REPORT ON THE EVALUATION OF THE AGRICULTURAL RESEARCH PROJECTS SUPPORTED

by
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Evaluation of the Agricultural Research Projects Supported by IDRC Thailand.

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CHAPTER 1

SUMMARY

This report was prepared by the Department of Technical and Economic Cooperation (DTEC) in collaboration with IDRC to evaluate five agricultural research projects, namely, the Village Level Rice Mill, the Post-Harvest Rice Technology, the Development of Ground-Nut Sheller, the Cassava Nutrition and the Semi-Arid Crops projects.

The evaluation team comprises the officials from DTEC, Thailand Institute of Scientific and Technological Research, Kasetsart University, and the Ministry of University, Affairs. This report was a product of field work and extensive interviews with project leaders, researchers, government officials, para-governmental agencies concerned and private companies. The team visited various sites and held discussions with farmers.

The objectives of the evaluation are to measure the research capability, the development of the method of approach and the stimulation lending to further research projects. The evaluation shows that the research projects sponsored by IDRC help upgrade the research capability and enhance substantially the research experience to Thai researchers. The financial support from IDRC also stimulates the researchers in various institutes to produce useful research works to community. The findings from the research projects have great potential to be used both academically and in general practice.

Both the evaluation team and project leaders agreed that the amount of assistance rendered by IDRC to each project in terms of financial support, project monitoring, technical consultation and problem solving is adequate and reasonable.

The summary of the findings is as follows:

1. PROJECT IDENTIFICATION AND FORMULATION

1.1 Among the five research projects evaluated, four were more or less initiated by Thai researchers and one was IDRC's initiative.

1.2 The evaluation team found that

1.2.1 The objectives of each project fitted into the national development framework of improving the standard of living of the farmers in rural area through the development in agricultural field.

1.2.2 The advantages of formulating the research projects by each individual researcher were the flexibility, direct scientific discussion and efficiency. The main disadvantage was that the research project might not fit into the national development framework. The evaluation team, however, agreed that the advantages outweighed the disadvantage.

1.2.3 The objectives of each project were clearly stated. However, some of the projects had problems in achieving the proposed objectives due to the lack of important data when the projects were formulated.

2. PROJECT OPERATION

2.1 The execution of most of the projects followed closely the plan laid-out during the formulation of the projects. This was made possible as a result of the researchers' capability and their effort.

2.2 Some projects had problems in operating according to the proposed plan due to the shortening of the time or external factors out of the researchers' control.

3. PROJECT MANAGEMENT AND MONITORING

3.1 In all projects, the support from IDRC was both adequate and reasonable.

3.2 In some projects, the following management problems arose:

3.2.1 **Job Insecurity** Job insecurity caused high rate of turnover of researchers and research assistants.

3.2.2 **Government Red-tape** The red-tape caused some difficulties in purchasing the required materials and reimbursing the expenses.

3.3 For project monitoring, it can be concluded that

3.3.1 IDRC had adequately monitored the five projects by regular visits of program officers, technical consultants and regional

comptrollers. There was a minor problem with the change of program officer since the project leader had to establish a working relationship with the new officer.

3.3.2 There was minimum monitoring from the recipient institutions and government agencies concerned.

4. PROJECT ACHIEVEMENT

The achievements of all five projects are satisfactory. The findings of the projects were adopted and used by various groups leading to the development of the agricultural field in Thailand.

5. DISSEMINATION OF THE RESULTS AND INSTITUTIONAL LINKAGE

The findings from the projects were disseminated in several ways. They were published in journals, presented in the seminars, workshops etc. The project teams have also tried to form the dissemination linkage both inside the country and abroad. IDRC played an important role in the latter case.

However, there seemed to be some problems in the dissemination of some of the findings of some projects. The main reasons were due to the lack of manpower, limited funds and the dissemination depending solely on individual effort without significant institutional backup.

6. DEVELOPMENT IMPACT

6.1 Direct Impact

The findings of the projects were directly applied to several projects of various groups such as government agencies, state enterprises, King's projects, private companies and the farmers. The application of the findings on a wider scale will be possible if more time is allowed.

6.2 Indirect Impact

The projects helped build up the research capability of Thai researchers, upgrade the teaching capability of the researchers, improve the reputation of the Thai researcher and institutions concerned and prevent the brain drain from the country.

7. RECOMMENTATIONS

7.1 The agricultural research projects supported by IDRC are useful and have direct impact on both academic and agricultural development in Thailand. The evaluation team recommends that IDRC should continue to support this kind of research projects. On the other hand, the Thai government should provide facilities for the development of the projects and contribute the top-up funds.

7.2 To eliminate some problems arisen in some of the projects evaluated, the evaluation team recommended that

7.2.1 The project leader should have sufficient research experience, enough materials and details prior to the formulation of the project.

7.2.2 The recipient's institutes should help solve problems in project management by:

7.2.2.1 providing suitable environment for research activities, job security and flexibility in project operation.

7.2.2.2 joining DTEC and IDRC in monitoring regularly the progress of the project and assisting in eliminating any problems which may occur during the operation and transition periods.

7.2.3 The recipient's institutes should assist in the dissemination of the findings of the project so that the findings can be implemented on a wider scale.

7.3 The evaluation team recommended that IDRC should extend its support to cover the gap between research and extension.

CHAPTER 2

OVERVIEW

In the evaluation of various agricultural research projects supported by IDRC, five projects, i.e. the Village-Level Rice Mill project, the Post-Harvest Rice Technology project, the Development of Ground-Nut Sheller project, the Cassava Nutrition project and the Semi-Arid Crops project were chosen as representatives of the group. The objective of this chapter is to present an overview of the evaluation of all the evaluated five projects to give a clear picture of the overall evaluation before presenting the detailed evaluation of each project in Chapter 3.

In this chapter, the evaluation team will present mainly the materials involving the impact on the objectives of the evaluation.

1. PROJECT FORMULATION

The evaluation team studied all aspects of projects formulation including project initiative, project proposal and the approval of the project. The team found that four out of the five projects were more or less initiated by the Thai side. The Post-Harvest Rice Technology project (Grain Dryer) was however IDRC's initiative. IDRC was interested in this latter project since 1974. That was the first year IDRC agreed to cooperate and support the research projects carried out in Thailand and sent her officials to observe these activities. IDRC officials have discussed this Post-Harvest Rice Technology project with Kasetsart University and the Agricultural Engineering Division, the Department of Agriculture. Since the latter is better equipped, IDRC finally agreed to support the project carried out by the latter institution.

There are three interesting points reflected from the findings.

1.1 The questions on how the program was initiated, by which side, and to serve what purpose should be explored. Most of the programs were initiated by the Thai side, hence they were bound to suit the Thai institution's plan. At the institutional level, Thai universities were encouraged to carry out research works to improve their personnel's teaching capability and to provide technical service to other

institutions. At the national level, the programs fitted well into the overall national development framework since both the programs and the national development plan were intended to raise the standard of living of the people, especially the farmers in the rural area. They fitted well even when each objective was considered in detail. This included the research and development of agricultural machinery which gave farmers a better bargaining power, raised their standard of living, promoted small industries in rural area and narrowed the economic gap between urban and rural areas and the research on agriculture which helped diversify the use of agricultural products, especially those of cassava which caused a lot more problems recently and required urgent attention from the Thai Government.

Though Post-Harvest Rice Technology project was IDRC's initiative, it fitted well into the Thai development plan.

1.2 The initiation of all five projects has a common characteristic, it is mainly based on individual approach. The Cassava Nutrition project was initiated during the participation of the Dean of Faculty of Agriculture, Khon Kaen University in the seminar on Cassava Processing and Storage held by IDRC. The Semi-Arid Crops project was made possible as a result of a visit by Professor L. B. Seimens of the University of Manitoba to Khon Kaen University. He advised the Dean of the Faculty of Agriculture to apply for a grant from IDRC. On one of his visits to Singapore, the Dean approached IDRC for support which was later on granted. The Development of Ground-nut Sheller project was communicated through the Dean of Faculty of Engineering, Khon Kaen University. IDRC's officials, on the other hand, played an important role in initiating the projects in the Department of Agriculture, Ministry of Agriculture and Cooperatives. DTEC, though serving as the representative of the Thai Government, was not in this initiation process because the work was initially with the Department of External Cooperation Division 2 with insufficient manpower. The work was later transferred to DTEC when a new division was established in DTEC to look after these matters.

Both advantages and disadvantages arose from the individual approach mentioned above. The advantages were flexibility and direct scientific discussion. The disadvantages were that the projects might

not fit well into the national development plant and/or repetition of the research works, including looking for supports from other sources when they were not available from the current sources.

1.3 The objectives of most projects were clear and feasible. Problems in executing some projects were due to lack of important data when the project was formulated or because the objectives were too broad.

2. PROJECT OPERATION

The operation plan and the methods of experimentation for the projects were well conceived for the required objectives. The team leader was well qualified to lead in each project.

Most of the projects achieved their objective on schedule. Two of the projects, namely Semi-Arid Crops and Cassava Nutrition projects encountered some problems in their operation. The objectives of the former project were too difficult to achieve and the operation plan was too broad. It was not surprising that they had to be revised. Some certain important data were not taken into consideration when the latter was formulated. Though the project was well supported by the Thai Cassava Dealer's Association, but because of its commercial impact, the work had to be carried out cautiously, with confidence in the data obtained and consequently requiring more time.

3. PROJECT MANGAGMENT AND MONITORING

3.1 Project Management

The supports from IDRC to all five projects were appropriate, adequate and reasonable. IDRC allowed enough flexibility in funds management which helped facilitate the project operation.

Initially there were problems concerning the incentive payment to the researchers. These problems have, at present, already been solved. The second problem was the high rate of turnover of the researchers due to job insecurity. The third problem, arisen from the inflexibility in purchasing materials and reimbursement of the expenses, was encountered only in government agencies but not in educational institutes. The latter managed to make a special arrangement for more

flexibility in utilising the funds.

3.2 Project Monitoring

IDRC has adequately monitored the research projects by regular visits of program officers, technical consultants and regional comptrollers. There was a minor problem with the change of the program officer once the project leader had to establish a working relationship with the new program officer.

The evaluation team noted that DTEC should pay more attention on the monitoring of the project.

4. PROJECT ACHIEVEMENT

The evaluation team differentiated objectives from goals. Objectives should be achieved but goals are not necessarily attainable by only one project.

With this view in mind, the evaluation team found that the achievements of all five projects were satisfactory. The projects involving research and development of agricultural machinery, namely, Ground-Nut Sheller project, Village-level Rice Mill project and Grain-Dryer (Post-Harvest Rice Technology) project had achieved their objectives of producing the prototypes and the workshop drawings. The Cassava Nutrition project had proved that cassava products could be used as a ration in animal feed. The Semi-Arid Crops project produced basic knowledge which would be useful for further researchers and/or used in promoting the plantation of better crops. For example, the project produced a new breed, the ground-nut RCM 387 which had potential to be a promoted breeding material and acquired data for moisture level in soils all year round.

The goals hereby implied the application of the findings from the project will be discussed at a later stage.

5. DISSEMINATION OF THE FINDINGS AND INSTITUTIONAL LINKAGE

Though the research projects helped build up the academic capability of the institutions concerned, the ultimate goal was to serve the community at large. Nowadays, owing to the limitation of natural

resources, the implementation of the findings was in many case as important if not more than the findings themselves. The evaluation team realised that the implementation was usually difficult to carry out and time consuming. However, if institutional linkage existed, it could be used not only to exchange information but also for dissemination of the findings and extension.

The findings of the projects were disseminated in various forms as follows:

1. Booklets or reports
2. Publication in journals
3. Publication in proceedings of seminar
4. Drawing or blueprint distributed to individual or private companies
5. Prototype sent to government agencies and institutions concerned for testing, and/or demonstration.
6. Serving as speakers in short courses or workshops
7. Holding a seminar as in Cassava Nutrition Project
8. Demonstration by the team or in collaboration with other agencies

The evaluation team found that there was sufficient institutional linkage in each project. The links covered the institutes, research units, para-governmental agencies and private companies in the country and abroad. IDRC played an important role in building up international institutional linkage.

