponds constructed over the next two-three years should be substantially increased over what is now programmed. The project level and farm level economics of the ponds should be studied in the 1982/83 seasons. They should be monitored to provide a basis for determining the necessary rate of expansion, and for giving early warning notice of marketing problems.

Buffalo

Buffalo were omitted altogether in the original project design. The role and prospects for buffalo production now warrant priority attention for two reasons. First, there is evidence of a shortage of power for cultivation in the project area. The shortage has been aggravated (or perhaps caused by) a decline in buffalo holdings in recent years and will be intensified by the increased power requirements of double cropping under irrigation. Second, there is evidence that the recent moves by the Thai Government to raise domestic petroleum product prices closer to international levels have begun to reverse the direction of the shift from buffalo to tractor power that has been going on for years. The reversal is reflected in a rise in buffalo prices (in this area of the Northeast) reported to be around one-third in the past two years. Several of the farmers interviewed had recently sold buffalo in the price range quoted at the Livestock Station, and had bought younger animals in their place, presumably to raise for sale in two to three years again.

The rise in demand for buffalo for draught purposes (and meat) may be a secular trend reversal. This could turn out to be a significant development in the agriculture sector's future participation in Thailand's general "structural adjustment" to the changes that have taken place in the world economy. It would also be of major importance for the Northeast which for past generations was the source of draught power for the rest of the country. Buffalo production may develop as a very significant, unanticipated source of future income growth in LNO. Irrigated production of fodder might give the area (and the other three NE projects) an advantage over much of the rest of the region.

According to the Livestock Station, it takes about one rai to keep one buffalo. Suitable varieties of grasses are already well tested. Breeding stock is also available and being loaned to villages in the LNO area. A major problem is reported to be a 30% death rate among calves in the first three months due to liver fluke, a problem not expensive to treat.

As with the fish ponds, the team was unable to pursue in any depth the potential for livestock production. It may become an important alternative to raising crops in the dry season. Farmers may allocate a greater proportion of their land, labor, and dry season irrigation water to livestock production. Tending buffalo is traditionally a child's activity, but children are spending increasing time in school. There appears to be no development yet of cooperative arrangements under which buffalo of several farmers are tended by one member of one family at a time.

While some work is reported underway demonstrating an integrated livestock-fish system at ten locations in LNO, we came across no indication of studies of the farm economics of livestock production to compare with, or integrate with crop production. Again as in the case of fish, it seems evident, prima facie, that livestock production may hold a great potential for LNO farmers. This potential is not reflected in the resources the RTG and AID are now putting into the project area for activities (like veterinary services to reduce disease losses) that must be provided by government. The AID project includes no funds at all for livestock; RTG funds are naturally provided to LNO at the same levels as in other districts outside the project area. The team draws conclusions for livestock, or at least for buffalo, similar to those for fish. The economics of buffalo production should be studied and monitored to provide an informed basis for future decisions, farmer training, etc. affecting the rate of production increase and the allocation of farm land and labor.

V. Economic Research

The team sees an important role for economic research. Our impression is that such research is likely to make effective contributions if it concentrates on specific questions relating to specific decisions that have to be made year by year over the next few years, rather than focussing on broad surveys. Some examples: a) what crops should DOA be trying out for agronomic feasibility, in light of marketing prospects; b) requirements for buffalo power in LNO, marketing prospects, and

farm economics; c) fisheries economics referred to above; d) analysis of the 1980/81 dry season experience as mentioned above. Such research should be closely coordinated with any comparable work being done at the other Northeast irrigation projects.

To feed into the projects management decision process, economic research should focus on specific questions relating to the marketing prospects and farm economics of particular, agronomically promising crops and of livestock (especially buffalo), rather than on broad household surveys. An evaluation of the results of the 1981/82 dry season production campaign should be made as soon possible to draw lessons for the management of the 1981/82 campaign.

Recommendations

a. The project design should be narrowed to comprise only the irrigation system, on-farm water management and use, and agricultural production. Cooperating agencies should utilize remaining project funds to address onlythese objectives. The consultant contract should be revised to correspond to the new emphasis.

b. A coordinating mechanism should be established to link major irrigation projects now being developed in the Northeast. This mechanism would address the technical, operational, research and training problems common to the projects.

Agricultural Aspects

This portion of the evaluation addresses on-farm agriculture in the LNO project. Four agricultural activities were examined for their current status, systems, water management (on-farm systems), soil improvement practices and agricultural communications.

Agriculture Cropping Systems

Current status and effectiveness, wet season

Glutinous rice is the principal crop grown in the wet season, occupying almost the entire command area (approximately 180,000 rai). The yields average 200-400 kg. per rai. These are half to one third of a potential of 800 kg. per rai reported by the Department of Agriculture. These low yields of native varieties are attributed to very little response to nitrogen fertilizer, poor soils and the farmers' lack of knowledge regarding improved water management practices. Increased applications of nitrogen fertilizer often result in lodging rather than better yields.

The LNO farmers have raised glutinous rice in the wet season for many generations and for many reasons will continue to do so, despite the apparent benefits to be gained by moving to improved varieties. The availability of supplemental irrigation water guarantees them a crop every year and presents no new cropping problems.

Even though glutionous rice is the preferred wet season crop, limited acreages of non-glutinous rice are grown for a cash crop.

The Agriculture Research Department at Sakon Nakhon has an intensive seven-point research and technology transfer program in operation. The seven-point program is as follows:

1. Research tests on yields of different rice varieties, soil fertility, trials and cash crop improvement (e.g. groundnuts, vegetables);

2. Testing rice based cropping systems. (With emphasis on 3 crops per year based on non-photo period sensitive, shorter growing season rice varieties);

3. Studies and tests on soil fertility and soil reclamation (organic matter & Ph.);

4. Seed multiplication projects for rice and groundnuts;

5. Testing integrated farming systems (diversification);

6. Sericulture farming;

7. Training and technology transfer. This is primarily for Kaset Tambons; however, some training is provided to the research field workers, and personnel from the Community Development Department, and the Department of Non-Formal Education.

In addition to the seven point program, some model farms have been established where the farmer receives intensive support and monitoring from the Department of Agriculture. As this program was established in 1980, information on only one dry season is available. The model farms have been divided into three operations:

1. Farm diversification: Rice, horticulture and truck crops.

2. Tri Commodity: (a) The cropping system on part of the farm is managed as a rice-based cropping system;

   (b) Alternative crops such as horticultural crops and vegetables;

   (c) Farm fisheries involving two fish pond designs.

3. Livestock enterprise: Chickens, ducks, pigs.

The Department of Agriculture thinks that mono-cropping is not profitable in LNO, and diversified farming would provide the farmer with an improved standard of living. The DOA will test the above mentioned crops on the model farms. If the results are successful, DOA plans to recommend proven technology packages to the agricultural development bank (BAAC). Farmers could then borrow money for developing alternative crops. DOA would like to increase the number of model farm test units but their budget is limited. If the program spreads, increased technical assistance at the farm level will be required.

Potential Agriculture Cropping Systems

During the 1980-81 dry season, approximately 20,000 rai were in irrigated crop production. The project plan calls for about 106,000 rai to be irrigated in the dry season. The plans for 106,000 cultivated rai could be achieved if the on-farm canal system is extended and more farms receive reliable irrigation water through development of on-farm water courses.

The availability of irrigation water in the dry season presents problems in cropping and irrigation not previously encountered by the LNO farmer. At the present, those farmers with plots a distance away from developed on-farm water courses do not have confidence in the irrigation system. They do not know which is the best dry season crop nor do those farmers receiving water through existing on-farm water courses fully understand improved water management principles for dry season crops. The farmers who did plant dry season crops, did so on only a small percentage of their lands. The balance of their rai remained idle. For a variety of reasons, many of the farmers interviewed indicated little or no interest in dry season cropping. These reasons include satisfaction with their present production and available off-farm employment.