There were limited dissemination and linkage to private companies in some of the projects, namely, Post-Harvest Rice Technology, Village-Level Rice Mill and Ground-Nut Sheller projects. This was due to limitation of funds, manpower and no significant institutional backup. The dissemination to private companies as in the Ground-Nut Sheller project was based on personal relationship. This, nevertheless, showed the good intention and effort of the project team to narrow the gap between research and extension.

The evaluation team noted that so far there was no agency who took responsibilities in the dissemination of the findings of the projects.

6. DEVELOPMENT PROJECT

6.1 Direct Impact

Even though there were extensive interviews with representatives of government, para-governmental agencies concerned, private companies and farmers (as listed in the appendix), the evaluation team still could not find sufficient data to show clearly the direct impact of the findings of the projects. This might be due to the limitation in the dissemination of the findings and time for the development of the impact.

The evaluation team, however, found that there was substantial extension of the findings resulting through the institutional linkage, such as,

6.1.1 Response to findings of Cassava Nutrition project from agencies concerned.

6.1.2 The researchers from the Village Level Rice Mill project were invited by the Marketing Agency for Farmers, a para-governmental agency, and the King's project, to demonstrate the operation of the mill to their officials and members.

6.1.3 Some examples showing the impact of the projects on private companies are:

The grain-dryers which were developed by one of the project teams were manufactured by Yuthapong Palate Co. Ltd. One dryer was purchased by a farmer in Kanchanaburi province. The Australian Government through the Aids to ASEAN Countries donated the dryers to the farmer group in Pathumthani and Pitsanulok provinces. The ground-nut shellers were produced by Lim Chiang Seng Co. Ltd., an agricultural machinery producing company. The operation of the machine was demonstrated in the Northern Region Agricultural Machinery Trade Fair in December 1983. So far five machines have been purchased. Owing to the institutional linkage, the evaluation team believed that the direct development impact will be clearly visible in the near future.

6.2 Indirect Impact

They are as follows:

6.2.1 Research capability and knowledge built-up in Thai researchers were achieved.

6.2.2 Academic qualification of the researchers in some of the projects were upgraded through the project funds and/or project findings.

6.2.3 The projects helped publicise the name of the institutions.

6.2.4 Research projects supported by IDRC helped reduce the brain drain by providing incentives and suitable environment for researchers.

6.2.5 Research projects supported by IDRC helped create new researchers by providing opportunities for fresh graduates to be trained.

6.2.6 Research projects helped improve teaching activities in both the institutes concerned and other institutes. For example, Nakorn Ratchasima Agricultural College adopted the ground-nut sheller as teaching materials.

6.2.7 A special case, the farmers in Kalasin province used the ground-nut sheller introduced by the project team to produce the stripped nut. However, the demand of the stripped nut at that time was low, the farmers used the unsold products to expand their ground-nut plantation area.

7. RECOMMENDATION

7.1 Though each evaluated project was rather small and involved not so much funds, the development impact of the project could be significant if there existed an efficient and systematic mechanism to help disseminate the findings and in the extension of the project aiming at the goal set earlier.

The weak points of the projects evaluated were the development impact of the project. The main problem seemed to be the dissemination of the research findings. Besides the limitation in funds and manpower, there were also other obstacles in the dissemination and implementation of the findings. When the project team started a new topic, the effort spent on the follow-up of the previous project was even less.

The evaluation team recommended that more effort and funds should

be provided for the dissemination and extension of the findings. This should be done systematically with all necessary institutional linkage.

7.2 The evaluation team agreed that IDRC has adequately monitored the projects by regular site visits. There was, however, minimum monitoring from the government agencies concerned including DTEC. DTEC should pay more attention on the monitoring and cooperate closely with IDRC.

7.3 IDRC has always provided scholarships and funds for the training of project members. This produced a direct impact in building up research capability and academic qualification of the Thai researchers. The evaluation team recommended that these funds should still be included in the package. However, the problem of manpower shortage should also be considered during the approval of these funds.

CHAPTER 3

DETAILS OF THE EVALUATION OF EACH PROJECT

A. The Evaluation of the Post-Harvest Rice Technology Project

1. Background

Thai farmers always face the problem of high moisture level in grain, especially paddy from deep water field which deteriorates rapidly and fetches low price in the market. The most common and simplest drying method is sun-drying. However, this method of drying is possible only when the weather is clear, dry and warm. Usually the deep water paddy and the first corn crops are harvested in the rainy season when the humidity is relatively high. During that period, the grain dryer is required to remove the moisture from the grain to reduce the loss both qualitatively and quantitatively.

Post-Harvest Technology Project was initiated by IDRC's officials. In 1974, IDRC, for the first time, agreed to cooperate and provide aids to Thailand. IDRC's officials, in that year, visited Kasetsart University and Agricultural Engineering Division, Department of Agriculture, Ministry of Agriculture and Cooperatives to discuss about the formulation of the project. Kasetsart University responded by submitting a program to IDRC. In that program, the university proposed a joint project between the University and the Department of Agriculture. The latter would be responsible for the fabrication of the grain dryer and the former on the test and experimentation. The Department of Agriculture, however, thought that the drying process, which was a post-harvest technology process, was under the responsibility of the Department and the Agricultural Machinery policy of the Ministry, would be better carried out by only single organization. After another round of visit by IDRC's officials, it was agreed that the project should be carried out by the Department of Agriculture. The Department hence afterwards formulated with assistance from IDRC's officials and submitted the new proposal of this project.

The content of the project was changed twice. The original proposed by the Department of Agriculture was "Post Production Rice

Technology Research Project". It was later changed to 'Post-Harvest Rice Technology (1976)". The project was divided into two phases:

(1) The first phase lasted about 2 years from mid 1976 to mid 1978.

(2) The second phase lasted for 23 months from mid 1978 to mid 1980.

2. OBJECTIVES

The original objective was to work on "Post Production Rice Technology Research" which covered both the drying and storing processes. The aim was to design a dryer for deep water paddy which was suitable for farmers' usage and could be fabricated locally. After careful consideration, IDRC pointed out that the objective was too broad and suggested the deletion of the storing part but extended the first part to cover the dryer for other kinds of grains, disseminating the findings to other ASEAN countries and conducting a survey on current post-harvest technology of important crops in Thailand. IDRC, at the same time, raised the supporting funds from C$45,000 to C$78,000 and assisted in the design of questionnaire.

3. PROJECT SCHEDULE

The sequences of project execution as carried out by the officials from the Preservation and Processing Section were as follows:

3.1 Conducting a survey on current post harvest technology of important crops in Thailand. The chosen crops were rice, corn, soy-bean, mung-bean and ground-nut. The aim was to obtain information about the harvest season, drying, milling, cleaning, conveying, marketing processes, the yields and any problems relating to post harvest technology of these crops.

3.2 Designing a grain dryer. The survey as stated in 3.1 showed that the farmers never used the dryers before. The project team thus tried to set a criteria for the suitable dryer for Thai farmers. It was concluded that the dryer should comprise a bin, heater, blower and flow control mechanism. The aim was to design a low-cost dryer which could be manufactured locally and run at low operating cost. For example

(1) The bin was fabricated from plywood but steel grate was used for

drying floor.

(2) Earlier, the project team used diesel furnace not kerosene burner as heater because though kerosene was cheaper but rather inconvenient. Later on, after the oil crisis, the project team used husk furnace because husk was available everywhere and cheap. The ash problem was solved by building a cyclone to trap the ashes in the hot air before entering the drying bin.

(3) The blower was modified from Cyclo fan which was available in the market so that it could be manufactured locally at a reasonable cost. The blower was modified to blow the hot air radially so that the ashes would fall into the designed ash-trapper. It was modified seven times before the right one was obtained and adopted.

3.3 Testing the prototype. After the fabrication of the prototype, the experimental design was conceived. The machine was used in drying the paddy of 2 feet thick with two variables, i.e. temperature and quantity of hot air. The findings were concluded and reported.

3.4 Field Test. In 1977, the dryer was brought to three Agricultural Cooperatives to test the drying of the paddy. The results were satisfactory, but some technical problems such as irregular flow of husk especially wet husk had to be solved. The dryer was also tested for the drying of coffee seed, longan and chilli.

4. PROJECT MANAGEMENT AND MONITORING

4.1 Project Organization The project was under the responsibility of the Preservation and Processing Section, Agricultural Engineering Division, Department of Agriculture. Since the project carried significant impact and was funded by international centre, two levels of committee were set up.

(1) Managing team comprised high level officials of the Department of Agriculture. They were responsible for supporting, monitoring and solving any problems which might occur.

(2) Research team comprised team leader and several researchers. They were responsible for executing the project according to project

schedule.

The name list of both teams were presented in paper No. 1, page 30.

Besides the two teams, research assistants, technocrates and workers were temporarily employed. However, the turnover of these workers was high due to job insecurity.

4.2 IDRC's Officials The project team mentioned that IDRC's officials had rendered their help since the formulation of the project. Their advice was reasonable and there were regular visits of about 2 days each from IDRC's officials. They usually came in a group comprising economic technical officer and comptroller. The monitoring of IDRC's officials helped stimulate the progress of the project. The visits were carried on even after the completion of the project resulting in the formulation of a new project on Village Level Rice Mill, also supported by IDRC.

4.3 Financial Management The total funds for the project was C$98,200. IDRC contributed C$78,000 while the Thai Government provided the top-up of C$20,200. The funds were sufficient for fabricating, experimenting and testing the dryer but not enough to cover the extension which was important since it helped accelerate the development impact. There was no problem on IDRC's financial regulations but there were some delay caused by the regulations of the Thai side. This delay, however, did not affect the progress of the project.

5. PROJECT FINDINGS

5.1 Grain Dryer The capacity of the dryer is about 2 Kwean of paddy. Husk furnace is used to produce hot air. The machine is able to separate the ashes from the hot air before entering the drying bin. The diesel furnace is also provided in case husk is not available. The manufacture and operation of the dryer are safe and convenient. The operating time for each batch is less than 10 hours. The power of the engine is 8 horse-power. Total fabrication cost is ฿6,400 comprising:

(1) drying bin costing	฿2,500
(2) blower	฿1,500
(3) husk furnace, and	฿1,400
(4) diesel furnace	฿1,000

The cost does not include the labour cost and cost of the engine. Generally speaking, the engine consumes about 1.5 litre of petrol per hour and the diesel furnace 1.75 litre per hour. The operating cost depends on the type of grain and level of moisture content in the grain.

5.2 Training and Further Studies Two project members were sent to the Philippines for training on Post-Harvest Technology for one month. The funds were also granted to the assistant team leader to read for his Ph.D. in Agricultural Engineering for one year. He had to assist himself after that period.

The team leader mentioned that the training in the Philippines was not very useful since the duration was too short and it was towards the end of the project. However, the knowledge gained from the training benefited the other projects.

5.3 Experience obtained from the Project

(1) **Experience on project formulation and operation planning.** The project enhances the experience on project formulation and operation planning of the officials in the Preservation and Processing Section, the Department of Agriculture.

(2) **Experience on project management.** The project gave the opportunities for the project team to experience the project financial and personnel management, material purchasing and cooperation with international centres.

(3) **Research experience.** The project helped train new researchers to gain more experience in conducting research works. Most of the researchers in the project are now working on several other projects such as Portable Grain Dryer, Post Harvest Technology Training Centre and Village Level Rice Mill projects, etc.

6. INSTITUTIONAL LINKAGE

6.1 Local Linkage There were exchanges of academic information with Kasetsart, Khon Kaen and Chiang Mai Universities. The grain dryer was tested and demonstrated to the farmers, and Farmer and Agricultural Cooperative groups in collaboration with the Department of Cooperative Promotion and the Department of Agricultural Extension. After the completion of the project, the blue-print of the dryer was given to the local private companies in various regions.

6.2 International Linkage There were exchanges of academic information among IRRI in the Philippines, other institutes in ASEAN countries and the project team. The team helped train the Indonesian researchers and disseminate the blue-print of the dryer to several countries in the region. These were carried out through IDRC.