Results to date from agronomic research on LNO soils indicate the best adapted crops for the dry season in the project area are groundnuts, non-glutinous rice, melons, sugar cane, chili and vegetable crops. Based on interviews with the farmers and the Livestock Department, there is evidence that the farmers may increase their buffalo herds. If this occurs, farmers may choose to grow forage crops in the dry season. However, farmers may need additional economic incentives, such as market prospects for forage crop seed, before they are willing to invest in this type of low return crop. Extensive information in soil-crop-water relationships is needed to develop feasible dry season crop alternatives, including forage crops.

Agriculture research programs being conducted by various departments should be continued at or above the present level to develop alternative crop and agrono- mic practices for the dry season with special attention to the water requirements of the various crops. Research programs should take into consideration those crops that provide maximum benefit to the national economy and are important to Thailand's agriculture export goals.

Anticipating an increase in buffalo numbers, current research programs should be restructured to develop varieties of grasses and legumes grown individually and in combination (grass + legumes) for livestock forage. These crops are also very beneficial as soil improving crops.

Water Management (On-Farm System)

Current practices and effectiveness

Basin or paddy flood irrigation systems used in LNO can be efficient methods of water application. Irrigation water must be applied at uniform depths and quantities to replenish the available water holding capacity of the crop root zone. Present irrigation practices, especially in the dry season, are very inefficient due to the lack of on-farm delivery ditches and the general absence of irrigation water management skills by the farmers.

Current land consolidation (LC) models under construction by RID include heavy soil cuts and fills to level the land. This practice is detrimental to the soil structure and fertility, and it changes the soil texture in the cut areas. Field observations made after a heavy rain indicated that the bunded fields of one LC area were not leveled to the degree required to achieve improved water management. Some portions of the fields were high and dry while other portions had 15 to 20 cm. of standing water. The irrigation engineer with the Berger consultant team, surveyed several fields in a LC model before and after land leveling. His engineering surveys of the elevations before leveling indicated the fields were level enough to achieve good irrigation water distribution within the bunded areas. Elevation surveys made on the same fields after LC leveling indicated that several bunded fields had elevation differences of 30 cm. It is impossible to apply irrigation water management on fields with 30 cm. difference in elevation. Land leveling specifications for paddy and basin flood irrigation require a tolerance of + 1.5 to 2 cm. This degree of leveling is also the tolerance to which the more progressive farmers have, over many generations, leveled their fields. The consultants' measurements show that farmers generally want fields more level than land consolidation leaves them.

Conditions that are often a detriment to irrigation water management are:

1. Many farmers are reluctant to adopt new methods. They prefer to apply their traditional wet season methods of irrigating to the dry season crops. This results in over-irrigation and damage to many crops.

2. The large number of small land holdings, many of irregular shape and locations, make it difficult to supply each farm with water.

A reliable supply of irrigation water is a prerequisite to water management; but, this alone will not guarantee efficient irrigation practices. Proper irrigation water application involves applying water to the soil before the moisture in the soil profile is depleted to levels that will reduce plant growth. Water has to be applied in the right amount and at proper intervals depending on soil and crop needs. Proper irrigation water management can only be achieved by providing direct on-farm technical assistance to the farmer.

Efficient water management is dependent on a supply system from the RID head gate to each farm unit. This can only be achieved by constructing water courses to deliver water to each farm boundary.

In the LNO project there is a serious need for improved main and on-farm drainage. On-farm drainage to permit timely, orderly removal of excess rainfall or irrigation water is essential for optimum agriculture production and water management. The farmers in LNO are accustomed to paddy rice irrigation methods. When farmers apply the same method to dry season crops, it results in over irrigation. Most of the current alternative dry season crops will have reduced yields of poor quality if they are over irrigated or if water is allowed to stand on the crop for several days. Excessive rainfall at the end of the dry season, when standing crops are about ready for harvest, must be drained off the land to prevent crop losses. Excess water removal by drainage, is also necessary to facilitate tillage and land preparation operations. Properly designed and constructed drainage systems will also aid in preventing waterlogging and resultant salinity problems.

Technical Assistance in Water Management (Short Range)

A new Integrated Rural Development Training Center has been completed in the LNO project. At this center a small model farm has been established by DOA to provide training in modern

agriculture techniques. The farm layout includes plot-size fields planted in a variety of crops and an improved irrigation ditch system with turn out control gates. The facility will be used to train Agriculture Extension Agents and contact farmers in improved agronomic techniques and irrigation water management. The contact farmer is generally the village leader, the progressive farmer, or the farmer to whom the others turn for any kind of information.

The agriculture extension agents (Kaset Tambons) conduct one or two village meetings per month to disseminate information on a variety of subjects, e.g. recommended crops, new crop varieties, fertilizer recommendations, insecticides, herbicides, and irrigation water management. The agents provide one or two pieces of information per meeting about a specific subject. They try to cover topics relevant to the area and to the season. However, the farms in the LNO area (and the Northeast in general) are so diverse, that the information is often irrelevant to many farmers. Agents often have problems answering questions which go beyond the specified subject matter. As a result, these meetings may have little impact on farming practices in the project area.

DOA representatives indicated that there is very limited information available on irrigation water management. Present DOA programs do not include research on crop consumptive use, amounts of soil moisture available to crops grown on different soils, crop irrigation frequencies, water measurement and losses in the delivery system. The Kaset Tambons need training in these items if they are to transfer irrigation water management technology to the contact farmer. Based upon farmer responses in interviews by the Evaluation Team and on field observations of irrigated crops, it was concluded that very little irrigation water management information is being presented to the contact farmer, and the farmers really have very little knowledge of proper water application to crops.

The training center should develop more comprehensive courses in irrigation water management to provide training for Kaset Tambons and contact farmers. Course outlines are available for soil-plant-water relationships from USAID missions in Egypt, Pakistan, India and Turkey.

<u>On-Farm Water Management Training Outline (Condensed Outline)</u>

Soil-Water-Plant Relationships:

1. Soil:

   i) Classification
   ii) Chemical properties
   iii) Physical properties
   iv) Soil textures, etc. (Field)

2. Soil Water:

   i) Kinds of soil water
   ii) Movement of water in the soil
   iii) How water is held in the soil
   iv) Soil moisture tension
   v) Available water
   vi) Water intake

3. Plants:

   i) Rooting characteristics
   ii) How plants get their moisture
   iii) Kinds of root system
   iv) Residual moisture--extraction depth
   v) Consumptive use
   vi) Irrigation water requirements
   vii) Methods to determine soil moisture

4. Agronomy phase of soil and water conservation on irrigated lands:

   i) Cropland management principles
   ii) Reclamation of saline and alkalai soils
   iii) Weed control
   iv) Field planting trials

5. Engineering:

   i) The metric system
   ii) Engineering surveys
   iii) Irrigation water measurement

6. Equipment:

   Specifications for soil scraper
   Tractor scraper operation in field
   Land plane operation in field
   Equipment maintenance

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7. Economics:

Basic economic concept
Land leveling evaluation
Watercourse evaluation

8. Managemenmt:

Management general
Code of ethics for Government
On-farm project scheme
Organization structure
Line staff organization
Position description
Government rules and procedure
OFWMT directives system for correspondence and filling
Financial rules
Personnel

9. Precision Land Leveling:

i) Topographic survey
ii) Plotting and design
iii) Layout
iv) Construction supervision

10. Watercourse Construction:

i) Profile survey
ii) Water loss measurements
iii) Design
iv) Layout
v) Construction supervision

Soil Conservation and Soil Improvement Practices

Current status and effectiveness

Reconnaissance level and detailed soil surveys of the LNO project have been made. The reconnaissance survey indicated more saline areas than were mapped in the detailed survey. Field observations by the Evaluation Team tend to support the reconnaissance survey indications of large saline areas. The soils of LNO are classed as very poor for intensive agriculture production, especially for dry season crops. There are two major soil series, the Roi Et and Korat. These soils are very low in organic matter, less than 1.0 percent. The continued use of soil amendments can cause numerous chemical toxicity

problems. Year round irrigation without proper on-farm drainage and water management practices will also increase the salinity problems.

The LC models in Pilot Areas 1, 3, and 3a involve large areas of land leveling with heavy cuts and fills. The heavy cuts remove the very fragile top soil (organic matter) and expose infertile subsoil. Present agronomic practices include utilizing or burning all crop residue and returning very little to the soil. It is very doubtful that the soil in the cut areas will be as productive as it was in its undisturbed state.

The two major soil series are:

(i) Roi Et Series (41)

Consisting of a fine sandy loam to loamy sand, light brown to grayish brown, overlying a light brown or pinkish gray sandy clay loam, generally the soils are deep and poorly drained, medium acid over very strongly acid, formed from old alluvium and occur on lower terraces; the relief is almost flat to slightly undulating. Used mainly for paddy rice, yields range from 15 to 25 tang per rai. Without the proper inputs and management practices, dry season crops can be grown under irrigation on Roi Et soil with only marginal returns. Problems include low fertility, low moisture holding capacity and low organic matter in the soil.

(ii) Korat Series (51)

Consisting of a light gray to grayish brown or dark yellowish brown, fine loamy sand, over a slightly heavier pale brown sandy clay loam; moderately well drained, moderate to strongly acid, occurring on gently undulating to rolling parts of the middle terraces and along the upper section of the low terraces. These soils are mainly used for upland crops, kenaf, corn, cassava and sugar cane. Seldom used for paddy rice. Problems are low fertility, poor moisture holding capa- city and low organic matter.

DOA research is being conducted at various research stations. Some on-farm trials are being conducted at LNO. Current soil research includes studies and tests on soil fertility and soil improvement. Emphasis is being placed on developing crops to be grown as green manure which can be incorporated into the soil as organic matter. The legume Sesbania is currently being tested; however, seed supplies are very limited and farmers may be reluctant to grow this low value crop.

A 3 year operational research program should be conducted on the LNO model pilot area 2. To facilitate this research, more detailed soils information is needed to assist in planning drainage systems and making recommendations regarding soil amendments to correct acid and saline conditions and in preparing land leveling designs to keep soil cuts to a minimum. A detailed soil survey should be made in pilot area 2 with special emphasis on identifying the saline areas. This information could provide additional technical data for agronomic and improved water application. Suggestions could then be given to farmers for improved agronomic and water management practices.

The soil-water-plant research should be continued with increased emphasis on conducting research on the two major soil series in the LNO project area. The trials should include testing wet season non-glutinous rice, glutinous rice and alternative dry season crops and their responses to combinations of different fertilizers, soil amendments and green manure.

Recommendation

Research on dry and wet season crops suitable for LNO soils should be expanded. Non-glutinous rice, glutinous rice, and alternative dry season crops should be tested for their response to fertilizers, soil amendments and green manure. Agronomic practices which encourage both diversified cropping patterns and soil conservation need to be developed and disseminated to the farmers.

In land leveling projects in other countries which have involved heavy cut areas and loss of the topsoil, there has been long-term damage to the soil. The removal of the topsoil (organic matter) exposes the subsoil which is infertile and difficult to cultivate in the dry season. The subsoil, when dry, hardens, restricting water and root penetration. To improve the organic matter (topsoil) content of the soil will require many years of growing legume crops, plowing under green manure, soil amendments and heavy applications of animal manure every year. Under present farming methods, it would be difficult for the farmer to apply these practices; however, a long range goal of the project should be to encourage farmers to apply these conservation practices on their farms. Field trials should be continued on the heavy cut areas VS non-cut areas on the benchmark soils in the LC models in Pilot Areas 1, 3 and 3a to evaluate crop production on these areas. Results of such trials will be needed to guide decisions on future land development methods (i.e. land leveling or ditch and dike).

Any amount of leveling, even 2 or 3 inches, in the LNO soils will damage most of the topsoil. This should be avoided if possible. Irrigation system designs such as contour level or bench terrace basins can be adapted to the topography to minimize leveling cuts. One construction technique to save the topsoil is to stockpile the topsoil during the cutting operation, then place it over the cut areas. This practice should be investigated as an alternative to leaving the cut areas without topsoil.

Agriculture Communications

1. Current status and effectiveness

a. Private sector

Field observations indicate there is some agricultural information obtained by the farmers from merchants selling agriculture supplies. This information regards crop varieties, fertilizer, and insecticides. Merchants or middle men visit the village and verbally agree to purchase a specific dry season crop for a specific price. This influences the farmer's decision about which dry season crop to plant. However, the farmers are somewhat skeptical about the information they receive. They are especially suspicious of verbal agreements with the merchants.

b. Public sector

The farmers interviewed were aware of the government's extension program and recognized the methods which are used to disseminate reliable agronomic information. According to the Agriculture Extension Agent, there are 13 DOAE Kaset Tambons working in the LNO project area. They are operating according to the Training and Visitation system developed under a World Bank project. Each Kaset Tambon is responsible for contacting 100 village contact farmers and providing them with new technology information. However, there are not enough Kaset Tambons to extend the program to sufficient numbers of farmers. The Kaset Tambons are so thinly spread that they cannot spend enough time with each contact farmer to provide adequate training. Moreover, the workload prevents dedicating time to follow up contacts to determine the effects of previous training. Also, as mentioned earlier, farmer responses indicated that they did not receive much information on improved irrigation water management practices.

Information obtained from farmers and field observations of agronomic and irrigation practices indicate an intensified extension effort is needed in the LNO project. Any accelerated field assistance to the farmer would also serve as an evaluation of the impact additional agriculture extension agents could have on agriculture production in similar project areas. The present training and visitation plan should be continued and the number of Kaset Tambons be increased to 26, or 1 for each 50 village contact farmers. Agricultural personnel should receive additional training in irrigation water management and dry season alternative cropping systems. Information booklets should be developed in laymans terms for farmer distribution. This kind of information should be developed for on-farm water course construction and irrigation water management. Sample publications can be obtained from other USAID missions and on-farm irrigation projects in Turkey, Pakistan, India and Egypt.

Recommendation

Agricultural personnel should be trained to transfer irrigation water management technology to the field. Comprehensive courses for these agriculturalists must be taught and extension materials dealing with on-farm water management directed to the farmers should be developed.

Project Management

Introduction to Integrated Rural Development

In the 1977 Project Paper, the LNO project was broadened from an irrigation project into an integrated rural development project. The project objectives were to improve the quality of life of the families residing in LNO. In addition to research, extension, inputs and agriculture marketing activities to support the production objectives, the project also includes community development, health and family planning services, and adult education. Various forms of community participation were envisaged. A special feature of the project is the on-site management arrangement arrangement under which representatives of the numerous RTG departments involved are to reside at LNO, sharing a single office complex, and developing joint or closely coordinated activities contributing toward common objectives. The RID Project Field Director is designated as Director of the coordinating committee of the "Team Leaders" from the different departments. The AID loan and RTG counterpart funds finance the extra LNO activities for each of these departments. The departments receiving these funds are:

Non-Formal Education Department

Community Development Department

Department of Agricultural Extension

Department of Agriculture

Department of Fisheries

Office of Agricultural Economics

Department of Public Welfare

The departments of Health and Livestock are represented on the coordinating committee, participate in the joint planning, but receive no extra funds from the AID loan or RTG counterpart.