6.3 Dissemination of the Findings It was carried out in various forms as follows:

(1) Booklet
- "Research and Design of Paddy Dryers for Farmers", Department of Agriculture
- "Grain Drying and Grain Dryer", Preservation and Processing Section, Agricultural Engineering Division
- "Report on the Survey on Post Harvest Technology in Thailand 1976", Preservation and Processing Section, Agricultural Engineering Division, Department of Agriculture

(2) Papers presented in conferences in various countries receiving aids from IDRC

(3) Blue-print. Ten copies were sent to various ASEAN countries and forty-eight copies to local private companies.

(4) Papers published in Journal of Post Harvest Digest.

7. DEVELOPMENT IMPACT

Only short-term impact will be discussed.

(1) The designed grain dryer was produced by Yuthapong Palate Co.

Ltd. So far 1 dryer was purchased for drying corn and chilli.

(2) The grain dryer was adopted and produced in other ASEAN countries. Malaysia has already produced 15 machines.

(3) Australian Government was interested in the dryer and had purchased a total of 8 machines to be donated through Aids to ASEAN countries for the Post Harvest Technology Promotion program. In Thailand, the program was carried out by the Department of Agricultural Extension. Four dryers were being installed for farmers' usage in Pathum Thani province and four in Phitsanulok province.

(4) The grain dryer helped enhance the reputation of the Preservation and Processing Section, the Agricultural Engineering Division among the other ASEAN countries.

Discussion and Recommendation

1. GENERAL

Though the findings from the survey on the use of post harvest technology in Thailand indicated that grain dryer was not yet adopted by farmers, the machine had great potential for farmers' usage in the near future. The irrigation system in Thailand has been developed a great deal recently and more than one crop in a year are now common. The second crops are usually harvested at relatively high moisture level. Unjustified weight deduction is usually imposed for produce with high moisture content. As an example, the agreement among Silo Merchandize Dealer group stated that the rate of weight deduction (for 1981 crop) was 194 kg per ton for corn with moisture level at 22.1 - 22.0 (?... translator) percent.

Besides the unjustified weight deduction, the wet produce has to be sold right away after the harvest which will usually be at the same time and hence at the lower price. However, if the dryer is available, farmers can store their produce and sell when it is in higher demand.

2. DISCUSSION

2.1 Project Findings against Its Objectives The original objective was to work on the Post Production Rice Technology Research covering both the drying and storing processes. Later on IDRC suggested the deletion of the storing process but extending the usage of the dryer to other types of grains. Though original objective was not achieved but the grain dryer which could be used for various kinds of grains such as corn and chilli was developed, produced and used by the public.

2.2 Suitability of Prototype for Farmers' Usage The prominent features of the dryer are low operating cost, usable with both husk and diesel fuel, producible by local factories, partially producible and reparable by the farmers themselves. However, the machine still has the following deficiencies:

(1) Inconvenience in the usage. Grain must be carried up and down from the drying bin.

(2) The machine is too big for farmers but too small for rice mill factories.

The price of grain dryer excluding the power supply engine as quoted by the manufacturer is $25,000. To recover the investment cost, the machine must be used throughout the rainy season, i.e. for about 6 months. This implies that purchasing the machine for individual usage will not be profitable, since it will be used only for a few days each year. As an example, a farmer in central plain with average paddy field of 20 Rai (2.5 Rai is about 1 acre ... translator) will produce about 10 tons of paddy and need to use the dryer for only about 5 days each year. The machine is thus more suitable to local paddy dealers or farmer groups than individual farmer. If the drying is to be widely adopted, the price of the agricultural products with high and low moisture content must be substantially different. The unjustified weight deduction scheme will serve as an incentive for farmers to utilise the dryer.

2.3 Research Method The method and steps of approach adopted by the researchers showed their capability. However, it is noted that too few

field tests both on the types of crops and the number of experimentation were carried out.

2.4 Project Management and Monitoring The project monitoring carried out by IDRC's officials was adequate and reasonable. There were some funds managing problems such as delay in purchasing the required materials, etc. due to the stringent regulations of the Thai side. New project leader must be aware of these obstacles and prepare the project schedule accordingly.

2.5 Dissemination of the Findings Though the findings of the project were adopted in other countries in ASEAN, they were not yet widely dissemianted in Thailand. This was due to the lack of dissemination funds and manpower. Besides distributing the blue-print and publications, the dissemination should also cover demonstration of the machine and clarification of public doubts, if any.

2.6 Project Achievement The project achievement is satisfactory both academically and practically. The findings are original in Thailand. Though Asian Institute of Technology (AIT) was also working on the same project, the approach was different since AIT adopted solar energy as heating source.

Though the dryer seemed to be more suitable for local dealers than individual farmer, it is still useful for the community at large since the agricultural produce will be improved both qualitatively and quantitively.

3. RECOMMENDATION

3.1 Improvement of the Dryer The prototype should be modified and improved. The blower should be modified to suit the power supply engines commonly used by the farmers. The dryer should be strengthened and allowed, as many parts as possible, to be fabricated and repaired by the farmers themselves. Besides the modification for individual usage, the dryer should also be designed for cooperatives' use. These modifications should be carried out by the Preservation and Processing Section, the Agricultural Engineering Division financed and supported by the Ministry of Agriculture and Cooperatives and the Government of

Thailand.

3.2 Dissemination of the Dryer Dryer is not yet widely known among Thai farmers. So far, the demonstration and dissemination of the machine is still limited due to insufficient funds and manpower. It is recommended that the demonstration and dissemination of the dryer should be more seriously carried out with the funds and support from the Ministry of Agriculture and Cooperatives. The dryer used by either the farmers or the local dealers will benefit the community at large since it helps reduce the unnecessary wastage of agricultural produce.

3.3 IDRC Involvement IDRC's policy in supporting small but important project such as this Grain Dryer project is in line with Thai researchers and the Government of Thailand's policy. IDRC's technical support is adequate and reasonble. The regular visit of IDRC's officials help speed up the progress of the project. IDRC should pursue further in these lines of policy and conduct.

Members of the Team

Managing Team

1. Dr Prakob Kanjanasoon	Director, Department of Agriculture
2. Mr Paderm Thitatharn	Deputy Director, Department of Agriculture
3. Mr Sompoj Suwanawong	Deputy Director, Department of Agriculture
4. Mr Samnao Raktrakul	Head, Agricultural Engineering Division
5. Ms Sriwai Singhakajen	Head, Preservation & Processing Section

Research Team

1. Mr Maitree Thongsawang	Team Leader
2. Mr Maitree Naewpanit	Assistant Team Leader
3. Mr Tawee Umsooriya	Researcher
4. Mr Reungsri Sihawong	Researcher
5. Mr Pramote Khammeung	Researcher
6. Mr Prarop Thavornratna	Assistant Researcher

B. The Evaluation of Village Level Rice Mill Project

1. BACKGROUND

From either production, export or domestic consumption point of view, rice is always the most important economic crops for Thailand. Since rice is the main diet of Thai population, it is grown everywhere all over the country. Statistics showed that in 1982/83, Thailand produced 17.77 million tons of paddy and exported 3.8 million tons of rice bringing in 22,463 million baht in revenue. Before either consuming or exporting, paddy has to be converted to rice, the rice mill industry can thus be found everywhere in Thailand.

The small capacity rice mill currently used in many villages in the country is usually a local product. Most of them are of the low efficient type. An example is the One-Pass Engelburg Type which is still popular in paddy producing village. This type of rice mill produces low turnout and requires high operating cost. The manufacturer, however, later on upgraded the machine and produced the Multi-Pass Type rice mill. This latter product is more efficient than its predecessor but still not good enough. The energy consumption is also too high. Many problems arose in repairing such machine, since spare parts from different factories are not compatible.

In 1984 (1974... translator), the standard and test of this small capacity rice mill were not yet available, the Agricultural Engineering Division, Department of Agriculture, Ministry of Agriculture and Cooperatives thus started working on the research and development of the rice mill. The Division concentrated on the design and production of the prototype of the village level small capacity machine of Single-Pass and Single-Pass Double Roll types. The results were however, not yet satisfactory, especially in the process of separation of broken seeds. In 1979, the Division thus proposed the research project on Village Level Rice Mill to IDRC for the supports.

This project is part of the Ministry of Agriculture and Cooperatives plan on the development of agricultural machines. The project was originated from the Ministry and proposed to IDRC for financial support.

2. OBJECTIVES

The original objectives proposed by the Department of Agriculture to IDRC were:

(1) to develop village level rice mill suitable and producible locally. The machine should be convenient to use, more efficient, low operating cost and provide higher yield.

(2) to introduce and demonstrate the machine to the farmers in the rural area.

(3) to stimulate and promote the local industry to manufacture the same type of machines to eliminate the problems of the incompatibility of the spare parts from different sources.

After careful consideration, IDRC agreed to the proposed objectives but suggested adding the clause "to conduct a comparative study of the prototype and currently available machines" in the objectives. This is to evaluate the efficiency and capability of the machine to be developed.

3. PROJECT SCHEDULE

3.1 The Survey of the Village Level Rice Mill Currently Available

A survey on the village level rice mill was widely carried out all over Thailand by the Preservation and Processing Section of the Department of Agriculture. The aims were to find out the general characteristic and types of the rice mill, the usual adopted process of milling, the use, the repair and maintenance service and the operating cost. The collected information was used as the basis in the development of the prototype. The findings from the survey was reported in "The Survey on Village Level Rice Mills 1979". There were 12 types of rice mills currently in use.

3.2 Suitable Type of Rice Mill and the Test of the Prototype

The project operations were carried out consecutively as follows:

(1) Analyse the information gathered in 3.1 and choose the machine which is popular, productive and easy to maintain.

(2) Develop the machine by setting standard based on its efficiency and the quality of the product.

(3) Design the prototype to be able to mill at least 150 kg of paddy per hour.

(4) Fabricate the prototype of two stone roll type (separate part) in one steel frame. The main components are: Hopper, stone roll paddy husker, stone roll whitener, husk discharging fan and a power supply unit.

After the fabrication, the test was conducted to determine the optimum operation conditions of the prototype such as the optimum speed of the stone roll paddy husker, etc.

3.3 Comparative Study

The comparative study between the prototype and the 12 currently available rice mills were carried out. The quality of the rice, the yield and the operating cost were all compared.

4. PROJECT MANAGEMENT AND MONITORING

4.1 IDRC's Officials

IDRC's officials comprised program officer, technical advisor and comptroller. At the beginning of the project, they visited the project regularly for about 2 days each time. However, when problems arose, they extended their stays (sometimes up to 1 week) to give extra advice. The project team and the people involved agreed that regular visit from IDRC's officials helped stimulate the progress of the project. The assistance of IDRC's officials is reasonable, such as when technical problems were reported to IDRC, the technical advisor from IDRC would visit the project and give advice. At a later stage, there were some changes of program officers and less regular visits resulted in slower progress of the project.

4.2 Finance

The funds of the project were totalled C$105,000 of which C$72,000 were contributed from IDRC and C$32,000 from the Thai Government. The amount was not enough to cover the expenses of the project especially

the comparative test, since a large amount of paddy had to be purchased. The comparative test was later on abandoned and the funds were used to produce the blue-print of the Grain Dryer in Post-Harvest Rice Technology project.

There was sufficient flexibility in the IDRC's regulations on fund management, but there were some problems in managing the funds even the part contributed by IDRC due to the regulations in the Department of Agriculture. IDRC's officials assisted many times in solving these fund managing problems especially in changing the spending items and extending the project time.

4.3 Researchers

Researchers comprised government officials, temporary researchers and workers. There were high rate of turnover of temporary researchers causing the delay of the project since new staff had to be recruited and trained.

5. PROJECT FINDINGS

5.1 Village-level Rice Mill The mill comprises

- Hopper for paddy of 20 kg capacity
- Stone roll paddy husker of 28 cm in diameter
- Stone roll whitener of 28 cm in diameter
- Husk discharging fan of centrifugal type with the blade of 28 cm in diameter and 28 cm in width
- Two layer tray type separator

Size The size of the mill is 84 cm wide, 100 cm long and 196 cm high.