Compared with "full-scale" integrated rural development (IRD) projects in other countries that have been designed and financed with external assistance, this project appears on paper to pay only lip-service to the concept of integration. Some of the full-scale projects elsewhere have semi-autonomous authorities established over the area, are vested with considerable power apart from the pre-existing political

jurisdications they overlap, and control large funds, sometimes greater than the resources available to the regular jurisdictions. Their power to coordinate, or direct, is sometimes greater than is available normally in the government structure, except at the highest levels. In some cases, the salary scales are also higher than the regular government salaries, enabling the IRD authority to draw talent away from other parts of the government.

By contrast, the LNO integrating arrangements are based only on coordinating authority. The usual authority lines between different ministry staff located in the project area, and their changwat and Bangkok levels, are not disturbed. The extra funds involved are modest.

Despite the limited departure of these arrangements from the ordinary RTG bureaucratic structure--or perhaps because the departure is so limited--the RID aspect of the project shows signs of very commendable progress, partly in directions not foreseen in the Project Paper.

The Evaluation Team found considerable evidence of the benefits of the integrated project team concept. First, there are numerous instances of closer coordination of functional activities than would normally take place between amphoe or changwat level officials and activities. Second, the integrated approach has resulted in greater focus of activities on the primary task confronting several departments operating in the LNO project area, viz. getting a return for the farmers and the country from the large investment the government is making in the irrigation facilities. The Evaluation Team got a glimpse of what has probably been the major challenge and accomplishment of the IRD team thus far--the administration of the price guarantee program. The committee met many times to deal with problems which threatened the success of the program. At times, the team leadership had to cross bureaucratic lines to overcome certain key problems. The last steps were being carried out during the visit of the Evaluation Team (mentioned earlier), again with the active IRD team leadership playing a general program management role not bound by their personal departmental positions. There seems little doubt that the production promotion program could not have been implemented were it not for the existence, and the determination of the IRD team. Third, this example of integrated planning and operations may prove very useful in the other three NE irrigation projects, and in other areas and projects generally that call for the cooperation of different RTG agencies. Fourth, we observed the high degree of

motivation and desire for joint programming among all the participant Team Leaders, even those from agencies not getting special budgets under the AID loan arrangements. Fifth, there appeared to be a greater degree of flexibility in adjusting to local needs than may normally be the case where local officials are constrained by the objectives and top-down budgeting based on nationally determined priorities.

While these are all very positive developments in the directions envisaged under the Project Agreement, the benefits obtained from this integration could be increased if the management system were strengthened.

A. Current Project Organization and Practices

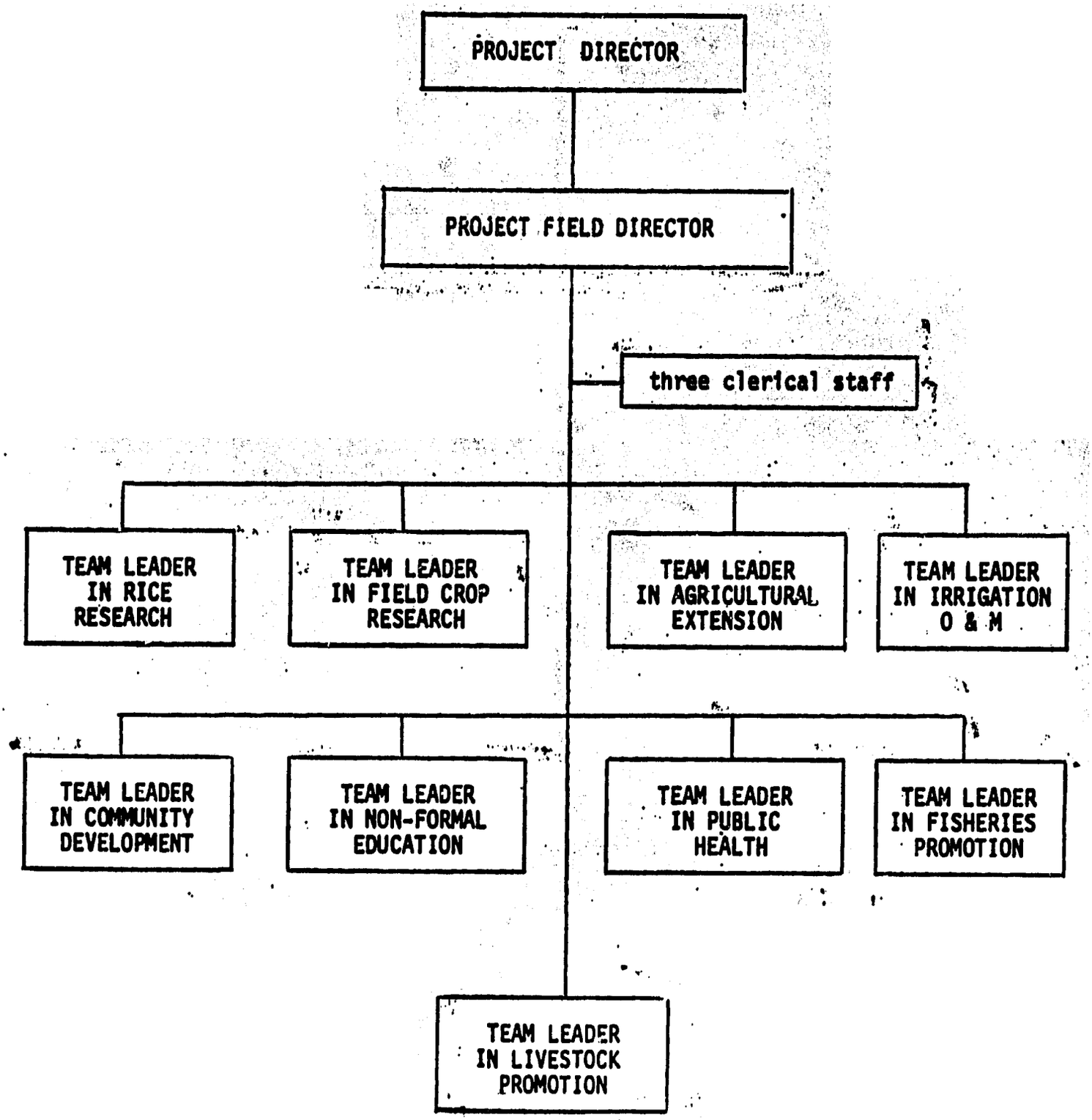
The administration of Lam Nam Oon Integrated Rural Development Project consists of (1) the Project management proper, and (2) the coordination committees.

1. The Project Management Team

The team is composed of a Project Director, a Project Field Director, nine team leaders and a number of their subordinates (See Chart No. 1 on p. 85). The project directorship is vested in the hands of the Deputy Director General in charge of Operations and Maintenance Activities of the Royal Irrigation Department, whose office is in Bangkok. The Project Director is responsible for approval of the project loan funds, both Thai Government Budget Funds and USAID loan funds. He approves the annual project plan but administers only the RID budget funds. The other portions of the project loan funds are administered by the respective departments 1/ supported by the loan. The administrative and the financial documents are processed through the regular channel of all the departments involved, and are treated routinely.

At Lam Nam Oon, where the Project Administration Center is located, the Chief Engineer in charge of Construction of the LNO Project has been appointed the Field Director. The Chief Engineer in charge of Operations and Maintenance has been made the RID Team Leader. The Community Development Department provides a full-time Team Leader stationed at Lam Nam Oon, who, in addition to conducting the CD activities, is also Secretary

1/ Although the Department of Public Welfare is included in the same project paper, it functions separately from the LNO Integrated Rural Development Project.