Machine Capability The rate of milling is 150 kg of paddy (per hour...translator)

Milling Recovery

- Rice (total)	65.2%
- Rice	62.1%
- Broken rice	2.8%

- Fine broken rice 0.3%
- Coarse bran 10.2%
- Fine bran 5.2%

Power Supply Unit

- Diesel engine of 8-12 horse-power, or
- Electrical motor of 7 horse-power

Energy Consumption The rate of fuel consumption is about 1.6 litre/ hour.

5.2 Training of Project Members

Three members were sent to IRRI, the Philippines for short course training. The training helped the officials from the project to understand and to gain more experience on the designing aspects. The project engineer was also sent to Japan at the invitation of the Japanese Government to attend a training for 6 months. The trainings to be delivered by the project team such as those for students or officials from other countries were not yet carried out since the program was completed just recently.

5.3 Experience Acquired from the Projects

There were two main areas, the project management and research:

(1) **Project management** The experience in encountering and solving the problems arising from fund and personnel management would enhance the capability of the members of the team in formulating and managing other research projects.

(2) **Research** The project provided research experience to fresh researchers. The officials in the Preservation and Processing Section have gained experience on the design aspect. The project created opportunities for the members to form international linkage through IDRC. The project helped the researchers to gain more confidence in carrying out the research works and provided opportunities for them to practise solving the related problems.

6. INSTITUTIONAL LINKAGE

There were both domestic and international institutional linkages. Findings and information were exchanged, published, presented and demonstrated through these links.

6.1 Domestic Link The project team received good supports from local companies producing small capacity rice mill. Other links were as follows:

(1) **The Department of Cooperative Promotion** The officials from the Department were trained on the operation of the rice mill by the project team.

(2) **The Marketing Agency for Thai Farmers** The officials from the agency were trained on the operation of the village level rice mill.

(3) **The Department of Agricultural Extension** On the Post Harvest Technology Promotion project.

(4) **King's Project** The project team cooperated with the King's project officials in demonstrating and disseminating the rice mill to the farmers in rural areas.

(5) **Local Agricultural Machinery Company** The aim is to disseminate the blue-print and introduce the village level rice mill to farmers in various regions.

6.2 International Link The project team communicated with various ASEAN countries and those receiving aids from IDRC. Academic information and research findings were exchanged through both private communication and participation in conferences held by IDRC.

6.3 Dissemination of the Findings To achieve the objectives stated earlier in section 2, the project team had to distribute the blue-print of the mill and demonstrate the efficiency and capability of the machine to the public. Upon completing the testing of the prototype, the project leader had proceeded as follows:

(1) The blue-print of the rice mill was prepared and given to local factories and people involved. Several copies were also sent to

other nations such as Bangladesh and some ASEAN countries.

(2) The operation of the machine was demonstrated in various places such as at Phikulthong project, Sirinthorn Land Settlement village, Narathiwat province, in National Agriculture Fairs at Amphoe Kamphangsan, Nakhon Pathom province and in Agricultural Machinery Trade Fairs at Nakhon Sawan province, etc.

(3) The machine was manufactured by Yuthapong Palate Co. Ltd., Tiwanonda Road, Nonthaburi province based on the blue-print obtained from the project team. The cost of each machine excluding the power-supply engine is ฿25,000.

7. DEVELOPMENT IMPACT

Since the project has just been completed, the development impact of the project is not yet clear. At present, the visible ones are:

(1) The project enhanced the reputation of the Department of Agriculture on research capability. Some of the ASEAN countries adopted and manufactured the designed rice mill for their uses.

(2) Yuthapong Palate Co. Ltd. was interested in manufacturing the rice mill and has acquired the blue-print of the machines. So far no order was received by the company.

(3) Most of the farmers who watched the demonstration of the machine liked the machine for its efficiency and reasonable price affordable by them.

Discussion and Recommendation

1. GENERAL

The introductory report on the "Preservation and Milling of Rice in Thailand" published by Agricultural Economics Division, Ministry of Agriculture and Cooperatives stated that in 1980, there was a total of 25,292 rice mills in Thailand comprising 18,434 small mills in various villages, 5,653 medium mills and 1,205 large mills serving large communities or for exporting purpose. Usually, farmers in the village

preferred to use the service from small mills since they gave back the rice, bran and broken rice. The latter two were used in animal feed. The large rice mill usually gave about 50-60% of rice back to the farmer. It was usually not the former's own rice.

During the late Field Marshall Sarit Thanaratana's regime, small rice mills were not encouraged because they produced rice of low quality and did not distinguish the types of rice. this caused the closedown of a large number of these small mills. In 1975, the regulations were amended allowing the farmers to run their own small mills. However, if the machine provided more than 18 horse-power, it had to be registered with the Ministry of Industry and renewed every year. Owing to these difficulties and the high fuel price, there were not many small mills being set up. At present, the farmers, especially in the form of farmers' group, were encouraged by the Department of Agricultural Extension, to set up the small capacity village level rice mills.

2. DISCUSSION

2.1 Program Objectives The first objective was achieved since the prototype of strong, durable and less energy consuming rice mill was obtained. It would be too rash to conclude the achievement of the second and third objectives since they were concerned about the development impact and more time after the completion of the project had to be allowed. The objective on the comparative test of the new rice mill was not yet reached. Fortunately, the performance of the new developed machine could be evaluated based on the collected information from the survey of all 12 types of the rice mill currently in use. If new comparative study was conducted, more funds would be necessary especially for the purchasing of paddy for the test.

2.2 Program Management and Monitoring Some problems such as those on purchasing the required materials and personnel management, propped up during the execution of the project. The problem arising from the monitoring by IDRC's officials was the change of program officer causing certain delay in project operation.

2.3 Research Method The research method was adopted based on the technology of developing the village type rice mill. The machine was

designed through the optimum performance of each part. The approach was different from the currently manufactured machine which was fabricated through several generation experience. The project team had sufficient research experience and capability.

2.4 Test Results The comparative test of the new developed rice mill with the surveyed machines of types 1 and 2 showed that the efficiency of the milling of the new machine was greater than the latter by more than 100% but consumed about 0.48 - 0.58 litre per hour more of fuel. The comparison with type 4 showed the superiority of the new machine in several aspects such as quality of rice and the power-supply engine. There were not much differences when the comparison with type 3 was carried out. The power of the engines was about the same. The milling capability and quality of rice from the new mill were a bit better but fuel consumption was also a bit higher.

The comparison with the remaining 8 types showed that the performance of the new rice mill was better in all aspects. The only difference was the degree of excellence (extracted from the Results of the Survey on Village Level Rice Mill 1979 and the Development of Village Type Rice Mill).

2.5 Development Impact The project team has produced a prototype of the village level rice mill which received favoured remarks from both the farmers and foreign representatives. The project also provided the opportunity for researcher especially new comer to practice solving research problems and enhance their research experience. Most of the project team members were still working on Post Harvest Technology projects. It also helped build up confidence and pride in the researchers.

2.6 Project Results The project was successful academically, since it was original. Practically it could not compete with private companies since several generation experience was adopted in the latter. The success of the extension of the rice mill depended on the demonstration and dissemination to the public. If local factories agreed to produce the rice mills as designed, the problems on incompatility of spare parts would be solved.

3. RECOMMENDATION

3.1 Personnel Temporary project researchers and workers were paid at the same rate as government officials but with jobs much less secured. This caused the high rate of turnover of these temporary workers and consequently the delay of the progress of the project. If they were paid say 50% higher to compensate for the job insecurity, the project would be able to get better personnel to work through the whole course of the project.

3.2 Financial Management The delay and inflated price of the purchase of the required materials for the project can be solved by amending the regulations of the Thai side. The Department of Agriculture should authorise the purchasing power to the project team leader since IDRC's financial regulations allow them to do so. If this is adopted, the project team would be able to acquire materials, equipment and personnel earlier, at lower price and as required.

3.3 IDRC's Officials Towards the end of the project, there were changes of IDRC's program officer and less regular visits. If not necessary, the program officer should not be changed.

3.4 Finding Dissemination Owing to lack of funds and manpower, the dissemination and demonstration of the rice mill were not yet widely carried out. The Minstry of Agriculture and Cooperatives should provide more funds and manpower to cover this important part. If possible, the Preservation and Processing Section should hold seminars for small capacity rice mill manufacturers to introduce and demonstrate the capability of the prototype of the rice mill.

C The Evaluation of the Development of Ground-Nut Sheller Project

1. BACKGROUND

Ground-nut Sheller is not yet popular among Thai farmers because the shellers, currently available, have low deshell efficiency and produce high percentage of broken seeds. Each farmer usually produces about 570 kg per crop and need no sheller machine. Most of the farmers sell their produce without deshelling to dealers. The price of ground-nut with shell is about half of the stripped one, and the weight of the nut is 65% of its total weight. It is obvious that excluding the cost of deshelling, the stripped ground nut will provide about 30% extra income to the farmers.

The Department of Agricultural Engineering, Faculty of Engineering, Khon Kaen University, realising the importance and impact of the ground-nut sheller using manpower proposed the development of such machine. The machine should be highly efficient, not costly and possess high deshelling capability.

2. OBJECTIVES

The project was conceived by Dr. Vinit Chinsuwan of the Department of Agricultural Engineering, Faculty of Engineering, Khon Kaen University and introduced to IDRC through the Dean of the Faculty. The project did not result from the Thai government policy but was the direct effort of the University to enhance the agricultural knowledge and experience in Thai farmers of the Northeast. The ground-nut sheller should provide more income for the ground-nut growing farmers.

The main objectives of this project were:

2.1 to develop and improve simple, efficient and low-cost ground-nut sheller;

2.2 to disseminate technology on ground-nut sheller to farmers in collaboration with the Agricultural Engineering Section, the Department of Agriculture and the Land Settlement Division, the Department of Public Welfare;

The following were extra objectives:

2.3 to test, evaluate and improve the ground-nut shellers currently used in Thailand;

2.4 to develop, test and evaluate the designed (efficient and low-cost) ground-nut sheller;

2.5 to promote the local production of ground-nut sheller through the training of local skilled workers;

2.6 to promote the designed ground-nut sheller through training and demonstration.

The main objectives were realistic and there was no change afterwards.

3. PROJECT PLANNING AND SCHEDULE

3.1 Project Planning

IDRC officials did not propose any changes in the objectives of the project but after the discussion with the project leader, they agreed to alter the project planning as follows:

3.1.1 The format for project proposal should be compatible with the IDRC's.

3.1.2 IDRC's officials encouraged more work on dissemination of the findings to farmers and people concerned.

3.1.3 The project funds were modified to suit the operation.

Other aspects of project operation such as project sites which were specified at Khon Kaen University and Ubol Ratana Land Settlement Village, operating time and project officers were not changed.

3.2 Project Schedule

3.2.1 Survey the ground-nut planting situation and the need for ground-nut shellers.

3.2.2 Test the currently available ground-nut shellers. Both the lever and milling types were considered.

3.2.3 Design, improve and fabricate 3 types of ground-nut shellers. They were the milling, rubber-roller and woodened blade types.

3.2.4 Test and evaluate the performance of all three developed ground-nut shellers.

3.2.5 Carry out the field test of all 3 shellers

3.2.6 Disseminate the shellers through publication, blue-print, machine demonstration, seminars and training courses to farmers and officials concerned.

Details on project operation and results were presented in "Report on Ground-Nut Sheller Research Project 1983".

4. PROJECT MANAGEMENT AND MONITORING

4.1 Project Monitoring

IDRC's officials visited the project sites and discussed about the project works twice a year. They usually spent about $\frac{1}{2}$ - 1 day each visit. The visit was carried on even after the completion of the project since more new joint projects were formulated and carried out.

The advantages and disadvantages of direct IDRC's monitoring were as follows:

Advantages (from the interview with project leader and the Dean of Faculty of Engineering)

1. Any project problems, either technical or managing, could be discussed directly.
2. Technical information could be transferred effectively and directly between the two parties.

Disadvantages (from the interview with the Dean of Faculty of Engineering)

The Dean mentioned that at times, the monitoring and questioning were

repeated. This might be due to the lack of good communication among IDRC's officials.