PROJECT DIRECTOR
PROJECT FIELD DIRECTOR
three clerical staff
TEAM LEADER IN RICE RESEARCH
TEAM LEADER IN FIELD CROP RESEARCH
TEAM LEADER IN AGRICULTURAL EXTENSION
TEAM LEADER IN IRRIGATION O & M
TEAM LEADER IN COMMUNITY DEVELOPMENT
TEAM LEADER IN NON-FORMAL EDUCATION
TEAM LEADER IN PUBLIC HEALTH
TEAM LEADER IN FISHERIES PROMOTION
TEAM LEADER IN LIVESTOCK PROMOTION

for the LNO Field Project Team. While the other Team Leaders work part-time at Lam Nam Oon, their regular assignments are at either provincial offices or nearby experimental stations. In addition to these personnel, the project field director has assigned three temporary workers from the construction crews as clerical and typing staff of the Integrated Rural Development Project. The project field director occasionally draws upon his construction workforce and construction equipment and accessories to assist the Integrated Rural Development Project efforts.

The LNO field team consists of a project field director and nine team leaders.2/ The team meets every month to discuss plans, help solve problems and exchange information. The team attempts to work in a concerted way, i.e. having one common integrated plan and joint operations or service teams. They have so far gained some success; however they have very limited operational flexibility since they have to abide by their agencies' guidelines and budget regulations.

At Lam Nam Oon Project Administration Center, the Louis Berger Company currently has two full-time and one part-time consultants working under a contract with the Ministry of Agriculture and Cooperatives. They assist and advise the project team in planning and implementation. The consultants also prepare monthly and quarterly reports to be submitted to various concerned parties in the project.

2. The Coordination Committees

The Project Paper designated two coordination committees to provide policy direction and guidance to the project management team as well as to facilitate the implementation of the project. One is at the national level and the other is at the provincial level.

The national coordination committee is supposed to meet approximately once a year. The last meeting was April 17, 1980, at which they acknowledged the FY 1980 work plan and the budget as well as the progress of the project. The national level committee is rather far from the operations of the project; and hence they do not do much about the problems of the project management unless being informed by the provincial committee.

2/ The Livestock Team Leader is just being included, while the Family Planning and the Potable Water functions were taken over by a single Public Health Team Leader.

LNO PROJECT ADMINISTRATION

National Irrigated Agriculture Committee

National Coordinating Committee
LNO Integrated Rural Development Project

Chairman: MOAC Under Secretary of State

Vice Chairmen: Governor, Sakon Nakhon Province
Deputy Director-General, RID

Committee Members: Representatives of CDD, DOAE, DOA, DOF, NFED, PWD, MODH, BAAC, NESDB, BOB, CSC, CLCO

Secretary: Director, Projects Division, MOAC

LNO Provincial Coordinating Committee

Chairman: Governor, Sakon Nakhon Province

Vice Chairman: LNO Project Field Director

Committee Members: Provincial Officials of LD, PWD, DCP, Chief Districts Officers (of the Areas covered by LNO Project)

All Team Leaders

Secretary: Sakon Nakhon Provincial Community Development Officer

B. Analysis and Recommendations

The present administration of the Lam Nam Oon Integrated Rural Development faces a number of managerial problems that have hindered them from working efficiently and accomplishing the project objectives and targets.

1. Insufficient Organizational Support from Bangkok's Project Center

There is no project management staff or core working group in Bangkok that supports the Project Director, Project Field Director, and Team Leaders. Therefore, field personnel must travel to Bangkok frequently to initiate actions, follow up actions, seek information, and provide reports. Simple, but very important, financial documents have occasionally required more than five months to be reviewed and approved. There are other examples of unnecessary delays, misunderstandings, embarrassments, and frustration that could have been avoided by good staff work in Bangkok.

One person should be assigned to the Royal Irrigation Department in Bangkok to facilitate communications between the field and Bangkok. This person should deal with all correspondence of the LNO Project. He should call meetings of representatives of all the departments involved in the Project to deal with administrative problems and delays. He should communicate to RID and other agencies, guidelines and due dates set by the Project Field Director for processing documentation. The official should report regularly to Project Management the status of project actions. This official should also help prepare the necessary agenda for meetings by the National Coordinating Committee. A precise job description for the official will be necessary for clear understanding of the purpose and function of his position. This official may assume other duties at the same time, but his responsibility for Project administration should be stipulated.

To allow this representative to work effectively, a project liaison officer for each participating department should be appointed. The department liaison officers should function as the Bangkok staff for the Project and see that all the department and team leader actions needed to support the Project are done correctly and on time.

2. Lack of Agricultural Technical Staff at the Field Management Center

The location on site of the CDD Team Leader has proven highly productive. Free of regular changwat-wide duties, he has been able to devote full attention to LNO, to constantly and directly interact with LNO farmers, and to give important support to the activities of other departments. The Team Leaders say that the regular meetings of the team committee has led to increased personal interaction, and great interest in problem-solving in the LNO area, and that the inter-departmental cooperation at the Lam Nam Oon is much more effective than at the changwat and amphoe levels. Still, it was clear to the Evaluation Team that LNO Team Leaders posted at the changwat level were forced by their changwat-wide responsibilities to limit the attention they could devote to LNO.

The effectiveness of the Team concept would be greatly enhanced if the RTG returned to the intention originally expressed in the Project Paper of posting resident Team Leaders. It is essential that a full-time irrigated agricultural specialist appointed as Team Leader for the research and extension activities at Lam Nam Oon. He should work in the same administrative manner as the Team Leader in Community Development. He should work intensively to see that the agricultural activities are consistent with the Project plan.

3. Lack of Planning Staff at the Field Management Center

Project management has the responsibility to accomplish the specified objectives and targets within the stipulated period of time. To achieve these, all activities must be well planned, supported and monitored. In the past, operations planning had to be put aside because of the difficulty in organizing project activities, and to acquiring necessary personnel and funds to carry out such work. The administrative process to approve the FY 1981 is another example supporting the need for a Bangkok based staff office and staff coordination with Lam Nam Oon. The plans for FY 1981 were not approved by the RTG until April 1981, seven months after the fiscal year began. USAID has not yet approved the plan for reimbursement by the loan, since the RTG has not yet been able to provide a summary financial report on Project expenditures. There is a need to plan, monitor, coordinate and

evaluate Project activities. The project field director should be responsible for planning, data collection, problem identification and reporting.

Another hindrance to project management is the Project Paper itself. Much of the data within the paper is inaccurate and the objectives unrealistic. However, project managers still refer to the Project Paper as a primary reference source. Managers should cease to regard the Project Paper as the final guideline to project management. They should, instead, base future plans on present-day realities, updated information, and the current status of the project.

4. Integrated Procedures Need Further Development

Lam Nam Oon Rural Development Project has been formulated as an integrated one whereby the various activities are planned to fit into the same package in order to arrive at the project goals. These activities are under the responsibility of several different departments. Thus, the success depends on the cooperation of these departments as well as the techniques of integration to be used. However, project management has no mechanism at Lam Nam Oon or Bangkok to encourage integration of activities. Each department representative has to find ways to work together with others. The integration which has occurred has been due only to the voluntary cooperation of the team members. The unified work plan and the financial plan represents the latest attempt to coordinate activities of participating agencies. Much more needs to be done.

The following techniques of integration should be supported or initiated:

1) The idea and use of a unified work and financial plan should be promoted and supported. The program budget that will be introduced by the Bureau of the Budget this year should be used to develop the unified plans for the Project.

2) Other integrated operations procedures should be put into practice, such as the integrated operations room, the common utilization of farmer groups (the need for separate CD groups, AE groups, the NFE groups, the FG groups, etc., should be reviewed) and the common use of facilities (such as the conference rooms, the training centers, vehicle service, and other equipment) by all elements working in the Project.

5. Training Has Yet To Be Upgraded

LNO project organized one orientation conference for some participating officials in December, 1979, and provided an extra training program for tambon agricultural extension officers for a short period prior to May, 1980. The project management was able to enlist the assistance of outside resource persons to help implement these two programs. This level of effort at orientation and training obviously is inadequate. Many government officials still do not understand what their responsibilities are and are not technically able to assist the farmers in irrigated agriculture. Common and separate training programs should be launched for all participating officials. However, special emphasis should be made on "relevancy" and "quality" of the training programs. Relevancy means that the contents of the programs should be specific to the needs of the LNO situation and LNO management's requirements. Quality training programs may be obtained only by selecting qualified trainers and using proper training techniques and training materials.

In this connection, we mention the production of quality training materials. There is little evidence that Government agencies have the capability to produce quality training films, slides and curriculum. Private firms should be contracted to produce the necessary training materials. These materials would be useful for all the irrigation projects in the Northeast. If Lam Nam Oon Project funds are not available for this, the Government should provide budget funding.

6. Insufficient Incentive to Operating Personnel

The Lam Nam Oon Integrated Rural Development Project requires efforts from the field staff that quite often are more arduous than they would face in performing more routine government jobs.

According to the Thai Government regulations, personnel who work away from their duty stations are entitled to special daily allowances. However, the budgets of most agencies are limited and can pay only a few days of the allowance to its officials. Some agencies, like the Fisheries Station, the Public Health Office or the Non-Formal Education, seem to solve this problem by not scheduling field work unless funds are available. The Community Development Department and the Agricultural Extensions Department, on the other hand, expect their personnel to spend approximately twenty days.

monthly in the field. Because of limited budget, the Community Development Workers receive only ten days allowance while the tambon agricultural extensions officers now receive full allowances funded from the World Bank loan.

In order to boost morale of the officials who have to devote their efforts to the success of the project, and to give them equal treatment, consideration should be given to allocate more man-day allowances to those officers who actually work according to the project schedule and requirements.

7. Lack of Phased Program in Implementation

Lam Nam Oon project command area covers approximately 185,800 rai of land in three districts of Sakon Nakhon Province. This area contains land with various types of terrain, varieties of soils and different potential for economic development. It is essential that the planning for development of the command area be based upon clear criteria reflecting potential economic improvement and that priority sites within the command area be identified for future year activities. There is no evidence at this time that future year activities are based upon a reasonable criteria that establishes priority sites for development.

A phased program of area development should be prepared for each part of the land in the Lam Nam Oon area. In preparing this, it is necessary for the project management to set up the criteria of differential development areas. This criteria should be consistent with the government policy. The Louis Berger consultant's technical note that describes criteria and selection process should be reviewed for its suitability as the basis for phased planning.

8. Anticipated Problem of Project Transfer

As stated in the Loan Agreement, the USAID loan funds supporting the Project are expected either to be expended by March 1983, or to be deobligated. The loan funds provide salaries, per diems, supplies, equipment, and gasoline for much of the activity that is aimed at increasing dry season agriculture. This type of activity will be required for many years after March, 1983. For example, applied research of water delivery systems and on-farm application of irrigation water must be continued; demonstrations and crop trials must continue; operation of the Integrated Training Center must continue.

A plan for transferring the Lam Nam Oon system into normal operations of the O & M Office, the provincial, or the district units should be conceived now. In preparing the plan, a series of consultations need to be made with the Provincial Coordination Committee, which can then call upon their units to carry over the system and upgrade it where necessary. The transfer plan, when made known to the take over party, will stimulate their interest in the project activity now. It is necessary to prepare the transfer plan now because departments must prepare their own plans and budgets one or two years in advance. The transfer plan will help to ensure that the operation and activities required will be supported by all the departments involved.

9. Land Settlement Assistance

The Project Paper recognized the need to provide assistance to the up-stream land settlement into which many of the farm families flooded out by the Lam Nam Oon reservoir would be relocated. The Project Loan contains funds for sericulture development in the Land Settlement. This activity, very useful in itself, does not contribute to improving dry season agriculture in the downstream command area, and diverts management from the principal focus of the Project.

The upstream sericulture project be separated from the Lam Nam Oon IRD Project and be managed under the USAID supported Sericulture/Land Settlement Project.

Recommendations

A. Project management should be reorganized to provide for clearer lines of authority. More systematic information flow and closer management attention. This could include the assignment of one person to work within RID to assist the Project Director and the formation of a Project Implementation Working Group composed of designated representatives of participating agencies to facilitate action within an agency and coordination among agencies.

B. The National Coordinating Committee should be reactivated to meet regularly to review project progress, set implementation targets and provide overall guidance to the operating units.

Project Outputs

The Project Paper for the Lam Nam Oon Integrated Rural Development Project contains eleven outputs listed in the Logical Framework and twenty seven indicators of achievement of these outputs. The Evaluation Team attempted to compile data for the record on cumulative actual accomplishment through FY 1980 compared with the originally planned accomplishment. The results of this inquiry are recorded below. (NA = not available).

Output	PP Plan 1980 (cum.)	Actual 1980 (cum.)
1. Irrigation system and agricultural land improvements completed.		
a) Main canal and laterals (Km)	305	345
b) Drainage system (Km)	120	75*

* The Berger consultants have recommended that completion of the drainage system be delayed until a study of area, project and farm drainage is undertaken. Indications of salinization suggest that the drainage system may need a different design.

c) Land consolidation area (000 rai)	2	4
d) Ditch and dike area (000 rai)	102	16*

* The type of D/D work done in the project is different from the type indicated in the Thai Law (see text)

e) No. of detailed research plans completed and being applied	3	1*

* Operational research plans were to be developed for 3 pilot areas. By the time the consultants arrived, land preparation had been completed on 2 areas. The consultants decided that reliable, detailed research was not possible on these areas. The third area (Pilot Area 2) will be the subject of operations research.

2. A road net completed providing for maintenance of the irrigation system and increased mobility, etc.

a)	Feeder roads (Km)	70	70
b)	O & M roads (Km)	230	*

* About 30 Km of O & M roads have been completed in pilot areas. The original target is questionable. In a large portion of the project area, such roads can only be constructed if farmers agree to yield strips of land alongside channel yet to be constructed. The Pilot Area 2 model, if used intensively, would lower the O & M road requirement.

3. On-farm operation and maintenance of the water supply and drainage system effected

Amount of self-help contributions by farmers to O & M charges (Baht millions)	1.56	0*

* Target was based on a much more rapid expansion of the system than has occurred. In any event, the target is now unrealistic as farmers, as yet, are not expected to contribute (see text).

4. A community development program in which villagers actively participate

a)	No. of families receiving CDD occupational promotion and other assistance (000)	52	NA*

* This activity started late, no records have been kept, and is not being implemented in the manner planned. CD program is operating in all 60 villages of the project area, at about the maximum pace available funding permits.

b)	No. of villagers in model villages who participate under Saraphi project (% of total village families)	55	0*

* It was decided not to introduce the Saraphi project in the Project Area Instead, an "Integrated Rural Development Training Center" is being constructed, an activity not included in original project plans.

5. A 3-step organization of farmers

a)	No. of CDD groups organized (30 members/group)	100	0*

* To date, groups have only been formed for purposes of receiving training from various agencies in their own specialties.

b)	No. of Farmer Associations organized or reorganized- minimum of 30 farmers each	9	0
c)	No. of cooperatives organized or reorganized (500 members/group)	2	0

6. A functioning agricultural research and extension program

a)	No. of farmers accepting and using results of applied research and extension programs	4,500	*

* Approx. 3,000 farmers used the groundnut variety recommended for the 1980/81 dry season. Another 123 farmers participated in various trials during the dry season and 48 in the wet season.

b)	No. of farmers engaged in model farm village program	111	0*

* Program not started yet.

7. Farm input, advisory services and marketing package provided

a)	Agrilime in use (mt)	19,500	0*

* Agrilime not yet determined to be useful. Testing is being conducted.

b)	No. of farmers receiving institutional credit. (% of total families)	55	?
c)	No. of farmers assisted by the Marketing Organization	24,800	2,000*

* 1980/81 dry season was first year of RTG intervention in marketing. Number refers to groundnut producers.