The project team usually contacted IDRC's officials directly, bypassing the DTEC's officers.

4.2 Project Management

There was no problem in managing the funds contributed by IDRC. IDRC's regulations were flexible and the funds provided by IDRC were adequate. The Dean of Engineering could authorise the payment from the funds and when necessary could be carried out even after the materials were already purchased.

Personnel Management

Owing to the lack of incentive payment to government officers, there was no participation from other departments in the University. However, research assistants to the project were paid better than government officers of the same rank. This helped keep them through the whole course of the project.

5. DEVELOPMENT IMPACT

5.1 Three types of ground-nut shellers were developed. They were milling, rubber roller and woodened blade types. All three were low-cost machines and run manually.

5.2 No researcher or research assistant was sent for training or study abroad. Only the team leader attended the meetings.

5.3 The project as the first to be supported by IDRC and carried out by the Department of Agricultural Engineering, served as the starting point for the Department to experience efficient project operation and technical knowledge through IDRC. It also helped establish linkage with IDRC and enhance the reputation of the Faculty of Engineering and Khon Kaen University.

5.4 Dissemination of the Findings

5.4.1 Thirty ground-nut shellers were distributed to various organizations during the project operation and twenty-one more after the completion of the project.

5.4.2 The operation of the machines were demonstrated to the public totalling 5 times.

5.4.3 Two training courses and workshops were held by the project team.

5.4.4 Eleven copies of reports were published and disseminated.

5.5 Others

The experience acquired from the project showed that farmers required the ground-but strippers leading to the formulation of a new Ground-Nut Stripper project.

6. INSTITITIONAL LINKAGE

Academic information and research findings were exchanged among the institutions concerned, both in the country and abroad. They were:

- Agricultural Engineering Division, Department of Agriculture
- Department of Agricultural Extension
- Thai - IRRI project
- Thai - Netherlands Complete Land Settlement Development project
- Oil Seed Crops project, Sri Lanka
- Central Institute of Agricultural Engineering, Bhopal, India

The ground-nut shellers were sent to, tested or produced from the prototype in the following organizations:

- 5 Tertiary Institutes
- 10 Agricultural and Agricultural Extension Offices
- Ministry of Science, Technology and Energy
- 2 Research Institutes
- 3 Private Companies

7. DEVELOPMENT IMPACT

Since the project has just been completed, the development impact is not yet fully visible. What can be seen now are:

7.1 The farmers in Kalasin province adopted the ground-nut sheller of rubber roller type to produce the seeds. The machine reduce the deshelling time of one bucket of ground-nuts from 6 - 7 hours to 10 - 20 minutes. This helped them to cultivate more land for ground-nut plantation.

7.2 The findings were adopted as teaching materials in Khon Kaen University.

7.3 The sheller of rubber roller type was adopted for production by the private companies. No report on the selling of the machine was so far available.

Discussion and Recommendation

1. Extra objectives needed not be specified since they were implicitly parts of the project operation for the main ones. Objectives should be stated briefly covering only what could really be achieved.

2. IDRC's officials were efficient and possessed lots of experience in project formulation and operation. Their advice, monitoring and project evaluation were all of benefit to the project team.

3. The research team was capable of carrying out the research work and achieved the proposed objectives. The dissemination of the findings and the development impact required more time before they can be evaluated effectively.

4. No obstacle arose during the course of the project. This might be due to a small number of researchers and flexibility in regulations on fund management of both the University and IDRC sides.

5. Three types of ground-nut shellers were developed. They were used by the farmers in Northeastern region of Thailand to produce seeds

for planting not for sale. The machine helped expand the ground-nut plantation in the region since the seeds must be planted right after the deshelling and the new sheller could work about 13 - 36 times faster than deshelling by hands.

6. The dissemination of the findings was not yet widely executed. In the private sector, 4 machines were produced by Lim Heong Seng Co. Ltd., Nakhon Sawan province but none was reported sold so far. There was no report of producing any shellers in Khon Kaen province. The people in Kalasin province mentioned that it was not profitable to invest in the machine since the farmers were used to the free service and might not want to pay. Some would like to get a larger capacity machine. A farmer in Amphoe Ban-Pong, Ratchaburi province used the sheller of rubber roller type to deshell the ground-nut for sale. An electrical motor had to be fixed to the machine to relieve the manpower.

However, the project team has tried to disseminate the sheller to farmers through both the Changwat and Amphoe Agricultural Extension Offices and agencies concerned.

7. The project team did not communicate to or through DTEC except sending in the reports and results. DTEC should take more role in communicating with IDRC and the project team.

8. From the comparative study between the developed manual shellers (milling, rubber-roller and woodened blade types) and the manual lever and the motor impact types, it can be concluded that the efficiency of all 4 manual types are of the same level and is higher than the motor impact type. The milling, rubber-roller, woodened blade and motor impact types cause about 3 - 5% of broken nut but about 10 - 17% will result if the level type is used. The deshelling capability of the motor impact type is about double of those of the manual types, but the operating cost of the former type is higher since fuel and maintenance of the engine have to be provided.

It can be concluded that the developed ground-nut shellers are suitable for farmers with about 750 (570?..translator) kg yields of ground-nut or farmer groups who need the seeds for planting. For larger amount of ground-nut, the capability of the three shellers is limited,

since the machines were designed for small groups and manpower cannot exceed a bound. In this latter case, the motor machines are recommended.

D. The Evaluation of KKU-IDRC/Cassava Nutrition Project

1. BACKGROUND

Thailand exports about 90% of the cassava products she produces. More than 90% of the cassava products in the EEC Common Market come from Thailand. The price of Thai cassava products is usually about 5 - 10% lower than those produced elsewhere. This is due to, they claim, the low quality of Thai products containing broken chips, fine particles, and foreign materials such as sand and dust, etc. The price of the cassava products in Thailand follows closely that of EEC Common Market, which in turn depends on the demand and supply. When the price falls as a result of lower demand, the Thai farmers are the ones who suffer the most. It is imperative to study and try to improve the cassava nutrition quality, by reducing the amount of foreign materials in cassava products so that they are acceptable in foreign markets and enjoy the same price as the products from other sources. The study should also help to promote the domestic use of cassava products, thereby reducing the full dependency on the EEC Common Market.

The project was originated from the meeting of Dr. Kawee Jutikul, Dean, Faculty of Agriculture, Khon Kaen University and the IDRC's officials who organised the seminar on "Casava: Processing and Storage" at Pataya on April 17 - 19, 1974. Dr. Kawee mentioned that Thailand was one of the biggest cassava exporting country but never used her own products as animal feed domestically. Since Thai cassava products were always criticized by foreign dealers to be of low quality, there should be a study on how to improve the nutrition quality of the products and adopted them as animal feed. At that time, researchers at Khon Kaen University were experimenting on the use of cassava products as feed for swine. It should be interesting to expand the project to cover a wider area. The officials from IDRC who were also interested in promoting the use of cassava products in animal feed locally agreed and were willing to render their support.

In June 1974, the IDRC officials comprising Dr. Araullo, the officials from the Cassava Dealers Association of Thailand, the officials from the Thai Chamber of Commerce and Dr. Z. Muller, the IDRC

consultant, visited Khon Kaen University to discuss and later on to agree in principle, to set up the research project on the above-conceived idea. The researchers at Khon Kaen University, afterwards, drew up the proposal and submitted to IDRC for approval and support.

At the beginning of the project, the Thai government was worried that the project might help to expand the cassava plantation area in the Northeastern region and consequently reduce the hard to conserve natural reserves. However, after learning that the project did not encourage the increase in plantation area but only try to improve the nutrition quality of cassava products so that they were acceptable in the world markets and their use in the country diversified so as to reduce the full dependency of the products on the foreign markets, they gave their full support.

2. OBJECTIVES

The original objectives of the projects were as follows:

Phase I (1975 - 1978)

1. To analyse the nutrition quality of Thai cassava products from various local factories.
2. To classify the type of Thai cassava products based on their nutrition quality.
3. To develop the methods of producing better quality cassava products.
4. To develop the ration for animal feed made from cassava products and to monitor the growth in animals fed by the feed derived from cassava products in substituion for cereals.
5. To improve the research capability of Thai researchers and undergraduate students at Khon Kaen University.

In other words, the main objectives of this project were to improve the method of producing good quality cassava products based on their nutrition quality and to substitute the cassava products for cereals in animal feed so that their use in Thailand was diversified to reduce the total dependency of such products on the foreign markets.

Phase II (1979 - 1982)

1. To monitor the change in quality of Thai cassava products after the dissemination of the findings of the project in the first phase.

2. To evaluate the nutrition values of various grades of cassava products based on biological test, for example, to determine the relationship between the amount of usable energy in animals and the percentage of foreign materials in the products and to conduct the comparative study of the results obtained from chemical analysis and those from biological test.

3. To improve the nutrition value of cassava products in animal feed using some simple techniques such as adding in the needed nutritious minerals, eliminating the poisoning effects and reducing the energy loss due to fermentation during the drying process.

4. To conduct the feasibility study on the substitution of cassava products for cereals in animal feed.

These original objectives were conceived with consultation with the IDRC's officials. There was no change in objectives during the whole course of the research project.

3. PROJECT SCHEDULE

The schedule of the project is as follows:

1. Collecting the sample of cassava products at various intervals from various factories in various areas and conducting the chemical analysis to find their nutritious and non-nutritious composition. The aim is to prove or disprove the claim of high percentage of foreign materials in Thai cassava products and to study the variation of nutrition quality of the products due to the changes in season, locality, price, demand and supply, etc.

2. Comparing the nutrition values of Thai cassava products with those from other countries.

3. Determining the parameters to indicate the quality standard of the cassava products.

4. Substituting the cassava products of various grades for cereals in feed for livestock (eg. poultry, swine and cattle). The objective is to

- conduct a comparative study of nutrition value between the results obtained from chemical analysis and those from biological test.
- determine the optimum quantity of cassava products in animal feed.
- conduct the feasibility study on the substitution of cassava products for cereals in animal feed.
- eliminate any limiting factors in the use of cassava products in animal feed.
- set the standard of cassava products based on the results of using them as animal feed and to set the lowest price indexes for various grades of the products as incentives for manufacturers to improve their quality.

5. Disseminating the findings of the research project by presenting and publishing them in various conferences and organising the seminars and workshops for the officials, the manufacturers and the potential consumers of cassava products. They are advised on how to improve the nutrition quality of the products and how to use them as animal feed.

6. Monitoring the trend in the changes of the quality and the use of the products in animal feed to serve as an evaluation of the project.

4. PROJECT MANAGEMENT AND MONITORING

4.1 Finance

The project was divided into 2 phases. In the first phase, the financial assistance from IDRC and the Thai Government were C$153,300 and C$74,592 respectively. In the second phase, IDRC contributed C$225,600 and the Thai Government ฿4,675,000. The funds were enough to cover the operation cost but the team had to be cautious on spending since the prices of materials and labours had inflated. There was no problem in financial management since IDRC was flexible in the management of the funds.

The supports from IDRC in terms of grant, technology and management helped make the project to achieve its proposed objectives. IDRC officials also assisted the Thai researchers to acquire modern and up-

to-date technology.

There was, however, one obstacle at the beginning of the second phase (1979 - 1982). The proposal of the second phase to be submitted to IDRC via DTEC was delayed because the objectives of the project had to be reviewed in relation to the overall national development plan. This was unnecessary since the review had already been conducted during the submission of the first phase.

4.2 Project Monitoring by IDRC's Officials

1. Program officers visited the site once a year. They spent 1 - 2 days per visit.
2. Comptrollers visited the site once in 2 - 3 years. They spent 2 - 3 days each time.
3. Senior officials from Canada visited the site twice in 8 years. They spent 2 - 3 days in a visit.
4. Technical consultants visited the site 3 - 4 days each year. They also spent about 2 weeks at the site at the beginning of the project. They were indispensable though at times it was difficult to satisfy their specific requirement. The final decision was, however, mainly made by the Thai researchers themselves.