8. Improved services provided for family planning, health and home economics/nutrition

a)	No. of village health agents installed	68	26
b)	No. of health center workers who have completed advanced training	12	N.A.
c)	No. of families provided with home economics and nutrition training	115	N.A.

9. Functioning model farmer with active nuclear family achieving spread effect from training and assistance which has been received

a)	No. of model farmers/ nuclear families who have been provided training	1,300	0*

* Project staff have decided model farmer program is unworkable because of the necessity of coordinated action by too many separate agencies.

b)	No. of farmers who have been assisted by model farmer and the nuclear family	5,200	0*

* See 9.a above.

10. Live-long Education Center

No. of training classes completed	504	0*

* Construction of training center not yet completed.

11. Increased fish production for food and income purposes realized from fish stocking and training programs

a)	Reservoir fish density (Kg/rai)	25	*

* Fish density not followed but should be high due to large scale stocking (about 5 million fingerlings) and low level of fishing activity

b)	No. of Boy Scouts trained in artificial propagation of fish	200	50
c)	No. of families receiving fish culture assistance	400	120

PERSONS CONTACTED BY THE EVALUATION TEAM

Royal Thai Government

A. Lam Nam Oon Project Field Team

1.	Mr. Vichai Sanguanphaiboon	Project Field Director
2.	Mr. Kitti Klai-Angthong	Deputy Field Director for Irr. System
3.	Mr. Sansonthi Boonyothayan	Deputy Field Director for Rural Development Activities
4.	Mr. Virat Vareerat	Deputy Field Director for O&M
5.	Mr. Suthin Tancharoen	Design Engineer

B. Sakon Nakhon Province and Other Field Officers

1.	Major Arun Sangkhasuban	Deputy Governor, SKN
2.	Mr. Niphan Prachantasane	Chief, Agri. Extension, SKN
3.	Mr. Kong Wichienproed	Chief, Livestock Station, SKN
4.	Mr. Khemchart Nimsomboon	Chief, Fisheries Station, SKN
5.	Mr. Utai Pisone	Chief, Research Division, NEAC/Khon Kaen
6.	Mr. Kosit Kosanasanti	Chief, Non-Formal Education, SKN
7.	Mr. Chayant Mapol	Chief, Sub-Regional Office, Road Construction & Maintenance for Irrigation Projects, RID/SKN
8.	Mr. Sutchai Pongsittisuk	Chief, Health Office, SKN

C. Ministry of Agriculture and Cooperatives, Bangkok

1.	Dr. Anat Arbhabhirama	Minister, Ministry of Agriculture and Cooperatives
2.	Dr. Thalerng Thamrong-Nawasawat	Under-Secretary of State, MOAC
3.	Mr. Thana Thongton	Director, Projects Division, MOAC
4.	Mr. Amphan Punnakant	Deputy Director-General, RID
5.	Ms. Nawarat Phomtong	Chief, Design Division, RID/SKN
6.	Mr. Chaiwat Prechawit	Civil Engineer/RID
7.	Mr. Natawudh Bhasayavan	DOA
8.	Mr. Charoen Khalparisuthi	DOA
10.	Mr. Vijai Napamornbodi	DOA
11.	Mr. Cherng Chinnupatam	Chief, Planning & Projects Branch, Planning Division
12.	Mr. Sutthipun Phromsubha	Ag. Extension, DOAE
13.	Dr. Wanee Samphantharak	Land Policy and Planning Division, Department of Land Development

D. NESDB

1.	Dr. Snoh Unakul	Secretary-General, NESDB

E. BOB

1.	Mr. Thanit Meesuk	Evaluation & Report Division, BOB
2.	Mr. Wathana Wongkietirat	Evaluation & Report Division, BOB

II. Louis Berger International, Inc. - Consultants

1.	Mr. James Dalton	Team Leader
2.	Mr. William Bell	Engineer
3.	Mr. Erroll Coles	Engineer

III. USAID/Thailand

1.	Mr. Donald Cohen	Director
2.	Mr. Robert Queener	Assistant Director
3.	Mr. David Bathrick	Director, O/ARD
4.	Mr. Frank Gillespie	Project Manager
5.	Mr. Kamol Chantanumate	Assistant Project Management
6.	Mr. Jerry Wood	O/ARD
7.	Mr. Bruce Odell	Director, O/PPD
8.	Mr. Jack Williamson	Assistant Program Officer

UNITED STATES GOVERNMENT

memorandum

DATE: March 27, 1981

REPLY TO ATTN OF: Frank L. Gillespie, O/RD

SUBJECT: Lam Nam Oon IRD Project (493-0272) - Evaluation

TO: Mr. Robert W. Nachtrieb, Thailand Desk Officer, ASIA/PTB

I would appreciate your circulating copies of the attached scope of work to Maureen Norton and other appropriate persons in the ASIA Bureau; to Gil Corey and Jim Lowenthal in DSB; and to persons in PPC who are interested in Lam Nam Oon.

Thanks very much for your assistance.

Attachment: a/s

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

OPTIONAL FORM NO. 10
(REV. 7-76)
GSA FPMR (41 CFR) 101-11.6
5010-112

This copy without attach.

THAILAND

LAM NAM OON INTEGRATED RURAL DEVELOPMENT PROJECT

SCOPE OF WORK FOR EVALUATION

1. The Project (Loan $4.5 million; Grant $100,000; Host Government Budget $39.3 million)

The Lam Nam Oon Integrated Rural Development Project (493-0272) Loan Agreement was signed January 20, 1978. The project purpose is "to demonstrate in a typical irrigated area in Northeastern Thailand an integrated and coordinated approach to rural development that (a) significantly increases agricultural production and (b) improves the quality of life over a broad spectrum." The intended beneficiaries are the approximately 10,000 poor farm families living in the vicinity of the Lam Nam OOn Dam. The project is to include: (a) completion of construction of the irrigation system in the Lam Nam Oon project area; (b) construction of a road network for maintaining the irrigation system, doubling as a feeder road system for the farmers; (c) operation of an on-farm irrigation system; (d) an integrated program of community development, agriculture research and extension, provision of farm inputs, farm products marketing, health and family planning services, and adult education; and (e) assistance to approximately 150 farm families resettled from the reservoir area to the upstream resettlement area through the intro-

duction of modern sericulture activities. A project assistance completion date of September 30, 1982 was specified. The project is now behind its original schedule. Approximately $700,000 of the loan funds had been disbursed as of February 1981.

2. Purpose of the Evaluation

The purposes of this evaluation are to set forth, for technicians and policy makers in the RTG and AID, (a) specific conclusions re project effectiveness and progress to date and prospects for achievement of the project purpose within the current plan, time frame, and available funding; (b) recommended actions to improve overall project performance and as appropriate; (c) specific recommendations for Project redesign to enhance the probability of purpose achievement. Recommendations for redesign of the Project will be sufficiently detailed to be readily developed into an operational plan by project management.

The report will include a recommended management information system for implementing and monitoring the Project.

The evaluation report will answer the following major questions:

a. Present status of project. (1) What has actually been accomplished under the project to date?
(2) Other than late start-up, what are some of

the key factors responsible for slow progress? (3) What are other major factors explaining problems associated with the Project to date? (4) Are the original assumptions related to project design valid?

b. Project feasibility. (1) What is the likelihood that by continuing within the project's current design, the project purpose can be attained? (2) how should the project design be modified to increase the likelihood of success? (3) Is the Project focus on development of the entire area still desirable, or should a more limited-scope project purpose be defined, e.g., operation research in irrigation development and management in a selected portion of the command area? (4) How does the Project relate to National Programs and priority interests of the Government.

c. Managerial arrangements. (1) What are the current deficiencies in project administration, at the field and Bangkok levels? (2) What organizational and management adjustments are essential for effective implementation? Are these adjustments realizable? What lessons can be learned about management arrangements for future USAID projects? (3) How well have the consultants

performed? How can the consultants be more effectively used? (4) What procedures and/or personnel does AID need to effectively monitor and manage project resources?

d. Required actions. What organizational, managerial, technical and procedural actions are required by the RTG and AID to improve the trend of project implementation? Are the necessary resources available in AID and the RTG?

e. Redesign actions. There is a general presumption that some adjustment of the Project design will be necessary. Early in their project assessement, the evaluation team should make its own determination concerning the need for redesign and the extent of such redesign effort. The team would then be requested to develop firm ideas for Project redesign that include duration of time required, resources needed and outline of activities over the duration. The team would be expected to produce a document from which the Government and USAID could move to detailed project planning.