5. THE FINDINGS FROM THE PROJECT

5.1 Research Work

1. The quality of Thai cassava products

a) The price of Thai cassava products in foreign markets is about 97.5% of those from Indonesia and only about 86.4% of those exported from China. This may be due to the low nutrition value of the products, containing foreign materials and other factors such as political and commercial consideration. The government should encourage and facilitate the production of high quality cassava products by giving incentives in investment, assisting in opening up the new markets, etc. so that the Thai products can compete favourably with the products from other sources.

b) Thai cassava products contain about 2.3 - 2.4% of sand which is higher than the products from other countries. This is due to very low standard of quality control in the manufacturing process and can definitely be improved.

c) Based on the regulation laid down by the Ministry of Commerce but stressing on the reduction of foreign materials in the cassava products, the project team proposed that the products were classified into 4 grades. The composition of the products, methods of manufacturing and the minimum price indexes of various grades of the products were as follows:

Grade	Main Constituent			Lowest Price %	Manufacturing Process
	Fiber Highest %	Sand Highest %	Flour Highest %		
1	2.0	0.4	70.0	110.0	Wash before processing
2	3.0	1.0	67.0	107.0	Sieve out sand and dust before processing
3	4.0	1.7	64.0	104.0	Dust and sand are not introduced before processing
4	5.0	2.4	60.0	100.0	Current product

2. **The substitution of cassava products for cereals in animal feed.** From a total of 27 experiments being conducted in the past 8 years, the findings and recommendations from the project on the substitution of cassava products for cereals in animal feed can be summarized as follows:

a) **The percentage of cassava products in animal feed**

(1) Spring chicken of 0 - 8 weeks. The maximum percentage of cassava products is 57.5 for grain feed and 20.0 for powdered feed.

(2) Hen. The maximum percentage of cassava products in the feed

is 40.0 for the first 7 weeks and 60.0 for 7 up to 20 weeks and 50.0 during the egg laying period (22 - 62 weeks).

(3) Swine. The maximum percentage of cassava products in the feed is:

50.0 for swines of	15 - 35 kg in weight
60.0	35 - 60
70.0	60 - 100

(4) Diary cattle during the milking period. The maximum percentage of cassava products in the feed is 65.0 for low protein content feed and 69.0 for feed with protein content up to the standard of diary cattle feed.

b) **Recommendation**

(1) Feed containing high quantity of cassava products should be supplemented by high protein content feed, for example, if the percentage of cassava products in the feed exceeds 40.0, 5% of fish powder should be added in the feed and in poultry feed, the minimum percentage of fish powder is 7.5.

(2) About 0.1 - 0.2% of Methionine should be added in single-stomach-animal feed with higher than 40.0% of cassava products.

(3) Minerals and vitamins should be added in the feed with cassava product content and should not allow the use of cassava products with high quantities of fiber and fine particles.

(4) At least 5% of fat should be mixed with the feed with higher than 50.0% of cassava products.

(5) Feed with more than 30% of cassava products should be fed as grain or wet feed to increase the appetite of the animals.

(6) Leaves and pigment shall be added in poultry feed with higher than 30% of cassava products to brighten up the colour of their skin and eggs.

c) **Effect of foreign materials in cassava products on the growth of animals**

The amount of foreign materials usually found in the Thai cassava

products does not affect the rate of growth of poultry or swine but reduces the nutrition value, the digestion capability and the efficiency of using up especially when there are more than 40.0% of cassava products in the feed.

d) **Poisoning effect in Hydrocyanic acid in cassava products**

The amount of Hydrocyanic acid found in Thai cassava products does not affect the growth rate of poultry fed by the feed with up to 50.0% of cassava products. However, about 0.15 - 0.20% of Methionine should be added in to help eliminate the poisoning effect.

e) **The substitution of cassava products in other energy-producing animal feed**

In Thailand, if the price of cassava product is lower than 55.0% of that of the corns, the substitution will be commercially viable. If the price of cassava products is lower than 77.0% of that of the corns in European markets, the above substitution will also be commercially feasible.

5.1 Others

5.2.1 The Training of Project Officers

1) **Further study** Owing to the project, three researchers were able to pursue their postgraduate studies, two for the doctoral degrees and one for his master.

a) Reading for Ph.D. in Poultry Production

Mr Kanok Palarak, a project researcher, received the training grant from the project to read for his Ph.D. in poultry production. He obtained his Ph.D. degree from Tokyo University of Agriculture in March 1984.

b) Reading for master degree in Animal Nutrition

Mr Suwit Theerapantuwat, under the grant from IDRC, studied and obtained his master degree from Nagoya University in May 1983.

c) The findings of the project as Ph.D. works

Mr Narong Kitpanit obtained his Ph.D. degree in Animal Nutrition

from Tokyo University of Agriculture in 1981 by submitting his thesis containing part of the findings of the project.

2) **Participation in Conferences** The conferences which the researchers from the project have participated and presented the findings of the project are:

1. The 4th Conference of the Tropical Root Crops Society at CIAT, Colombia, 1976.

2. International Workshop on Cassava as Animal Feed held by IDRC, Canada, 1977.

3. International Workshop on Cassava Processing and Utilization held by Khon Kaen University - ASPAC/FFTC at Khon Kaen University, 1978.

4. The 5th Conference of the Tropical Root Crops Society at Zebu State University, the Philippines, 1979.

5. The International Feedstuffs Institute Workshop on Studies on Feeds and Feeding of Livestock and Poultry, Feed Composition, Data Documentation and Feeding Systems in the APHCA Region at Manila Midtown Ramada Hotel, the Philippines, 1980.

6. Symposium on Progress in the Use of Cassava as Animal Feed in the 12th International Congress of Nutrition, San Diego, California, U.S.A., August 1981.

5.2.2 Training Programs Resulting from the Project

Some of the project researchers were invited as guest speakers in the short courses for local farmers arranged by National Swine Farming Research and Training Centre.

The project helped to train the researchers and project personnels in handling research and administrative works. The findings provide more knowledge and experience to researchers enhancing their teaching and researching capability.

5.3 Experience from the Project

5.3.1 Project Management

The project provided opportunities for the project members to gain

their experience in financial management, problems solving methodology, project management, personnel management and institutional linkage. Many problems arose when many people were involved in the project. The main one was the high rate of turnover of researchers due to job insecurity. The project gave the members the opportunities in gaining experience in tackling such a problem.

5.3.2 Academic

The project helped develop the research capability of the members. The knowledge and experience gained from working on the project helped upgrade the teaching and further research activities.

6. INSTITUTIONAL LINKAGE

6.1 Agencies Concerned

They were: The National Swine Farming Research and Training Centre, Kasetsart University, Cassava Dealer Society of Thailand, Thai Chamber of Commerce, International Feedstuff Institute (IFI), U.S.A., Centro International Agricultural Tropical (CIAT), Colombia, ASPAC/FFTC, Taiwan, Tropical Products Institute, U.K., MARDI, Malaysia, University of Pertanian, Malaysia, Guelph University, Canada, Udhayana University, Indonesia and ADAB, Australia.

6.2 Dissemination of the Findings

The results from the research project were disseminated in various ways:

6.2.1 Annual Report

1. Cassava Nutrition Project Annual Report 1975/1976, 1977, 1978, 1979 and 1980.
2. The reports were summarised and published in various journals.

6.2.2 Papers published in Journals or presented at Conferences

1. S. Khajarern and J.M. Khajarern, "A preliminary study in the utilization of cassava products as energy source for broilers" presented at the IV International Symposium on Tropical Root Crops, Centro International de Agricultural Tropical (CIAT), Coli, Columbia, August 1

- 7, 1976 and published in the proceedings of the symposium, edited by Cock, J.R. MacIntyre and M. Graham, International Development Research Centre, Ottawa, Canada, IDRC-080, p. 246.

2. S. Khajarern, J.M. Khajarern, N. Kitparnit and Z.O. Muller, "Cassava in the nutrition of swine", presented at the workshop on cassava as animal feed, the University of Guelph, Ontario, Canada, April 18 - 20, 1977 and published in the proceedings of a workshop held at the University of Guelph, Ontario, Canada, IDRC-095e, p. 56.

3. "Substitution of cassava root products for cereals in livestock and poultry feed", presented at the ASPAC/FFTC-KKU Seminar on Production and Utilization of Cassava, Khon Kaen University, May 10 - 20, 1978 and published in ASPAC/FFTC Extension Bulletin No. 122, Feb. 1979.

4. S. Khajarern, J.M. Khajarern, K. Phalaraksh, N. Kitpanit and S. Terapuntawat, "Cassava: A potential concentrate for animal nutrition in the tropics", presented at the Australian Development Assistance Bureau (ADAB) Seminar on Animal Health and Nutrition in the Tropics, James Cook University, Townsville, Queensland, Australia, Feb. 18 - 23, 1979 and published in Proceedings of the Seminar by ADAB, pp. 135 - 136.

5. S. Khajarern and J. Khajarern, "Feed Resources in Southeast Asia", presented at the IFI-APHCA International Workshop on Studies on Feeds and Feedings of Livestock and Poultry and Feed Composition, Data Documentation and Feeding System in Asia, the Far East and the Southwest Pacific, Midtown Ramada, Manila, the Philippines, Jan. 22 - 24, 1980 and to appear in Proceedings of the Workshop, International Feedstuff Institute, Logan, Utah, U.S.A.

6. S. Khajarern and J. Khajarern, "Cassava as Swine Feed".

7. S. Khajarern, J. Khajarern, N. Kitpanit, J. Sutasorn and W. Sajawatna, "Substitution of cassava root products for corn in Swine Feed", published in proceedings of the 10th National Seminar on Agriculture and Biology (Animal Section) 1978, pp. 202-213 and in Journal of Swines, Vol. 3, No. 12, 1977, pp. 53-60.

8. S. Khajarern, J. Khajarern, N. Kitpanit, J. Sutasorn and S. Udchachon, "Introductory Study of Cassava as Swine Feed", published in proceedings of the 16th National Seminar on Agriculture and Biology

(Animal Section), 1978, pp. 193 - 201.

9. J. Kharjarern, S. Khajarern, S. Theerapantuwat, P. Sakiya, S. Sunthornsorn and W. Pathnakulchai, "Substitution of cassava root products for corns in chicken feed", published in proceedings of the 16th National Seminar on Agriculture and Biology (Animal Section), 1978, pp. 262 - 274.

10. J. Kharjarern, S. Kharjarern, T. Bansithi and P. Sakiya, "A comparative study between cassava products and other feeds which produces energy in chicken feed", presented at the 17th National Seminar on Agriculture and Biology (Animal Section) Feb. 5 - 7, 1979.

11. J. Kharjarern, S. Kharjarern, T. Bansithi, K. Bansithi and P. Sakiya, "A study on the remaining poison of hydrocyanic grade from cassava in chicken", presented at the 17th National Seminar on Agriculture and Biology (Animal Section), Feb. 5 - 7, 1979.

12. J. Kharjarern and S. Kharjarern, "Substituion of cassava root products for corns in chicken feed", published in proceedings of the 15th National Seminar on Agriculture and Biology (Animal Section) 1977, pp. 114 - 123.

13. S. Kharjarern and J. Kharjarern, "The economics and public acceptance of cassava-based rations", presented at the XII International Congress of Nutrition Symposium on Progress in the Use of Cassava as Animal Feed, the Town and Country Hotel, San Diego, California, U.S.A., August 16 - 21, 1981.

6.2.3 Other Means of Dissemination

The findings was disseminated by delivering short courses to local farmers. The courses were arranged by National Swine Farming Research and Training Centre. They were held 2 times in Khon Kaen Province

2 times at Kasetsart University

1 time in Nakhon Pathom Province

and 1 time in Rayong Province

6.3 Application of the Findings by Other Groups

Though there was no official report on the application of the findings by other groups but the findings were used by the animal feed

producing companies, government agencies and the farmers. They were also adopted as basic data for teaching and further research projects. The objectives of the project were achieved but the development impact needed to be improved.

6.4 Activities of Research Team after the Project

They are involved actively in the following projects:

1) Farming System
2) Crop Residual Utilization
3) Animal Waste Recycling
4) Rabbit Production
5) Buffalo Research

7. DEVELOPMENT IMPACT

7.1 Direct Impact

1) The project team proposed the method of producing high quality cassava products and generated sufficient findings to support the use of cassava products in animal feed. The findings were reported to the National Cassava Policy Committee during the seminar held by the project team on Jan. 12, 1984. They were not yet implemented.

2) The findings were used for teaching materials and further research projects.

7.2 Indirect Impact

1) The project helped publicise the University, both locally and abroad.

2) The project helped build up research capability of the researchers.

3) The project improved the teaching activities in the University.

Discussion and Recommendation

The objectives of the project as submitted to IDRC were achieved.

The findings showed that cassava products can be used in animal feed. They also indicated the quantity of cassava products in the feed ration for various types of livestock. The method of producing high quality cassava products was proposed. The implementation of the findings was not, however, yet fully developed due to some non-academic reasons such as the present non-flavourable price structure. The findings also indicated the problems associated with the quality of Thai cassava products and their solutions. The project also helped upgrade the teaching standard at Khon Kaen University.

The support from IDRC is adequate and reasonable. IDRC has also monitored the project adequately by regular visits to project site.

The findings of the project are of academic value and have great potential for implementation if there are some changes in the price structures of raw materials for animal feed. The evaluation team recommended the publication of the summary of the findings and distribution to the agencies and people concerned.

E. Evaluation of Semi-Arid Crops Project

1. BACKGROUND

Before approaching IDRC for supports, the Faculty of Agriculture, Khon Kaen University, has already started studying soy-bean crops in 1970, groundnut in 1971 and sorghum in 1973. In the early period, only limited area was explored due to the lack of funds and manpower. The project was conceived in relation to the national plan on agricultural development in the Northeastern region of Thailand. At that time, jute and cassava were the main crops. The price of jute during that period was not stable while cassava caused extensive deterioration of soil fertility if planted repetitively. To solve these problems, more crops should be cultivated to provide more choices for farmers. The researchers chose sorghum, soy-bean and groundnut for their study.

Sorghum was chosen because it was a semi-arid crop which should be suitable for the soil and weather conditions in the Northeastern region of Thailand. Sorghum could also be used in animal feed which would be in great demand in the near future.

To improve the rather poor soil conditions in the Northeastern region, the bean (Nitrate producing) crops should also be included in the study. Since soy-bean and groundnut are commercially viable, they were chosen for the study.

Semi-arid crops project was originated from a visit by Professor I B Seimens of the University of Manitoba, Canada. During his visit to Khon Kaen University, he learned about the financial problem of the project and advised the team to seek the supports from IDRC. Dr Kawee Jutikul, Dean, Faculty of Agriculture, during his visit to Singapore, brought up the matters during the discussion with IDRC's officials. IDRC, after consultation with Dr Hugh Doggatt, Associate Director of AFNS and a sorghum breeder, agreed to render her supports.

2. OBJECTIVE

The original objectives as proposed by Khon Kaen University were:

1. To develop improved varieties of sorghum, soybean, and peanut

suitable for the Northeastern Region of Thailand.

2. To provide basic informations to support the breeding program, including studies of population breeding methods, genetic studies, and field plot techniques.
3. To identify the most efficient and productive plant types, and so to provide selection criterior for breeders and provide a basis for the development of improved agronomic practices.
4. To improve agronomic methods in cultivation of sorghum, soybean and peanut, especially when grown as crop mixture.
5. To develop cropping systems suitable for the Northeast Thailand.
6. To develop "technological packages" for improved production of sorghum soybean and peanut which could be extended to the farmers.
7. To study the utilization and provide quality testing service for sorghum, soybean, and peanut.
8. To provide a research framework for staff members and for student training especially for the graduate program at Khon Kaen University.
9. To cooperate with the Ministry of Agriculture and other institutes in conducting research, training and service concerning these three crops.

After consultation with IDRC's program officer who visited Khon Kaen University afterwards, the project team agreed to submit a new more specific proposal to IDRC via DTEC. The objectives were reduced to:

1. To develop improved varieties of sorghum, soybean and peanut suitable for the Northeastern Region of Thailand;
2. To provide basic information to support the breeding program, including studies of population breeding methods, genetic studies, and field plot techniques;
3. To improve agronomic methods in cultivation of sorghum, soybean and peanut, especially when grown as crop mixtures;
4. To provide a research framework for staff members and for student

training especially for the graduate program at Khon Kaen University, and to cooperate with the Ministry of Agriculture and other institutes in conducting research, training and service concerning these crops.

The main reasons for rewriting the new proposal were to delete the part on the extension which might encounter the problems on lack of manpower and to reformulate the more realistic objectives.

The Board of IDRC agreed to support the project but suggested the following changes:

1. The title of the project "Breeding and Intercropping of Sorghum, Soy bean and Peanut for the Northeast Thailand" should be changed to "Semi-Arid Crops (Thailand)".
2. The second objective in the second proposal is too ambitious and should be dropped out. The final objectives became
   1) to develop improved varieties of sorghum, soybeans and groundnuts suitable for the Northeastern Region of Thailand;
   2) to improve agronomic methods for the cultivation of these varieties; and
   3) to provide in-service and formal training in practical plant breeding and agronomy.

These became the objectives of the project and no change ever since throughout the whole course of the project.

3. PROJECT SCHEDULE

Since the objectives of the project were rather wide, covering several subjects, the operation planning and method of experimentation as stated in the proposal had to be also relatively less specific.

The project team usually set a plan for the experiments for one whole year, stating the experiments, their objectives, methods of experiments, duration and the responsible researchers. The plan was circulated in the team, sent to IDRC and given to visitors to the project. In the earlier part of the project, Dr. Hugh Doggett always sent back his comments. He served more or less as a technical advisor

to the project. There was regular correspondence in the earlier part but less at a later stage. Dr Doggett visited the project site once at the end of 1978.

The project team always tried to set the plan in relation to other organizations such as the Department of Agriculture, the Ministry of Agriculture and Cooperatives and Kasetsart University. Khon Kaen University, more or less served as the regional centre for the Northeastern area. The research on sorghum was carried out in close collaboration with the abovementioned organizations as they were working on the National Corn and Sorghum project. Though Khon Kaen University was not an official member but practically she was. The project team attended and presented the findings at annual meeting every year. The seeds for the experimentation in the Northeastern region were also obtained from the national project.

Since breeding is a time-consuming process and the project can never be finished on time if it is carried out, the project team thus worked mainly on the breeds from other sources.

In the early period, sorghum seeds were imported from USA, obtained from National Corn and Sorghum project and ICRISAT. Later on, only those which passed through the primary tests from the national project and ICRISAT were adopted. There were some changes in the method of experimentation during the course of the project, for example, recurrent selection process was applied to the imported population, but the method required large resources and the population was not suitable, the process was later on abandoned; At the beginning of the project, the team would like to produce a new breed which would not be affected by the Shoot Flies but the rearing of the flies failed and since both the National Corn and Sorghum project and ICRISAT teams were working on this subject, it was thus dropped from the study.

Soybean seeds were brought in from both sources in the country and from INTSOY and AVRDC, the international research centres for soybean.

Groundnut seeds were also obtained from ICRISAT and other sources in the country and imported from USA.

It can be concluded that this project involved the test of the suitability of the well-bred crops for Northeastern Thailand environment

and improving and selecting the good breeds from the primary yield trial from other sources.

The project avoid working on the topics which were currently carried out somewhere else, but concentrated on other areas, for example, intercropping, basic researches such as the seasonal distribution of plant diseases and insect and the study on the moisture content in soils, and soil microvariability causing irregular growth in plant, a common problem encountered in the Northeastern region of Thailand.

4. PROJECT MANAGEMENT AND MONITORING

4.1 Finance

The operation of the project was divided into 2 phases, the first was for 5 years (1975 - 1980) and one year (1981) for the second. IDRC contributed C$311,000 and Khon Kaen University C$206,380 in the first phase. In the second phase, the funds were C$46,500 from IDRC and C$59,496 from the University respectively. The funds were sufficient to cover the expense of the project.

There was no problem in managing the funds from IDRC side since the regulations were quite flexible. The problems arose on the Thai side, since by law, international assistance funds were considered as obtained through the government and the normal rules which was rather impractically applied. These rules were later amended allowing the project team more flexibility in managing the research funds.

4.2 Project Monitoring by IDRC's Officials

During the course of the project, the officials from IDRC visited the project site regularly for a few days once a year. The topics of discussion were usually on financial managing problems and the findings of the project. The discussion was indispensable, especially those on the fund management problems since many problems propped up unexpectedly. During the whole course of the research project, no problem was introduced by IDRC's officials, only their assistance.

Though the funds for short term consultants were available, no technical advisor worked on the project. This was possible due to good

institutional linkage with international centres. The project team received, many times, free advice from friendly international centre officials and prominent visiting experts. The funds were later used as scholarship for project researchers to pursue their postgraduate studies.

5. PROJECT FINDINGS

5.1 Technical

The findings were reported in detail in Research Highlight section of Summary Report 1975 - 1980. Very briefly, they were as follows:

5.1.1 Sorghum

1) Breeding materials from the National Corn and Sorghum project were not suitable for Northeastern region environment. The breeding materials from ICRISTAT were satisfactory but qualities of seeds and some other characteristic were not.

2) Recurrent section is an efficient method of selecting new breeding materials. However, the method required large resources.

3) The best season for sorghum plantation was during mid July to mid August.

4) Nitrate and Phosphate affected the growth of sorghum. Adding 25 kg of nitrate per hectare gave highest yield.

5) Grey leaf was the most frequent found disease in sorghum planted in the Northeastern region. Head Mold Leaf Blight was found moderately. Sorghum of some breedings was affected by the Charcoal Rot.

6) Shoot Fly was sorghum's main insect pest. The fly could be destroyed by Furadan. Web Worm damaged only those producing high density flower. Other less important was Army Worm. Besides insects, birds could also cause great damage to sorghum.

5.1.2 Groundnut

1) From the 231 lines tested, it was found that the breeding materials, Moket (medium seed) and RCM 337 (large seed) gave higher

yield than Tainan 9 which was currently under promotion. The two breedings were passed to the Department of Agriculture for further tests.

2) No fertilizer and insecticide were necessary for groundnut plantation. The best season of planting groundnut in Northeastern region was in July.

3) Suitable planting distance was 50 + 20 cm for groundnut with large seeds and 30 + 10 cm for the one with small seeds.

4) Leaf Minor and Leaf Roller were consecutively two main insect pests of groundnut. Late planting invited more damages from these two types of insects.

5) Cerrospora Leaf Spot and Rust were the main diseases. Seedling Blight caused damage only in some years.

6) Seedling Blight could be found in seeds and soils. It was found mostly before sprouting.

5.1.3 Soybean

1) From the test of more than 1000 lines, it was found that the breeding materials code-named Clark G3, Improved Pelican, Orba and UPLB Sy-2 gave high yield.

2) The suitable season for planting was from mid June to mid July. The planting distance between the rows of 30 or 20 cm gave higher yield than that of 50 cm by 20-30%.

3) Bean Fly, Leaf Minor and Leaf Roller were consecutively the three main insect pests of soybean.

4) There were more Bean Flies in June and November. Less Leaf Minors were found at the beginning of the rainy season but more towards the end.

5) Rhigoetonia Root Rot, Bacterial Pustule, Rust and Bacterial Blight were main diseases causing damage to soybean. Viruses were hardly found.

5.1.4 Soil

1) The main four soil series in Northeastern region were poor

and had low potential to be used as plantation and must be improved before planting.

2) There were poor spot soil distributed all over the region. The top soil was thin and not suitable for planting. The test in the laboratory showed the lack of sulphate in this type of soil. However, the field test did not confirm the findings from the laboratory. Adding in organic matters improved the rate of growth of the crops. Groundnut has the highest enduring capability to this poor spot soil.

3) The study of the moisture content in Yasothorn soil for four and a half years showed that during the rain gap period which occurred frequently at the beginning of the rainy season moisture content in soil was reduced below the critical point. It was thus advisable to avoid planting too early in the rainy season but start planting in July. There was sufficient moisture content in soil for planting for only 6 months in a year. Annual double crops required water from irrigation system.