Additional technical questions to be answered by individual team members are specified below.

4. Timing, Team Composition, and Responsibilities of Individual Team Members

a. Timing. USAID desires that the evaluation begin in April 1981 or as soon thereafter as possible. It is estimated that the evaluation will require four weeks' time for the core team members (two to three weeks for the field portion of the evaluation, plus time for preparation and report follow-up). Additional preparatory and follow-up time will be required of the team leader. An extension of the effort past four weeks will depend upon the need for, and the ease of, Project redesign. Two or three essential members of the team, augmented by USAID staff, should plan to continue for an additional two weeks and produce a basic Project Redesign document.

b. Team composition. The evaluation is to be conducted by a joint Thai-U.S. team. Team composition and basic focus of effort is provided below. Detailed sub-sets of questions and Issues will be identified and dealt with during the evaluation.

1) Organization/administration specialist (U.S.). Will serve as team leader, will manage the evaluation effort, and will be responsible for the quality and completeness of the overall evaluation report. His technical assignment requires he focus on the following items:

a) Assess administrative effectiveness at the field and Bangkok levels. Recommend changes to improve organization and management.

b) Assess extent to which Project is effectively "interpreting" planning, budgeting and implementation activities of participating agencies. Assess value of Berger's Project Note No. 2 as methodological approach to promote integration. Assess appropriateness of emphasizing integrated rural development rather than narrow focus on water distribution, on-farm water management, and related agricultural production and marketing.

c) How appropriate are current levels of personnel deployed to carry out Project activities of each participating agency?

What are the highest priority additional personnel and training needs? What kind of incentives might be introduced for more effective commitment by participating agencies and their assigned personnel?

d) How effectively has the Louis Berger consultant team performed in relationship to the contract scope of work? Do the RTG, consultants, and USAID have a common interpretation of the consultant role? How may overall consultant performance be improved? How adequate is the contract scope? Does the scope and consultant mix need to be modified or expanded?

e) Develop a Management Information System for the RTG and USAID Project Officers.

2) Organization Specialist (Thai). Will work with he U.S. specialist to answer above questions. e will also assess effect on Project of RTG udgeting and disbursing procedures, personnel evelopment, and various regulations re per diem, romotion, vehicle utilization, etc. He will valuate attitudes of RTG officials at various evels toward the Project. He will recommend

ways to improve the overall performance of Project management.

3) Agriculturalist (U.S.). Will examine current efforts and effectiveness related to: (a) development of optimal cropping systems; (b) agricultural information system; (c) soil conservation and soil improvement practices of the Government, of the farmers; (d) system wide irrigation water management practices; and (e) system by which farmer receives credit, inputs, and extension and marketing services required for effective cropping. Recommend ways Project can improve effectiveness of above.

(of Economist Statistician)

4) Agriculturalist (Thai). Will deal with same set of issues described in #3, but will focus special attention on appropriateness of land consolidation techniques with regard to preservation of soil fertility, farmer attitudes, and unit costs for command area development.

5) Irrigation Engineer (U.S.). Will deal with the technical aspects of design, operation, organization, and management of the irrigation/drainage system and will provide recommendations. Among the basic questions to be

answered are: (a) Will the overall system design/construction provide efficient conveyance of water to the fields? To what extent does the existing system provide real access to year-round irrigation? (b) Will the design provide equitable distribution and control of water? (c) Are current approaches for "intensive" command area development cost effective (include review of land consolidation techniques and Pilot Area 2 design)? (d) Does a suitable model for "Extensive" command area development exist, e.g., ditch-and-dike method? What is an appropriate division of labor between the Royal Irrigation Department and Project area farmers with respect to excavation of canals, land shaping, etc.? (e) Is the current system of operations and maintenance suitable for effective utilization of the system?

6) Water Resources Development Expert (Thai). Will work with the U.S. Irrigation Engineer on the same set of issues. He also will support the U.S. and Thai organization specialists. In addition to being responsible for the

comprehensive input combining technical aspects of irrigation systems with organizational and managerial aspects, he will deal with many specific questions, e.g.:

a) Why is construction now in 14th year? At what annual cost?

b) What is the area under irrigation (wet season - dry season)?

c) How is Project implementation affected by RID internal organization?

d) How well does the contract for consultants address the needs of the Project?

e) How appropriate is the maintenance equipment list relative to the needs of the system?

f) How appropriate are the designs and plans for land consolidation and on-farm water management?

7) Economist (Thai). Will deal with the following: (a) What are the principle constraints inhibiting dry season cash cropping? e.g. unpredictable water supply, marketing, input availability, labor, risk, etc. (In this regard he will

critique the consultant's marketing study.) (b) How can the Project affect these constraints? (c) How effectively is the Project ameliorating the constraints? (d) Recommend actions to improve effectiveness? (e) Assuming reliable delivery of water, how do the constraints change in magnitude?

8) Additional short-term consultants (Thai). Identification of specific topics during evaluation may require short-term assistance.

5. Methodology.

Information will be gathered through document review, site visits, interviews of Project personnel, intended beneficiaries, and Bangkok level officials. Individual team members must allocate their time in different ways (e.g., project area vs. Bangkok) to satisfy the requirements of their respective tasks; however, team meetings directed by the team leader will be needed to assure a coherent, comprehensive, succinct report. As an idea that might later become a recommendation for significant Project change is developed by team members, the idea should be shared with Thai Government personnel to early on assess its appropriateness.

USAID will provide basic documents for review by team members including the project paper and project agreement prior to their assembling for the evaluation. Other documents to be reviewed will be made available during the evaluation. The review of Thai Government and contractor documents is especially important.

The evaluation team will also involve members of the Ministry of Finance and/or Bureau of the Budget evaluation sections. Debriefings in Thai and in English will be given at appropriate times. The debriefings will convey tentative conclusions and recommendations.

6. Reporting Requirements

(a) Format of the Report. The report will contain the following sections (refer to example of format for AID evaluation reports attached to this scope of work):

- Executive summary (two pages, single space including statment of Project purpose and purpose of the evaluation);
- Statement of major findings and recommendations (short, specific, and succinct with each topic identified by subheading). Recommendations should be keyed to major findings and identify who should take the recommended action;

- Body of report (which must include the rationale and basis for the major findings and recommendations);

- Appendices as necessary (including evaluation scope of work and statement of methodology used).

(b) Procedures. The team will submit to the RTG and USAID project officers one written draft report in English for review and comments 5 days prior to their departure. Elements of the draft report prepared by Thai members of the team should be provided both in Thai and English. The team will also make an oral presentation to the appropriate USAID/Thai Government forum explaining the major conclusions and recommendations in the draft report. Ten copies of the final report in English will be sent to USAID four weeks after departure. To the extent necessary, the report will be translated into Thai by the Thai members of the team.

O/RD:FLGillespie
Initial Draft 3/11/81
Final Draft 3/25/81

LAM NAM OON EVALUATION - DOCUMENTS

1. PP

2. Agreement

3. LBI Contract

4. Monthly Reports (LBI)

5. RTG reports

6. Keller team review report (December 1980).