5.1.5 Intercropping

1) Intercropping of sorghum, groundnut and soybean gave less profit than just the bean crops.

2) If bean crops were planted along the rows of sorghum, they should be in East-West direction and the height of sorghum should be less than 170 cm.

3) Planting sorghum and bean crops at the same time reduced yield of the bean crops. Delaying the planting of sorghum up to one month increased the yield, beyond that no further effect.

4) Groundnut is the most suitable intercropping with sorghum. The planting distance of each row of sorghum should be 1.50 m and three rows of groundnut planted in between.

5.2 Others

5.2.1 The Training of Project Members

There were five categories of training of project members as supported by IDRC.

1) Further study. Four researchers pursued their further studies abroad, two for their master and two for their Ph.D. degrees.

2) Short courses. Four researchers attended the short courses of 1-6 months at ICRISAT and IITA.

3) Visit. Senior project members visited other institutions three times for 7-10 days each.

4) Attending conferences. Two researchers from the team attended and presented the findings of the projects at two international conferences.

5) Further research abroad. Dr Aran Pathanothai worked as Principal Millet Breeder at ICRISAT from 1958 (1978 translator) to 1980 as a result of this Semi-Arid Crops Project.

5.2.2 The Training Given by the Protect Team

1) **Training for Research Assistant**

The project served as a training ground for fresh graduates as research assistants. Though the turnover of these assistants is quite high due to job insecurity, they usually gained enough experience for their future works. Seventeen research assistants were trained in the project.

2) **Administration Officer**

As in the first case, there was high rate of turnover of those officers due to job insecurity.

3) **Student Assistant**

Fifty-nine students were hired as part-time trainees to the project.

4) **Special Project Student**

There were about five students each year working with the project for their final year special problems.

5) **Student Trainee**

The project served as the training ground for students for some of

their courseworks.

6) **Teaching Materials**

The findings and experience resulting from the project were used as parts of the teaching materials.

7) **Training for Outsider**

During the course of the project, there were hardly any training courses provided by the project team. Since training of the agricultural officers was carried out by the Department of Agriculture and sorghum and soybean are not the main crops in Northeastern region of Thailand. The program researchers were, however, sometimes invited as guest speakers in some training courses for example, the training course for about 50 Laotian Officers on the above three crops held by the Northeastern Region Agricultural Office.

After completing the project, the researchers have participated in several training courses on the subject about these three crops. Some examples are as follows:

(1) Training the border patrol police officers for psychological warfare (the officers to train the people in the communist infiltration area) on the planting and caring of the groundnut crops. The training was carried out once a week for 3 months for each batch. There were 5 officers in each batch. A total of 3 batches passed through the training course.

(2) Serving as guest speakers in the Delicate Agricultural Training project, training farmers for 1 day each year. There were about 10 farmers attending the course. This training project commenced in 1980.

(3) Serving as guest speakers in training farmer leaders of the Office of the Accelerated Rural Development held by Northeastern Region Farmers Association on Sorghum in 1982. About 50 farmers attended the course.

(4) Serving as guest speaker for farmer training program held by Redd Barna Organization at Khon Kaen province for 1 day in 1982. About 20 farmers attended the program.

(5) Participating in annual meeting of groundnut promoting officers.

The training provided by the project seemed to be adequate. The research capability in the researchers was developed. This was beneficial for both further research works and teaching activities in the University. The training program helped enrich both the researcher's experience and the trainee knowledge. No problem was encountered in the training but no evaluation was conducted on these training programs.

5.3 Experience from the Project

5.3.1 Project Management

Experience in financial management was acquired from the project. The main point was the amendment of the regulation on financial manage-ment of funds supported by international centres in the University. This helped increase the flexibility in managing the fund from international sources. The project also helped build institutional linkage.

5.3.2 Project Research

The project helped build up research capability, skill and experience in the researchers. After completing the project, several researchers became several other project team leaders. The knowledge and experience acquired from the project were used to improve the teaching materials and activities enabling and accelerating the postgraduate study program in the Faculty of Agriculture, Khon Kaen University.

6. PROJECT DISSEMINATION AND INSTITUTIONAL LINKAGE

6.1 Institutional Linkage In Thailand, the project has good rapport with National Corn and Sorghum Research Centre, Department of Agriculture, Kasetsart University, Chiang Mai University, Thailand Institute of Scientific and Technological Research and Northeastern Region Farmers Association. The international links are ICRISAT, INTSOY, AVRDC, Texas A & M University, IRRI and IITA.

6.2 Project Dissemination

6.2.1 Publication Findings were published in annual reports each year and summary report at the end of the project. The reports were sent to the organizations and institutions concerned both in Thailand and abroad (more than 250 copies of each report were distributed). They were also presented and published in the proceedings of the following conferences:

(1) National Corn and Sorghum Crops Annual Meeting held annually since 1975.

(2) Patanothai, A. 1977. Sorghum research at Khon Kaen University. Proceedings of the International Sorghum Workshop held at ICRISAT, Hyderabad, India, March 6-12, 1977. ICRISAT, India.

(3) Na Lampang, A., T. Charoenwatana, and D. Tiyawalee. 1980. Groundnut production, utilization, research problems and further research needs in Thailand. Proceedings of the International Workshop on Groundnut held at ICRISAT, Hyderabad, India, 13-17 October 1980, ICRISAT, India.

6.2.2 Presentation in the Seminar

6.2.2.1 Participation in seminars held by other organizations (see 6.2.1).

6.2.2.2 Seminars at Khon Kaen University

(1) Jointly organized with Agricultural Science Society of Thailand on groundnut and beans at Khon Kaen University in 1978 (with proceedings). There were 246 participants.

(2) Jointly organized with the Department of Agriculture as workshop on groundnut research (No. 1) at Khon Kaen University in 1981 (with proceedings). There were 80 participants.

(3) Jointly organized with the Pacific Seeds Co. Ltd. on Trends of Red Sorghum Market and Research and Experiment on Sorghum Crops in Khon Kaen University at Khon Kaen University in 1983. About 40 people from government

agencies, private companies and export enterprises participated in the seminar.

6.3 Extension by Other Organizations

6.3.1 High yield crops were sent to the Department of Agriculture for further testing (to get official approval, they must pass through the test set by the Department of Agriculture). As for groundnut, code named Moket, a selected crop was being tested at the final stage in the farm before being released as breeding materials. Some other crops are still either in primary or regional yield trial tests.

A selected large seed groundnut crop was adopted for planting by some farmers at Seka.

6.3.2 Findings from the project helped improve other research and agricultural extension projects. For example, the findings showed that groundnut could be confidently planted anywhere in the Northeastern region. Groundnut is now adopted in many parts of the region in the intercropping with other main crops. The findings also helped guide private company who wanted to promote the planting of sorghum in the region to choose the right spot of soils for such a crop. A similar advice was also given to EEC on the cassava substituted crops project. Information about these crops were also sought by several other organizations concerned.

6.3.3 It is difficult to evaluate the extension of the project since a) the agricultural promotion unit usually collects and makes use of data from several sources, b) sorghum and soybean are not the suitable crops for the Northeastern region and c) this is a basic research project. The only outstanding extension is the data on moisture content in the soils which has been heavily used in the planning of the planting system. The data also originated the setting of Drought Research Centre in the University with the supports from JICA.

6.4 Activities of Researchers after Completing the Project

Most of the researchers in the team are still with Khon Kaen University working on several other projects. Some of the researchers

have left for other institutes such as Prince Songkhla University but are still involving with research activities.

7. DEVELOPMENT IMPACT

7.1 Direct Impact

(1) The project originated the joint project with the Department of Agriculture and Kasetsart University on Groundnut Research project. This resulted in more joint projects on other crops with the Field Crops Research Institute of the same department.

(2) The findings from the project were adopted and implemented by other organizations. These were of great help in the formulation and development of other projects.

7.2 Indirect Impact

(1) The project helped establish the reputation of Khon Kaen University and the research programs of the University. The results from the project showed the research capability of the researchers and their effort in trying to solve the local problems. This resulted in more research projects and funds from other sources. The team leader of the project was, due to this project, invited to work with ICRISAT.

(2) The project helped improve the teaching activities by enriching the lecturers with the experience on local problems. It also helped speed up the postgraduate courses in the faculty.

(3) The project assisted in establishing institutional linkage with international centres which would be useful for the faculty future works.

(4) The project helped alter the regulation on the use of research funds giving more flexibility in fund management to other later projects.

(5) The project sets a good example of joint project team.

Discussion and Recommendation

This is a large project covering three types of crops and several research topics. Generally speaking, all of the objectives proposed to IDRC were achieved. Findings were adopted as teaching materials and data for other project formulation. Some were directly utilized. An important development impact was the scholarship and training grants allowing the researchers to improve their qualification which in turn had a direct impact on the long term development of the University.

The objectives of the project could however be improved. The original objective of finding suitable sorghum, soybean and groundnut crops for Northeastern region is difficult to achieve due to limitation in manpower and facilties. If the objective was modified to find suitable crops for Northeastern region, the project operation could be easier to set and the objective easier to reach. The latter could be carried out by finding first the suitable crops before experimenting on the improvement and extension of the crops.

The first phase, lasting for 5 years, was too long. It should be shortened so that the findings of the first phase could be evaluated and served as data for project formulation of the second phase.

Project planning and operation were satisfactory considering the available resources and manpower as against the proposed objectives.

The funds from IDRC were adequate and the regulations on fund management sufficiently flexible. There were adequate monitoring and site visits from IDRC's administration officers. However, more visits from IDRC's technical team were encouraged.

Appendix

Members of the Evaluation Team

Team Leader

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Members

1. Mr. Pracha Chausilp
   Head, External Cooperation Division 2, DTEC

2. Dr. Sutharm Areekul
   Department of Entomology
   Faculty of Agriculture
   Kasetsart University

3. Dr. Soopot Fangfupong
   Department of Field Crops
   Faculty of Agriculture
   Kasetsart University

4. Dr. Banterng Masang
   Evaluation Division
   Agricultural Economics Office
   Ministry of Agriculture and Cooperatives

5. Mr. Chote Wimolchalao
   Thailand Institute of Scientific and Technological Research

6. Mr. Sompong Patamavichaiporn
   Technical Division, DTEC

7. Mr. Apinan Pataratiyanonda
   External Cooperation Division 2, DTEC

Names of Persons being Interviewed

Khon Kaen Province

1. Dean of the Faculty of Engineering, Khon Kaen University
2. Dr. Kawee Jutikul, Dean, Faculty of Agriculture, Khon Kaen University
3. Mr. Bancha Maneechotiskul, Siam Machinery Pte. Ltd.
4. Mr. Kriangsak Kanoo, Resident, Ban Sumjai, Tambol Ban-Koh, Amphoe Meung

Kalasin Province

5. Mr Yon Poo-Ob, Resident, Ban Kokyai, Tambol Bua-Ban, Amphoe Bangtalad
6. Mr. Wara Pan-umpai, Resident, Ban Lao, Tambol Buaban, Amphoe Bangtalad
7. Mr. Kamjad Pooboon-erng, Resident, Ban Lao, Tambol Buaban, Amphoe Bangtalad
8. Mr. Tharworn Dondang, Resident, Ban Chiang-ngan, Tambol Buaban, Amphoe Bangtalad

Ratchaburi Province

9. Mr. Paisarn Apiratnawarakul, Chairman, Animal Feed Department, Nongpo Dairy Farm Cooperative
10. Mr. Garland E. Benton, Dairy & Livestock Feed Specialist, Nongpo Dairy Farm Cooperative
11. Mr. Cherdsak Somritjinda, Banpong Industry Co. Ltd., Amphoe Banpong.

Kanchanaburi Province

12. Mr. Prinya Busranupanusorn, Wangkhanai Sugar Refinery Co. Ltd., Amphoe Wangkhanai.

Nakhon Sawan Province

13. Mr. Chalermsak Bumroongthai, Lim Chiang Seng Co. Ltd., Amphoe Meung.

Bangkok Metropolis

14. Mr. Kriangkrai Mekwanich, Agricultural Development Division, Department of Agricultural Extension.
15. The Manager, Yuthapong Palate Co. Ltd.